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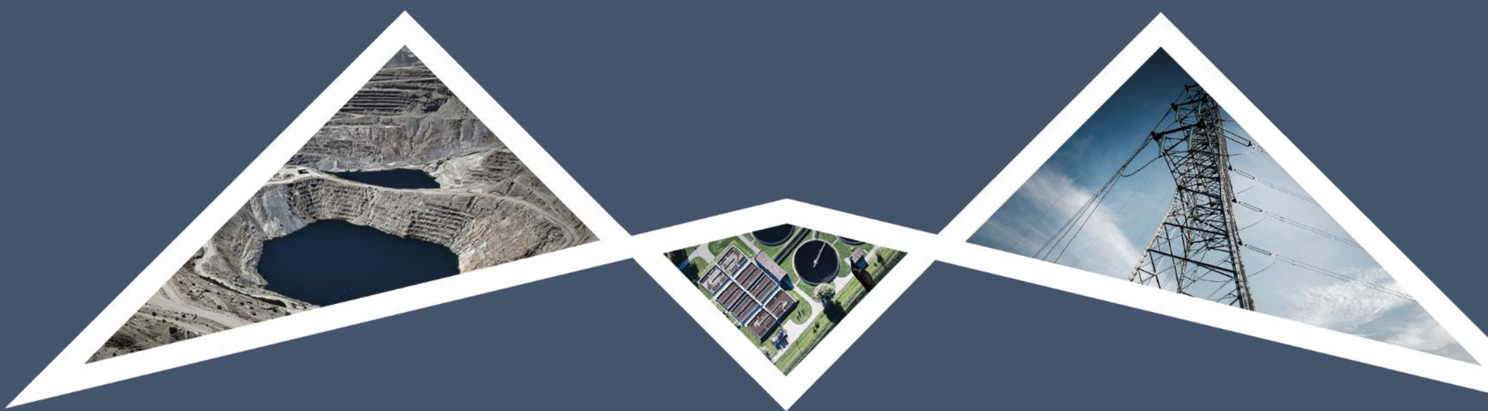
T 011 789 7170 E info@eims.co.za W www.eims.co.za

BASIC ENVIRONMENTAL ASSESSMENT REPORT

PROPOSED SEARCHER SEISMIC RECONNAISSANCE

PASA REFERENCE: 12/1/048

JUNE 2024



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CHECKED:	John von Mayer	Not Signed Sent Electronically	2024/06/13
AUTHORIZED:	Liam Whitlow	Not Signed Sent Electronically	2024/06/19

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ACRONYMS AND ABBREVIATIONS

2D	two-dimensional
3D	three-dimensional
ALARP	as low as reasonably practicable
ASA	Acoustical Society of America
BA	Basic Assessment
BAR	Basic Assessment Report
CBA	Critical Biodiversity Area
CITES	Convention on International Trade in Endangered Species
CMS	Convention on Migratory Species
CPUE	Catch per unit effort
CUD	cumulative utilization distribution
DFFE	Department of Forestry, Fisheries and the Environment
DFA	Development Facilitation Act (Act No. 67 of 1995)
DMRE	Department of Mineral Resources and Energy
EA	Environmental Authorisation
EAP	economically active population
EAP	Environmental Assessment Practitioner
EBSA	Ecologically and Biologically Significant Area
ECA	Environment Conservation Act (Act No. 73 of 1989)
EEZ	Exclusive Economic Zone

EIA	Environmental Impact Assessment
EIMS	Environmental Impact Management Services (Pty) Ltd
EMPr	Environmental Management Programme
ESAs	Ecological Support Areas
ESA	Early Stone Age
FAMDA	Fishing and Mariculture Development Association
FLO	Fisheries Liaison Officer
FRAP	Fishery Rights Allocation Process
GN	Government Notice
GPS	Global Positioning System
GRT	Gross Registered Tonnage
HABs	Harmful Algal Blooms
HIA	Heritage Impact Assessment
I&APs	Interested and Affected Parties
IBA	Important Bird Area
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICHC	Intangible Cultural Heritage
IDP	Integrated Development Plan
IEM	Integrated Environmental Management
IFC	International Finance Corporation
IMO	International Maritime Organisation
IMMA	Important Marine Mammal Area
IRP	Integrated Resource Plan
ISO	International Organization for Standardization
IUCN	International Union for the Conservation of Nature
IWC	International Whaling Commission
JNCC	Joint Nature Conservation Committee
kts	knots
LSA	Late Stone Age
MLRA	Marine Living Resources Act (Act No. 18 of 1998)
MMO	Marine Mammal Observer
MPA	Marine Protected Area
MPRDA	Minerals and Petroleum Resources Development Act (Act No. 28 of 2002)
MSA	Middle Stone Age
NBA	National Biodiversity Assessment
NDM	Namakwa District Municipality
NDP	National Development Plan
NEMA	National Environmental Management Act (Act No. 107 of 1998)

NEMPAA	National Environmental Management Protected Areas Act (Act No. 57 of 2003)
NGOs	Non-Governmental Organisations
NHRA	National Heritage Resources Act (Act No. 25 of 1999)
nm	Nautical Miles
PAM	Passive Acoustic Monitoring
PASA	Petroleum Agency of South Africa
PIM	Particulate Inorganic Matter
POM	Particulate Organic Matter
PPP	Public Participation Process
PTS	Permanent Threshold Shift
RMS	root-mean-square
ROV	Remote Operated Vehicle
S&EIA	Scoping and Environmental Impact Assessment
SACW	South Atlantic Central Water
SAMPI	South African Multidimensional Poverty Index
SADSTIA	South African Deepsea Trawling Industry Association
SAEON	South African Environmental Observation Network
SAHLLA	South African Hake Longline Association
SAHRA	South African Heritage Resources Agency
SAMSA	South African Maritime Safety Authority
SANHO	South African Navy Hydrographic Office
SANBI	South African National Biodiversity Institute
SANHO	South African Navy Hydrographic Office
SAWDN	South African Whale Disentanglement Network
SLO	Social Licence to Operate
SOPEP	Shipboard Oil Pollution Emergency Plan
SPL	Sound Pressure Level
SSF	Small Scale Fishers
SSFP	Small-Scale Fisheries Policy
TAC	Total Allowable Catch
TAE	Total Allowable Effort
TCP	Technical Co-operation Permit
TOPS	Threatened and Endangered Species
TSPM	Total Suspended Particulate Matter
TTS	Temporary Threshold Shift
VMEs	Vulnerable Marine Ecosystems

EXECUTIVE SUMMARY

Searcher Geodata UK Ltd (the applicant / Searcher) undertook a seismic survey project during 2021 and during that project, an Environmental Management Programme (EMPr) was compiled and submitted to the competent authorities in support of the Reconnaissance Permit 12/1/038. The Orange Basin 2D Seismic Survey (Petroleum Agency South Africa (PASA) Ref: 12/1/038)) was a multiclient 2D programme off western South Africa which was terminated prior to completion as a result of the outcome of a legal challenge related to the validity of the exploration permit issued by PASA. Ultimately the Reconnaissance Permit expired with only a small part of the 2D survey taking place. Only about 21% (~2 025 km) full-fold line being recorded from the planned 9 635 km programme when the vessel became subject to an interim court interdict and ceased operations within South African waters. In 2022, Searcher then proposed to undertake a 3D seismic survey further offshore and over a smaller area offshore of the west coast of South Africa. Searcher required an Environmental Authorization (EA) to meet with the new legislation under the amended National environmental Management Act (Act No. 107 of 1998 NEMA) EIA Regulations, 2014, including the required stakeholder consultation to undertake the seismic surveys as part of Reconnaissance Permit 12/1/043. An EA was issued to Searcher by the Department of Mineral resources and Energy (DMRE) on the 20th of December 2022 (ref: 12/1/043). Due to the prolonged appeal phase, viable acquisition windows and vessel availability, Searcher was only able to undertake the 3D seismic surveys as part of the 12/1/043 Reconnaissance Permit and EA between January and April 2024. Subsequently, Searcher was not able to complete the full extents of the intended survey during the 2023-2024 survey season.

Since a Reconnaissance Permit is only valid for 1 year, the 12/1/043 permit will expire on the 10 November 2024. **Searcher has consequently applied for and received a new Reconnaissance Permit for the same previously approved activity over the same area (12/1/048)**. A new EA is required for Searcher to continue under the new 12/1/048 Reconnaissance Permit application. Although the current EA application relates to a new Reconnaissance Permit application by Searcher and not a renewal of the previous permission, it is for the same activity over the same area. Subsequently, Environmental Impact Management Services (Pty) Ltd (EIMS) has been appointed as Independent Environmental Assessment Practitioners to undertake the EA Process for the Proposed Searcher Exploration Activities located offshore extending from approximately 256km offshore of St Helena Bay to 220 km offshore of Hondeklip Bay, off the West Coast of South Africa. EIMS has been appointed to prepare and submit an application for EA as per the requirements of the Environmental Impact Assessment (EIA) Regulations, 2014, as amended, promulgated under the National Environmental Management Act (Act No. 107 of 1998- NEMA) and the requirements of the Minerals and Petroleum Resources Development Act (Act No. 28 of 2002 – MPRDA).

The Reconnaissance Permit area of interest for the proposed 3D seismic survey is approximately 30 000 km^2 in extent. However, an area of approximately 7 800 km^2 (largely in the northern section) was surveyed[a] during the 2023-2024 survey season and will be excluded from Full Power Source[b] data acquisition during the proposed second survey period. The previously proposed and approved survey method will be followed which includes a single survey vessel equipped with seismic sources and streamers being used for the survey. The survey vessel will be supported by a minimum of one escort vessel. It is currently envisaged that the survey lines will remain mainly in the NE-SW or SE-NW orientation. The 3D survey will take in the order of 127 days including downtime and is proposed to be undertaken during the survey period (late December – May) but will likely commence in first quarter of 2025 and may extend into 2026. It must be noted that if any acquisition is to be undertaken in late December, then this must definitely be undertaken with a Passive Acoustic Monitoring (PAM) and preferably starting in the north and moving southwards.

A Basic Assessment (BA) application process is being undertaken to accompany the application for the EIA Listing Notices listed activities applicable to the project namely:

- **GN983, Listing Notice 1: Activity 21(b)**: Any activity including the operation of that activity which requires a reconnaissance permit in terms of section 74 of the Mineral and Petroleum Resources Development Act, as well as any other applicable activity as contained in this Listing Notice or in Listing Notice 3 of 2014, required to exercise the reconnaissance permit, excluding -

[a] 7 800km^2 survey area where viable full fold data has been acquired (excludes non active vessel manoeuvring, line turns, run in/outs).

[b] Full Power Source: Where the source array is at full power (excludes non active vessel manoeuvring, line turns and soft starts).

(a) any desktop study; and

(b) any arial survey.

PUBLIC PARTICIPATION PROCESS

The PPP for the proposed project is undertaken in accordance with the requirements of the NEMA EIA Regulations (2014), and in line with the principles of Integrated Environmental Management (IEM). IEM implies an open and transparent participatory process, whereby stakeholders and other I&APs are afforded an opportunity to comment on the project and have their views considered and included as part of project planning.

The comments received from I&APs during the initial call to register and comments period so far have been captured in the Public Participation Report (PPR) in **Appendix B**. The public consultation process thus far has been extensive, and every effort has been made to include representatives of all stakeholders in the study area. The public participation process will continue onto the public review and comment phase of the Draft BA. This phase will include placement of hardcopies in public places (various public libraries along the West Coast) and softcopy on the EIMS website (https://www.eims.co.za/public-participation/) as well as parallel feedback sessions and open day meetings. The BA report will be made available for public review for a minimum of the legislated 30-day review and commenting period from **21 June 2024 to 22 July 2024**. A high-level summary of the key comments and concerns raised and addressed during the initial basic assessment process (EIMS, 2022) presented below:

- Effects on migratory patterns along the West Coast;
- Long term marine life impact if the survey finds exploitable resources;
- Impacts on marine life between the survey site and the coast and how this will impact the future of tourism and agriculture;
- Climate change impacts associated with oil and gas;
- Effects on fisheries and catch rates;
- Food security;
- Free Prior and Informed Consent in public participation processes;
- Public Consultation Process perception as a “tick box exercise”;
- Public want a representative from Searcher to attend the second round of meetings;
- Impact on indigenous cultural heritage, historical connection to the sea;
- Previous surveys conducted by Searcher outside of the EEZ;
- Searcher’s return to survey in South Africa following court case;
- EIMS’ independence if the applicant pays for the services rendered;
- Alternative technologies to seismic surveys;
- Cumulative impacts associated with concurrent surveys and other activities in the area;
- A lot of the communities are very poor. Concern that there will be no economic benefits for the communities as a direct result of the survey;
- Presence of maritime heritage/shipwrecks;
- Request for an opportunity for virtual engagements;
- Community benefits from the project;
- Damage to the seabed as a result of the survey;

- Comments on the potential displacement of marine life, disruption of mating and feeding patterns, potential beach strandings;
- Impacts on local tourism;
- Effectiveness of Marine Mammal Observers;
- Potential impacts on Marine Protected Areas and Critical Biodiversity Areas;
- Opposition of the project by various stakeholders;
- Enquiries regarding sound propagation and modelling undertaken;
- Reliability and independence of appointed specialists;
- Comments on assessment of alternatives;
- Lack of local baseline studies;
- Enquiry on EIMS' and applicant shareholders government and political affiliations;
- South Africa's climate change commitments and energy mix for the future;
- Perceived procedural irregularities;
- Need and desirability of the project.

A high-level summary of the key comments and concerns raised during the current public participation process undertaken to date (call to register and initial comments) from the 19th of April 2024 to date are presented below:

- Concerns over stakeholder fatigue
- I&AP registrations and deregistration;
- Notification/information document requests;
- Request for clarity on the nature of the project;
- Request for files related to the location and situation of the project site;
- Concern about the impact on marine ecology and climate change;
- Competent authority registration and notification of further comments upon receipt of further information;
- Request to be notified when draft BAR is released for comments; and
- Concerns for fishing grounds as a result of the 3D seismic survey.

IMPACT ASSESSMENT

The BA report aims to achieve the following:

- Provide an overall assessment of the social and biophysical environments affected by the proposed project.
- Provide feedback on the initial survey undertaken between January and April 2024.
- Assess potentially significant impacts (direct, indirect and cumulative, where required) associated with the proposed project.
- Identify and recommend appropriate mitigation measures for potentially significant environmental impacts; and
- Undertake a fully inclusive public involvement process to ensure that Interested and Affected Parties (I&APs) are afforded the opportunity to participate, and that their issues and concerns are recorded, merit assessed and addressed.

The most significant risks and impacts identified were those that remain high in terms of significance even post mitigation measures being considered. The following impacts were determined to have a potentially moderate negative final significance:

- Impacts on livelihoods;
- Impacts on sense and spirit of place;
- Impacts on social licence to operate;
- Community expectations;
- Social unrest;
- Uncertainty from a social perspective;
- Concerns about cumulative social impacts; and
- Further marginalization of vulnerable groups.

Mitigation measures have been identified based on input from the Environmental Assessment Practitioner (EAP), public consultation, and specialist assessments. The associated EMPr (**Appendix E**) includes suggested mitigation mechanisms for avoidance, minimisation and / or management of the negative impacts.

The conclusions and recommendations of this BA are the result of the assessment of identified impacts by specialists, and the parallel process of public participation. The public consultation process thus far has been extensive, and every effort has been made to include representatives of all stakeholders in the study area. Specialist studies undertaken during the first EA application (2022) were updated using the latest available data to support the current application. The main conclusions from each of the updated specialist studies are presented below.

NOISE / ACOUSTICS

The noise modelling results were used to identify zones of impact for marine mammals and other species of concern based on relevant noise impact assessment criteria. Zones of impact were evaluated for physiological effects and behavioural disturbance, due to the immediate impact from single airgun pulses, as well as the cumulative effects of exposure to multiple airgun pulses over a period of 24 hours.

Due to the high level of impulsive signal emissions from the array sources, marine mammals are predicted to experience a permanent auditory threshold shift (PTS) at close proximity to the source arrays due to the immediate exposure to individual pulses. Marine mammals of all hearing groups except very-high-frequency cetaceans are predicted to experience PTS effect within approximately 45 m from the 2D and 3D source arrays at all assessed water depth scenarios. The maximum zones of PTS effect for very-high-frequency cetaceans are predicted to be within 270 m from the 2D and 3D array sources. The zones of a temporary auditory threshold shift (TTS) due to a single pulse exposure for marine mammals of all hearing groups except very-high-frequency cetaceans are predicted to be within approximately 85 m from the 2D and 3D source arrays. The maximum zones of TTS effect for very-high-frequency cetaceans are predicted to be within 500 m from the array sources. Behavioural disturbance caused by the immediate exposure to individual pulses are predicted to be within 4.6 km from the array source for marine mammals of all hearing groups.

The zones of cumulative impact (i.e. the maximum horizontal perpendicular distances from assessed survey lines to cumulative impact threshold levels) are estimated based on the modelling results and relevant assessment criteria. Among marine mammals of all six hearing groups, low-frequency cetaceans have the highest zones of PTS and TTS impact. The zones of PTS impact are predicted to range up to 500 m for the 2D survey and 800 m for the 3D survey respectively, from the adjacent survey lines for the relevant typical 24-hour survey operation scenarios considered, and the maximum zone of TTS impact is predicted to be around 5.0 km for the 2D survey and 8.0 km for the 3D survey respectively, from their relevant adjacent survey lines. Much lower zones of cumulative PTS and TTS impact are predicted for marine mammals of other hearing groups.

The zones of potential injuries for fish species with a swim bladder, turtles and fish eggs and fish larvae are predicted to be within 160 m from the 2D and 3D airgun array sources. However, fish species without swim bladders have higher injury impact thresholds, and therefore have smaller zones of potential injuries within 80 m from the airgun array sources. The behavioural disturbance for sea turtles caused by the immediate exposure to individual pulses are predicted to be within 2.99 km from the 2D array source and 2.55 km from the 3D array source. The zones of potential mortal injuries for fish species with and without a swim bladder, turtles and fish eggs and fish larvae are predicted to be within 60 m from the adjacent survey lines for all the 24-hour survey operation scenarios considered. For recoverable injury, the zones of impact are predicted to be within 20 m from the adjacent survey lines for fish without a swim bladder, and within 200 m for fish with a swim bladder for all the operation scenarios considered. The zones of TTS effect for fish species with and without swim bladders are predicted to be within 2 000 m for the 2D survey and 3 500 m for the 3D survey respectively, from the adjacent survey lines for the relevant 24-hour survey operation scenarios considered.

Existing experimental data regarding recoverable injury and TTS impacts for sea turtles and fish eggs and larvae is sparse and no guideline recommendations have been provided. However, based on a subjective approach, noise impacts related to recoverable injury and TTS on sea turtles are expected to be high at the near field from the source location while impacts are expected to be moderate for fish eggs and larvae. Impact is expected to be low for all of them at intermediate and far field from the source location.

Relevant mitigation measures are recommended to minimise impacts on assessed marine fauna. Recommended safety zones are based on the maximum threshold distances modelled for PTS (marine mammals and sea turtles) and potential mortal injury (fish) due to immediate exposure from single pulses and cumulative exposure from multiple pulses. Additional measures include the implementation of a soft-start procedure if testing multiple seismic sources. Delay soft-starts if slow swimming large pelagic fish, turtles, seals, or cetaceans are observed within the zone of impact.

MARINE ECOLOGY

The proposed 3D survey area falls into the Southeast Atlantic Deep Ocean Ecoregions. Although there is a lack of knowledge of the community structure and diversity of benthic macrofauna off the shelf edge, the South Atlantic bathyal and abyssal unconsolidated habitat types have been rated as 'Least Threatened', reflecting the great extent of these habitats in the South African Exclusive Economic Zone (EEZ). Only sections along the shelf edge and in the Cape Canyon are rated as 'Vulnerable' and 'Endangered'. Geological features of note in and adjacent to the proposed survey area are Child's Bank, Tripp Seamount, two canyons, the Cape Canyon and Cape Valley also occur to the south of the Reconnaissance Permit Area. Features such as banks and seamounts often host deepwater corals and boast an enrichment of bottom-associated communities relative to the otherwise low-profile, homogenous seabed habitats.

Due to its offshore location, plankton abundance is expected to be low, with the major fish spawning and migration routes occurring inshore on the shelf. The dominant fish in the area would include the migratory large pelagic species such as tunas, billfish and pelagic sharks. Seabirds will be dominated by the pelagic species such as albatross, petrels and shearwaters. Migrating turtles in the area would include the leatherback and loggerhead turtles. Marine mammals likely to occur offshore include a variety of baleen whales including humpbacks, Antarctic minke, fin and sei whales. Toothed whales will include sperm and killer whales, as well as a variety of beaked whales and dolphins. There are six offshore Marine Protected Areas (MPAs) in the general project area, but none fall within the Reconnaissance Permit Area. The proposed 3D survey area lies well offshore of these MPAs. Although there is no overlap of the 3D survey area with Ecologically and Biologically Significant Areas (EBSAs), critical biodiversity areas (CBAs) within the Reconnaissance Permit and 3D survey areas include both CBA1 (irreplaceable) and CBA2 (natural areas selected to meet biodiversity targets).

Potential impacts to the marine fauna as a result of the proposed 3D seismic acquisition include:

- Physiological injury and/or mortality;
- Behavioural avoidance;
- Reduced reproductive success/spawning;

- Masking of environmental sounds and communication;
- Collision of turtles/marine mammals with the survey and support vessels or entanglement in towed acoustic apparatus; and
- Indirect impacts on piscivorous predators due to seismic effects on prey species

The proposed survey activities to be undertaken by Searcher are expected to result in impacts on marine invertebrate fauna in the Orange Basin, ranging from negligible to very low significance. Only in the case of potential impacts to turtles and marine mammals are impacts of low significance expected.

The guidelines currently applied to seismic surveying in South African waters are those proposed in the Generic EMPR (CCA & CMS 2001) and by Purdon (2018). Purdon (2018) highlights the importance of developing mitigation guidelines both locally and regionally and points out that if South Africa is to maintain environmental integrity, mitigation guidelines for seismic surveys specific to the country, and based on the most recent scientific data, need to be implemented. These have been updated as necessary to include salient points from recognised international guidelines, particularly the Joint Nature Conservation Committee (2010, 2017) Guidelines, the 2013 New Zealand Code of Conduct for seismic operations (New Zealand Dept. of Conservation 2013) and recommendations made by Weilgart (2023). The proposed mitigation is thus comprehensive and in-line with, and in certain instances more comprehensive than, international good-practice industry standards.

In the opinion of the specialist, if all environmental guidelines, and appropriate mitigation measures recommended in this report are implemented, there is no reason why the proposed seismic survey programme should not proceed. It should also be kept in mind that some of the migratory species are now present year-round off the West Coast, and that certain baleen and toothed whales are resident and/or show seasonality opposite to the majority of the baleen whales. Data collected by independent onboard observers should form part of a survey close–out report to be forwarded to the necessary authorities, and any incidence data and seismic source output data arising from surveys should be made available for analyses of survey impacts in Southern African waters.

FISHERIES ASSESSMENT

Several aspects of the proposed activities were identified as posing a potential risk to the fishing industry and these risks were assessed with respect to each commercial fishing sector operational off the West Coast of South Africa. The aspects of the planned operations that were identified as posing a risk to fisheries include 1) noise emitted by the seismic survey operation; 2) safety zone around the survey vessel; and 3) accidental events such as hydrocarbon spill and loss of survey equipment to sea. The potential impacts arising from these aspects were assessed under the following categories: 1) the effects of increased ambient sound on fish behaviour and associated effects on recruitment and catch rates; 2) temporary exclusion of vessels from accessing fishing grounds; 3) water contamination due to accidental release of marine diesel and 4) obstruction to fishing operations as a result of lost equipment.

Under the Convention on the International Regulations for Preventing Collisions at Sea, a seismic survey vessel that is engaged in surveying, is defined as a “vessel restricted in its ability to manoeuvre”, which requires that power-driven and sailing vessels give way to a vessel restricted in her ability to manoeuvre. Furthermore, under the Marine Traffic Act, 1981, a vessel used for the purpose of exploiting the seabed falls under the definition of an “offshore installation” and as such it is protected by a 500 m safety zone. It is an offence for an unauthorised vessel to enter the safety zone. In addition to a statutory 500 m safety zone, a seismic contractor would request a safe operational limit (that is greater than the 500 m safety zone) that it would like other vessels to stay beyond. Safety clearances for seismic surveys are usually 6 Nm ahead and astern and 2 Nm to either side of the survey vessel, resulting in an exclusion area of approximately 165 km^2 around the survey vessel. The temporary exclusion of fisheries from the safety zone may reduce access to fishing grounds, which in turn could potentially result in a loss of catch and/or displacement of fishing effort (direct negative impact). The safety zone would be implemented around the seismic vessel for the duration of the project, resulting in a temporary (short-term) and transient impact.

Sound generated during the seismic survey is expected to be 256.4 dB re 1 µPa at 1 m peak sound pressure level (Pk SPL) and 250.2 dB re 1 µPa at 1 m (root-mean-square sound pressure level (RMS SPL) with a sound exposure level (SEL) of 232.4 dB re 1 µPa at 1 m at an operating frequency range of 5 – 300 Hz. The zone of mortality to fish eggs and larvae, as well as fish species with a swim bladder, is predicted to be within 160 m from the array source. Fish species without swim bladders have higher injury impact thresholds, and therefore a smaller zone of potential injury within 80 m from the array source. Impact of mortality to fish eggs and larvae as a result of cumulative exposure to multiple airgun array pulses was assessed to be 30 m from the adjacent survey lines for a 24-hour survey operation. The zones of mortal injury to fish ranges from <10 m for fish without a swim bladder, to between 30 m and 60 m for fish with swim bladders. Potential recoverable injury for fish species with swim bladders is predicted to be up to 200 m and temporary threshold shifts (TTS) are predicted up to a distance of 3.5 km from the survey lines for the 24-hour operation scenarios considered. Existing experimental data regarding recoverable injury and TTS impacts for fish eggs and larvae is sparse and no guideline recommendations have been provided. However, based on a subjective approach, noise impacts related to recoverable injury and TTS on fish eggs and larvae are expected to be moderate in the near field (tens of meters). Impact is expected to be low at intermediate field (hundreds of meters) and far field (thousands of meters) from the source location.

Generation of noise during the seismic survey has the potential to affect catch due to behavioural responses of fish to increased noise levels. For the current project, the potential impact of elevated sound levels (produced by seismic airguns) on behavioural disturbance to fish (and associated effects on commercial catch rates) may extend to a distance of ~4 km from the sound source. With the implementation of the project controls and mitigation measures, the residual impact due to seismic noise is considered to be of LOW NEGATIVE significance for the large pelagic longline sector. Due to the remote location of the Reconnaissance Permit area, noise would be expected to attenuate to below threshold levels before reaching fishing grounds of all other sectors viz. the demersal trawl, midwater trawl, demersal longline, tuna pole-line, small pelagic purse-seine, traditional linefish, west coast rock lobster and small-scale fisheries sectors. The Reconnaissance Permit area does not coincide with spawning areas of key commercial species and noise generated by the seismic source would be expected to attenuate to below threshold levels for behavioural disturbance before reaching inshore recruitment and/or nursery areas. The Reconnaissance Permit area is situated well offshore of distributional area of snoek during its spawning and migration periods (an important species for the linefish and small-scale fisheries sectors).

In order to mitigate the impacts on the large pelagic longline sector, it is recommended that prior to the commencement of survey activities, affected parties should be informed of the navigational co-ordinates of the proposed survey acquisition area, timing and duration of proposed activities and any implications relating to the exclusion zone that would be requested, as well as the movements of support vessels related to the project. The relevant fishing associations include FishSA, incorporating the main commercial fishery sectors, as well as the SA Tuna Association, SA Tuna Longline Association, Fresh Tuna Exporters Association and small-scale fishery groups including the South African United Fishers Front (SAUFF).

Other key stakeholders should be notified prior to commencement and on completion of the project. These include; the South African Navy Hydrographic Office (SANHO), South African Maritime Safety Association (SAMSA), Ports Authority and DFFE Vessel Monitoring, Control and Surveillance Unit in Cape Town (Vessel Monitoring System Unit). For the duration of the survey, a navigational warning should be broadcast to all vessels via Navigational Telex (Navtext) and Cape Town radio. In addition, it is recommended that updates of the scheduled weekly survey plan should be circulated to the operators of affected fishing vessels on a daily basis. A Fisheries Liaison Officer (FLO) should be present on board the seismic vessel or escort vessel for the duration of the survey in order to facilitate communications between the seismic and fishing vessels in the project area. It is the reasoned opinion of the specialist that the reconnaissance activities may be authorised, subject to the implementation of the mitigation measures proposed.

Small-scale fishermen along the Northern Cape and Western Cape coastlines are unlikely to range beyond 20 km from the coastline; thus, inshore of the proposed 3D survey area, which is situated 250 km offshore of the coast at its closest point. In South Africa, there is a long history of coastal communities utilizing marine resources for various purposes. Many of these communities have been marginalized through apartheid practices and previous fisheries management systems. In 2007 government was compelled through an equality court order to redress the inequalities suffered by these traditional fishers.

HERITAGE ASSESSMENT

A large section of the affected communities not only view themselves as small-scale fishers but also as indigenous people and, as such, are intrinsically linked to the ocean and the land they have lived on for centuries. The resurgence movement through which Khoi and San descendants are reclaiming their identity has, in recent decades, afforded these communities the ability to re-establish their cultural roots and grounding in an ancient landscape. This sentiment is echoed in the founding affidavit submitted (5 February 2022) during the appeal submitted to the first Searcher application by CJ Adams. It notes that the ocean is not only important for fishing but also has spiritual meaning and is a place of healing and holds healing powers for the indigenous communities. It further expanded that the ocean and its resources play an important part in their community's history and heritage.

The scientific studies conducted for this project identified impacts on the fishing stock as low for all types of species. A low negative residual impact is projected for these species. By inference, a potential impact on fishing yield could be expected and thus potential economic impact on communities due to reduced caught fish volumes. The recommended mitigation measures as listed in the specialist reports for the project focus on the reduction of impacts on fish species and the projected reduction of the impact on the commercial and small-scale fishery catch yield. These mitigation measures should then indirectly have a positive impact on the cultural heritage of the communities to be impacted.

In this assessment, marine-related intangible cultural heritage and people’s connection to the ocean is relevant. This type of heritage incorporates the unique ethos and identity of specific places linked with fishing villages; oral history; popular memory; cultural traditions; indigenous knowledge systems, rituals, beliefs, and practices (e.g., fishing techniques) associated with the ocean. A pre-mitigation negative impact is projected on a regional scale over the long term with a moderate intensity due to the potential indirect impact on the communities and, ultimately, their heritage, with a high probability of this impact occurring. The pre-mitigation impact is rated as medium. The potential residual impact with mitigation measures from the scientific studies is projected as low with a medium confidence factor.

At this stage, cumulative impacts are purely speculative. Still, the potential for the future increase in cumulative impacts due to current and future seismic surveys and the potential for future Oil and Gas production cannot be excluded but is not quantifiable at this stage for cultural heritage. Considering the assessment based on the findings of the fieldwork as well as the scientific studies relating to the impact on fisheries, the specialist is of the opinion that the impact of the proposed project on the cultural heritage resources can be mitigated through the implementation of the recommendations in the Heritage Assessment Report and reflected in this BAR.

SOCIAL ASSESSMENT

Searcher’s activities for this application would be of short duration if approved, and if viewed in isolation considering only technical risks as discussed in various specialist reports conducted as part of the EIA process, the impacts will be negligible. However, communities feel that there are significant gaps in the available data and from a social perspective the non-technical or social risks can potentially cause significant impacts. Although the marine fauna and fisheries specialists have indicated that the impacts on the marine fauna would be negligible, the communities, with generations of experience in the ocean, fear that the behaviour of the fish will change and that this would affect their catch rates and consequently their livelihoods. What is seen as a minor impact in a large eco-system may be experienced as a major impact by an individual. The marine fauna might not be affected greatly, but the fishing community fear that marine fauna might change its behaviour in response and that is a main concern from a social perspective.

Another concern is the cumulative impact of activities in the ocean where these communities earn their livelihoods. Their fears about the tipping point where their source of livelihood does not recover from all the activities in the ocean, and they are no longer able to make their livelihood as fishing communities must be considered. Currently these communities are able to sustain themselves, although it is difficult. The communities are not against development, but they want to see it happen in a sustainable way that does not jeopardise their source of livelihood. They have already seen how their livelihoods are being affected by mining that is taking place in the sea, pollution, climate change, over fishing and businesses such as factories that come and go and often and do not leave in a socially responsible way.

Searcher, as well as other companies that want to do surveys or exploration in the area, currently do not have social license to operate. A large part of this is due to a lack of meaningful consultation from a community perspective. If Searcher or any other seismic survey company wants to proceed with the project, they will need to engage in meaningful conversation with the communities and try to restore relationships. From a community and social risk perspective this is not negotiable.

Seismic reconnaissance projects and the development of the oil and gas industry are currently controversial in South Africa. For many stakeholders it is an emotional matter, for others the potential of impacting their livelihoods is the biggest fear. There are also stakeholders that feel that the exploration for fossil fuels is not in line with sustainable development and the fight against climate change. Other stakeholders feel that it is imperative for the growth and development of the South African economy to engage in these investigations.

From a social perspective it is clear that the communities and local people are divided about the oil and gas industry. If the project is considered in isolation, the impacts are negligible. However, the project does not happen in a vacuum, and the social environment is much wider than the footprint of the project. If the social risks and potential damage to cultural and indigenous rights are considered the impact on the social fabric of already vulnerable communities may be significant. Potential future benefits and the economic development of the country should the surveys find any significant resources are not disputed. From a social perspective the project can only be recommended after meaningful consultation, local research, education, and awareness raising has been done in the project affected communities. At this stage communities feel that they cannot make informed decisions. Although all legal processes have been followed, the seismic survey industry is not moving at the pace of the community, and in the long run this will be detrimental to the industry. Potential future benefits and the economic development of the country should the surveys find any significant resources are not disputed. The recommendation is therefore that the project can only proceed once the social mitigation measures have been implemented and the community are sufficiently informed and educated to able to engage in a meaningful manner.

IMPACT STATEMENT

The findings of the specialist studies conclude that there are no environmental fatal flaws that should prevent the proposed project from proceeding, provided that the recommended mitigation and management measures are implemented. Based on the nature and extent of the proposed project, the level of disturbance predicted as a result of the survey activities, the findings of the specialist studies, and the understanding of the significance level of potential environmental impacts, it is the opinion of the EIA project team and the EAP that the significance levels of the majority of identified negative impacts can generally be reduced to an acceptable level by implementing the recommended mitigation measures and the project should be authorized.

Some of the key critical mitigation measures are listed below (more specific detail is provided in **Section 11** of this report):

- Avoid replicate seismic surveys. 7 800km^2 area already surveyed[c] should not be surveyed further during the additional survey period and must form part of the exclusion zone;
- Plan seismic surveys to avoid most sensitive periods within the survey area for some marine fauna from early June to early December;
- Although a seismic vessel and its gear may pass through a declared Marine Protected Area, acoustic sources must not be operational during this transit;
- Ensure the seismic vessel is fitted with PAM technology, which detects some animals through their vocalisations;

[c] 7 800km2 surveyed area where viable full fold data has been acquired (excludes non active vessel manoeuvring, line turns, run in/outs).

- Define and enforce the use of the lowest practicable seismic source volume for production, and design arrays to maximise downward propagation, minimise horizontal propagation and minimise high frequencies in seismic source pulses;
- Ensure that ‘turtle-friendly’ tail buoys are used by the survey contractor or that existing tail buoys are fitted with either exclusion or deflector 'turtle guards';
- Ensure that solid streamers rather than fluid-filled streamers are used to avoid leaks;
- Make provision for the placing of qualified MMOs on board the seismic vessel;
- Maintain a pre-acquisition watch of 60-minutes before any instances of seismic source testing. If only a single lowest power seismic source is tested, the pre- acquisition watch period can be reduced to 30 minutes;
- Implement a “soft-start” procedure in certain identified scenarios or if testing multiple seismic sources;
- Implement a dedicated MMO and PAM pre- acquisition watch of at least 60 minutes (to accommodate deep-diving species in water depths greater than 200 m);
- Terminate seismic source on observation and/or detection of penguins or feeding aggregations of diving seabirds, turtles, slow swimming large pelagic fish (including whale sharks, basking sharks, manta rays [and devil rays-Namibia only]) or cetaceans within the 500 m mitigation zone;
- Terminate seismic source on observation of any obvious mortality or injuries to cetaceans, turtles, seals or mass mortalities of squid and fish (specifically large shoals of tuna or surface shoaling small pelagic species such as sardine, anchovy and mackerel) when estimated by the MMO to be as a direct result of the survey;
- Prior to the commencement of seismic survey activities the following key stakeholders should be consulted and informed of the proposed seismic survey programme;
- An experienced Fisheries Liaison Officer should be placed on board the seismic or guard vessel to facilitate communications with fishing vessels in the vicinity of the seismic survey areas;
- Notify any fishing vessels at a radar range of 12 nm from the seismic vessel via radio regarding the safety requirements around the seismic vessel;
- Implement a grievance mechanism in case of disruption to fishing or navigation;
- Re-assess post project, the effects on the identified communities and their intangible cultural heritage as well as of related economic damage and losses, and human development impacts. Based on the outcomes, provide resources and support for communities to develop and undertake safeguarding measures or plans to enhance the mitigation capacity of their intangible cultural heritage by fostering dialogue, mutual understanding and reconciliation between and within communities;
- Searcher should continue to implement the community engagement protocol that was developed in 2024; and
- Consult with communities on potential ways in which to make a positive contribution to the communities.

1 INTRODUCTION

Searcher Geodata UK Ltd (the applicant / Searcher) undertook a seismic survey project during 2021 and during that project, an Environmental Management Programme (EMPr) was compiled and submitted to the competent authorities in support of the Reconnaissance Permit 12/1/038. The Orange Basin 2D Seismic Survey (Petroleum Agency South Africa (PASA) Ref: 12/1/038)) was a multiclient 2D programme off western South Africa which was terminated prior to completion as a result of the outcome of a legal challenge related to the validity of the exploration permit issued by PASA. Ultimately the Reconnaissance Permit expired with only a small part of the 2D survey taking place. Only about 21% (~2 025 km) full-fold line being recorded from the planned 9 635 km programme when the vessel became subject to an interim court interdict and ceased operations within South African waters. In 2022, Searcher then proposed to undertake a 3D seismic survey further offshore and over a smaller area offshore of the west coast of South Africa. Searcher required an Environmental Authorization (EA) to meet with the new legislation under the amended National environmental Management Act (Act No. 107 of 1998 NEMA) EIA Regulations, 2014, including the required stakeholder consultation to undertake the seismic surveys as part of Reconnaissance Permit 12/1/043. An EA was issued to Searcher by the Department of Mineral resources and Energy (DMRE) on the 20th of December 2022 (ref: 12/1/043). Due to the prolonged appeal phase, viable acquisition windows and vessel availability, Searcher was only able to undertake the 3D seismic surveys as part of the 12/1/043 Reconnaissance Permit and EA between January and April 2024. Subsequently, Searcher was not able to complete the full extents of the intended survey during the 2023-2024 survey season.

Since a Reconnaissance Permit is only valid for 1 year, the 12/1/043 permit will expire on the 10 November 2024. **Searcher has consequently applied for and received a new Reconnaissance Permit for the same previously approved activity over the same area (12/1/048)**. A new EA is required for Searcher to continue under the new 12/1/048 Reconnaissance Permit application. Although the current EA application relates to a new Reconnaissance Permit application by Searcher and not a renewal of the previous permission, it is for the same activity over the same area. Subsequently, Environmental Impact Management Services (Pty) Ltd (EIMS) has been appointed as Independent Environmental Assessment Practitioners to undertake the EA Process for the Proposed Searcher Exploration Activities located offshore extending from approximately 256km offshore of St Helena Bay to 220 km offshore of Hondeklip Bay, off the West Coast of South Africa. EIMS has been appointed to prepare and submit an application for EA as per the requirements of the Environmental Impact Assessment (EIA) Regulations, 2014, as amended, promulgated under the National Environmental Management Act (Act No. 107 of 1998- NEMA) and the requirements of the Minerals and Petroleum Resources Development Act (Act No. 28 of 2002 – MPRDA).

The Reconnaissance Permit area of interest for the proposed 3D seismic survey is approximately 30 000 km2 in extent. However, an area of approximately 7 800km2 (largely in the northern section) was surveyed during the 2023-2024 survey season and will be excluded from full Power Sourced data acquisition during the proposed second survey period. The previously proposed and approved survey method will be followed which includes a single survey vessel equipped with seismic sources and streamers being used for the survey. The survey vessel will be supported by one escort vessel. It is currently envisaged that the survey lines will remain at the NE-SW or SE-NW orientation. The 3D survey will take in the order of 127 days including downtime and is proposed to be undertaken during the survey period (Late December – May) but will likely commence in first quarter of 2025 and may extend into 2026. **It must be noted that if any acquisition is to be undertaken in late December, then this must definitely be undertaken with Passive Acoustic Monitoring (PAM) and preferably starting in the north and moving southwards.**

Subsequently, Environmental Impact Management Services (Pty) Ltd (EIMS) has been appointed as Independent Environmental Assessment Practitioners to undertake the EA Process for the Proposed Searcher Exploration Activities located offshore extending from approximately 256km offshore of St Helena Bay to 220 km offshore of Hondeklip Bay, off the West Coast, South Africa. EIMS has been appointed to prepare and submit an application for EA as per the requirements of the Environmental Impact Assessment (EIA) Regulations, 2014, as amended, promulgated under the National Environmental Management Act (Act No. 107 of 1998- NEMA) and the requirements of the Minerals and Petroleum Resources Development Act (Act No. 28 of 2002 – MPRDA).

The proposed project area is located between approximately 256 km offshore of St Helena Bay, extending north along the western coastline to approximately 220 km offshore of Hondeklip Bay over a number of petroleum

[d] Full Power Source: Where the source array is at full power (excludes non active vessel manoeuvring, line turns and soft starts).

licence blocks. The survey area at the closest point is approximately 218 km offshore of the coast of the Western and Northern Cape. The Reconnaissance Permit area of interest for the proposed 3D seismic survey is approximately 30 000 km^2 in extent. However, an area of approximately 7 800 km^2 (largely in the northern section) was surveyed during the 2023-2024 survey season and will be excluded from full Power Source[e] data acquisition during the proposed second survey period. The previously proposed and approved survey method will be followed which includes a single survey vessel equipped with seismic sources and streamers being used for the survey. The survey vessel will be supported by one escort vessel. It is currently envisaged that the survey lines will remain at the NE-SW or SE-NW orientation. The 3D survey will take in the order of 127 days including downtime and is proposed to be undertaken during the survey period (December – May) but will likely commence in first quarter of 2025 and may extend into 2026 survey period.

A Basic Assessment (BA) application process is being undertaken to accompany the application for the EIA Listing Notices listed activities applicable to the project namely:

- **GN983, Listing Notice 1: Activity 21(b)**: Any activity including the operation of that activity which requires a reconnaissance permit in terms of section 74 of the Mineral and Petroleum Resources Development Act, as well as any other applicable activity as contained in this Listing Notice or in Listing Notice 3 of 2014, required to exercise the reconnaissance permit, excluding –

  (a) any desktop study; and

  (b) any arial survey.

The survey area corner coordinate points are listed in

- **Table 1**: Survey Area Corner Coordinate Points.

Point	Latitude	Longitude	Point	Latitude	Longitude
Reconnaissance Permit Application Area					
1	~30° 14' 20.3646"	~14° 04' 01.4328"	**12**	~32° 10' 00.5402"	~13° 58' 47.2533"
2	30° 27' 02.4644"	14° 16' 06.5743"	**13**	~31° 53' 40.5803"	~13° 50' 17.2474"
3	31° 00' 01.3293"	14° 47' 37.1143"	**14**	~31° 49' 20.6094"	~13° 47' 47.2497"
4	31° 05' 40.9497"	14° 53' 02.6665"	**15**	~31° 42' 20.6158"	~13° 44' 07.2416"
5	31° 05' 40.9497"	14° 59' 56.5256"	**16**	~31° 36' 40.6302"	~13° 41' 17.2488"
6	31° 05' 40.9497"	15° 09' 38.6339"	**17**	~31° 15' 30.7137"	~13° 33' 07.2379"
7	31° 15' 01.0986"	15° 09' 38.8124"	**18**	~31° 01' 20.7564"	~13° 28' 17.2401"
8	32° 00' 01.2222"	15° 09' 38.8811"	**19**	~30° 50' 40.7684"	~13° 24' 37.2354"
9	32° 35' 25.5423"	15° 09' 38.9210"	**20**	~30° 39' 24.9181"	~13° 21' 01.7084"
10	~32° 35' 33.6389"	~13° 54' 25.9869"	**21**	~30° 32' 20.7014"	~13° 35' 39.2243"
11	~32° 33' 10.4617"	~13° 54' 27.2447"	**22**	~30° 25' 05.6174"	~13° 47' 32.1985"
EZ A	~30° 40' 30.43"	~13° 21' 21.07"	**EZ D**	~ 31° 05' 24.61"	~14° 34' 08.27"
EZ B	~ 30° 35' 01.67"	~13° 34' 12.98"	**EZ E**	~31° 30' 04.88"	~13° 55' 28.74"
EZ C	~ 30° 20' 58.61"	~13° 56' 52.74"	**EZ F**	~30° 56' 52.61"	~13° 26' 50.26"
Survey Exclusion Zone					
EZ A	~30° 40' 30.43"	~13° 21' 21.07"	**EZ D**	~ 31° 05' 24.61"	~14° 34' 08.27"
EZ B	~ 30° 35' 01.67"	~13° 34' 12.98"	**EZ E**	~31° 30' 04.88"	~13° 55' 28.74"
EZ C	~ 30° 20' 58.61"	~13° 56' 52.74"	**EZ F**	~30° 56' 52.61"	~13° 26' 50.26"

Notes: 1: Indicative coordinates; the westernmost boundary of the permit area at sides 10-20 comprises the limit of the 200nm South African EEZ and is subject to change.

2: Indicative coordinates; the boundary of the permit area at sides 20 to 1 lie on the international median between Namibia and South Africa and is subject to change.

3: The survey exclusion zone represents an area of ~7 803km2 which was surveyed during the 2023-2024 window and will not form part of the new 2025/26 survey area.

[e] Full Power Source: Where the source array is at full power (excludes non active vessel manoeuvring, line turns and soft starts).

below. Close towns or points of interest include Cape Town, Hout Bay, Saldanha, Lamberts Bay, Hondeklip Bay and Port Nolloth.

Table 1: Survey Area Corner Coordinate Points.

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Notes: 1: Indicative coordinates; the westernmost boundary of the permit area at sides 10-20 comprises the limit of the 200nm South African EEZ and is subject to change.

2: Indicative coordinates; the boundary of the permit area at sides 20 to 1 lie on the international median between Namibia and South Africa and is subject to change.

3: The survey exclusion zone represents an area of ~7 803km^2 which was surveyed during the 2023-2024 window and will not form part of the new 2025/26 survey area.

1.1 REPORT STRUCTURE

This report has been compiled in accordance with the NEMA EIA Regulations, 2014, as amended. A summary of the report structure, and the specific sections that correspond to the applicable regulations, is provided in **Table 2** below.

Table 2: Report structure

Environmental Regulation	Description – NEMA Regulation 982 (2014) as amended	Section in Report
Appendix 3(1)(a)	Details of – i. The Environmental Assessment Practitioner (EAP) who prepared the report; and ii. The expertise of the EAP, including a curriculum vitae;	1.2
Appendix 3(1)(b)	The location of the activity. Including – i. The 21-digit Surveyor General code of each cadastral land parcel; ii. Where available, the physical address and farm name; iii. Where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties;	2
Appendix 3(1)I	A plan which locates the proposed activity or activities applied for at an appropriate scale, or, if it is – i. A linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; or ii. On a land where the property has not been defined, the coordinates within which the activity is to be undertaken;	2
Appendix 3(1)(d)	A description of the scope of the proposed activity, including – i. All listed and specified activities triggered and being applied for; and ii. A description of the associated structures and infrastructure related to the development;	3
Appendix 3(1)I	A description of the policy and legislative context within which the development is proposed including-	4

Environmental Regulation	Description – NEMA Regulation 982 (2014) as amended	Section in Report
	(1) an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks, and instruments that are applicable to this activity and have been considered in the preparation of the report; and (ii) how the proposed activity complies with and responds to the legislation and policy context, plans, guidelines, tools frameworks, and instruments	
Appendix 3(1)(f)	A motivation for the need and desirability for the proposed development including the need and desirability of the activity in the context of the preferred location;	5
Appendix 3(1)(g)	A motivation for the preferred site, activity and technology alternative	0, 3 and 9
Appendix 3(1)(h)	A full description of the process followed to reach the proposed preferred alternative within the site, including: – i. Details of the development footprint alternatives considered; ii. Details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs; iii. A summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them; iv. The environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects; v. The impacts and risks identified for each alternative, including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts – a. Can be reversed; b. May cause irreplaceable loss or resources; and c. Can be avoided, managed or mitigated; vi. The methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks associated with the alternatives;	0, 7, 8 and 9

Environmental Regulation	Description – NEMA Regulation 982 (2014) as amended	Section in Report
	vii. Positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects; viii. The possible mitigation measures that could be applied and level of residual risk; ix. The outcome of the site selection matrix; x. If no alternatives, including alternative locations for the activity were investigated, the motivation for not considering such; and; xi. A concluding statement indicating the preferred alternatives, including preferred location of the activity.	
Appendix 3(1)(i)	A full description of the process undertaken to identify, assess and rank the impacts the activity will impose on the preferred location through the life of the activity, including – i. A description of all environmental issues and risks that were identified during the environmental impact assessment process; and ii. An assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures;	0, 7, 8 and 9
Appendix 3(1)(j)	An assessment of each identified potentially significant impact and risk, including – i. Cumulative impacts; ii. The nature, significance and consequences of the impact and risk; iii. The extent and duration of the impact and risk; iv. The probability of the impact and risk occurring; v. The degree to which the impact and risk can be reversed; vi. The degree to which the impact and risk may cause irreplaceable loss of resources; and vii. The degree to which the impact and risk can be mitigated;	0, 7, 8 and 9

Environmental Regulation	Description – NEMA Regulation 982 (2014) as amended	Section in Report
Appendix 3(1)(k)	Where applicable, a summary of the findings and impact management measures identified in any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final report;;	11
Appendix 3(1)(l)	An environmental impact statement which contains – i. A summary of the key findings of the environmental impact assessment; ii. A map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicting any areas that should be avoided, including buffers; and iii. A summary of the positive and negative impacts and risks of the proposed activity and identified alternatives;	11.3
Appendix 3(1)(m)	Based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management outcomes for the development for inclusion in the EMPr;	11.4
Appendix 3(1)(n)	Any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation;	11.4
Appendix 3(1)(o)	A description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and mitigation measures proposed;	12
Appendix 3(1)(p)	A reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation;	11.3
Appendix 3(1)(q)	Where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required and the date on which the activity will be concluded and the post construction monitoring requirements finalised;	N/A
Appendix 3(1)I	An undertaking under oath or affirmation by the EAP in relation to – iv. The correctness of the information provided in the reports; v. The inclusion of comments and inputs from stakeholders and interested and affected parties;	13

Environmental Regulation	Description – NEMA Regulation 982 (2014) as amended	Section in Report
	vi. The inclusion of inputs and recommendations from the specialist reports where relevant; and vii. Any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties;	
Appendix 3(1)(t)	Any specific information that may be required by the competent authority; and	None
Appendix 3(1)(u)	Any other matters required in terms of section 24(4)(a) and (b) of the Act.	None

1.2 DETAILS OF THE EAP

EIMS has been appointed by Searcher as the independent Environmental Assessment Practitioner (EAP) to prepare and submit the EA application, Basic Assessment Report, and undertaking a Public Participation Process (PPP) to accompany the 12/1/048 Reconnaissance Permit Application. The contact details of the EIMS consultant and EAP who compiled this Report are as follows:

- Name: Vukosi Mabunda
- Tel No: + 27 11 789 7170
- Fax No: +27 86 571 9047
- E-mail address: searcher48@eims.co.za

In terms of Regulation 13 of the EIA Regulations, 2014, as amended, an independent EAP, must be appointed by the applicant to manage the application. EIMS is compliant with the definition of an EAP as defined in Regulations 1 and 13 of the EIA Regulations, as well as Section 1 of the NEMA. This includes, inter alia, the requirement that EIMS is:

- Objective and independent;
- Has expertise in conducting EIA's;
- Comply with the NEMA, the environmental regulations and all other applicable legislation;
- Considers all relevant factors relating to the application; and
- Provides full disclosure to the applicant and the relevant environmental authority.

EIMS is a private and independent environmental management-consulting firm that was founded in 1993. EIMS has in excess of 30 years' experience in conducting EIA's. Please refer to the EIMS website (www.eims.co.za) for further details of expertise and experience.

Vukosi Mabunda is a current Geographic Information Systems (GIS) Specialist and Environmental Assessment Practitioner with 6 years' working experience. He is one of the few dual registered professionals with the South African Council for Natural Scientific Professions (SACNASP) as a Professional Geospatial Scientist and Professional Environmental Scientist (Reg. #134178). He is also a Registered Environmental Assessment Practitioner (EAP) with the Environmental Assessment Practitioners Association of South Africa (EAPASA Reg. #2019/867). Vukosi has dual professional background in Geographic and Environmental Sciences having academic qualifications which focused on these disciplines as well as relevant work experience. Vukosi has experience in various environmental assessment projects ranging from Environmental Screening, Basic Assessments, Section 102 Amendments and Scoping & Environmental Impact Assessments processes. In addition, Vukosi has undertaken Water Use Authorisations applications through both the General Authorisation and Water Use Authorisation processes. The Curriculum Vitae of the EAP responsible for the compilation of this Report is included in **Appendix A**.

It must be noted that this report is an updated version of the EIMS 1518 Basic Assessment Report – Searcher Seismic Reconnaissance compiled by Mr John von Mayer and assisted by Mr Liam Whitlow and Mr GP Kriel in 2022 (EIMS, 2022). The current report was compiled by Vukosi Mabunda with the assistance of Mr John von Mayer. John von Mayer is a senior consultant at EIMS and has been involved in numerous significant projects the past 15 years. He has experience in Project Management, small to large scale Environmental Impact Assessments, Environmental Auditing, Water Use Licensing, and Public Participation. He is a Registered Professional Natural Scientist (400336/11) with the South African Council Natural and Scientific Professions (SACNASP) as well as a registered EAPASA Environmental Practitioner (2019/1247). The CV's of EAPs involved in this report are attached in **Appendix A**.

1.3 SPECIALIST CONSULTANTS

Specialist reports undertaken during the first EA application in 2022 were updated using the latest available data to support the current application. The updated specialist studies to address the key impacts that required further investigation include:

- Acoustic Technical Report (undertaken by Mr Luke Zoontjens of SLR Australia)
- Marine Ecological Assessment (undertaken Dr Andrea Pulfrich of Pisces Environmental Services (Pty Ltd);
- Fisheries Impact Assessment (undertaken by Ms Sarah Wilkinson of CapMarine (Pty) Ltd).
- Heritage Assessment (undertaken by Mr Wouter Fourie of PGS (Pty) Ltd); and
- Social Assessment (undertaken by Dr Ms Ilse Aucamp of Equispectives Research and Consulting Services (Pty) Ltd).

The specialist studies involved the gathering of data relevant to identifying and assessing environmental impacts that may occur as a result of the proposed project. These impacts were assessed according to pre-defined impact rating methodology (**Section 9.1**). Mitigation / management measures to minimise potential negative impacts or enhance potential benefits are put forward in this BA Report. The updated specialist reports that informed this BA report are included in **Appendix C**.

2 DESCRIPTION OF THE PROJECT AREA

Table 3 indicates the details of the project area for the proposed project including details on the project location as well as the distance from the proposed project area to the nearest towns.

Table 3: Locality details

Project Area	The proposed project area is located between approximately 256 km offshore of St Helena Bay, extending north along the western coastline to approximately 220 km offshore of Hondeklip Bay covering the Northern Cape Ultra Deep, Mid Orange Basin and Various Blocks offshore exploration areas.
Application Area	Proposed 3D Seismic Survey Area: approximately 30 000 km^2 in extent.
Magisterial District	Adjacent to the Namakwaland and West Coast District Municipalities.
District Municipality	Adjacent to the Namakwaland and West Coast District Municipalities.
Local Municipalities	Adjacent to various local municipalities: • City of Cape Town; • Cederberg Local Municipality; • Saldanha Bay Local Municipality; • Bergrivier Local Municipality; • Swartland Local Municipality; • Nama Khoi Local Municipality; • Ritchersveld Local Municipality; and • Matzikama Local Municipality.
Petroleum License Blocks Covered by Application Area	The following license blocks are covered by the application area: • 12/3/274 ER; • 12/3/343 ER; • 12/3/339 ER; and

	• Open area.

The locality of the proposed survey area is shown in **Figure 1**. The proposed project area is located between approximately 256 km offshore of St Helena Bay, extending north along the western coastline to approximately 220 km offshore of Hondeklip Bay over a number of petroleum licence blocks. The area of interest for the proposed 3D seismic survey is approximately 30 000 km^2 in extent. The survey exclusion zone represents an area of ~7 803km^2 which was surveyed during the 2023-2024 window and will not form part of the new 2025/26 survey area as indicated in **Figure 2**. Refer to **Appendix G** for the site maps.

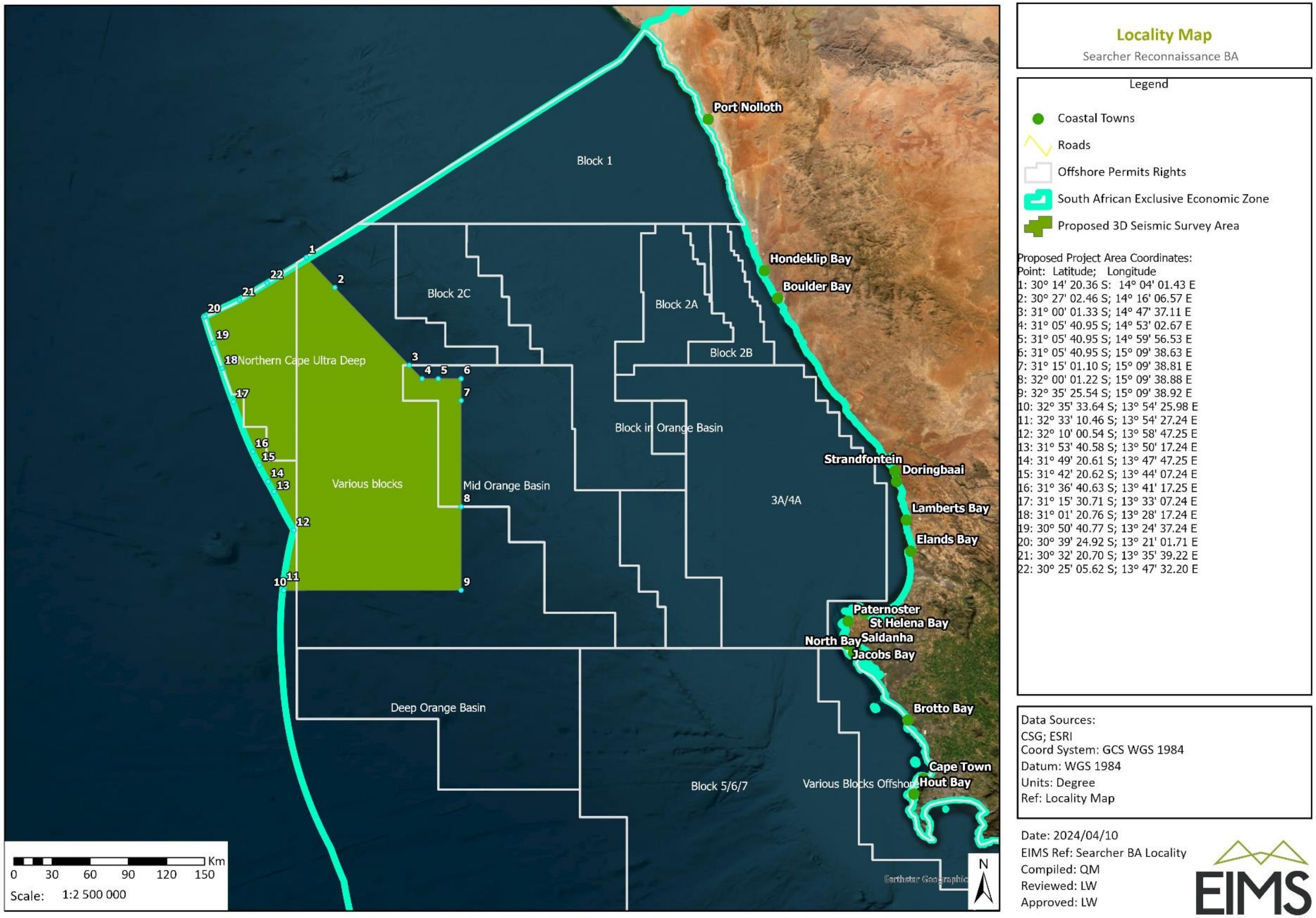

Figure 1: Locality map.

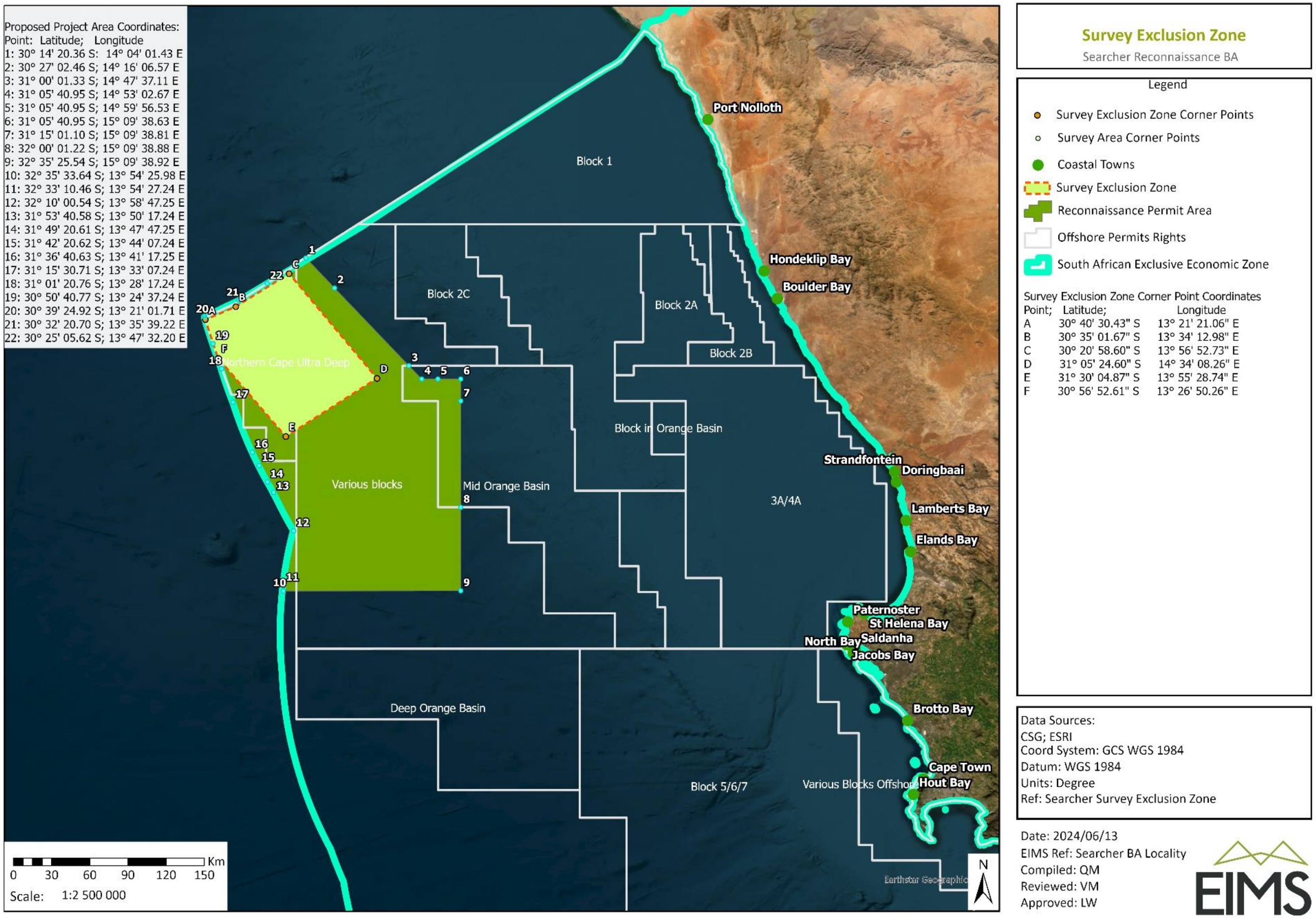

Figure 2: Exclusion Zone Map.

3 DESCRIPTION AND SCOPE OF THE PROPOSED ACTIVITY

As previously indicated in **Section 3**, Searcher recently undertook 3D seismic survey offshore of the west coast of South Africa as part of the approved reconnaissance permit 12/1/043. The survey commenced in January 2024 and ceased in April 2024 (survey window). Searcher was not able to complete the intended survey during the 2023-2024 survey season due to the viable acquisition windows and vessel availability. Since a Reconnaissance Permit can only be valid for 1 year, the 12/1/043 permit will expire on the 10 November 2024. **Searcher has consequently applied for and received a new Reconnaissance Permit to undertake the same activity over the same area (12/1/048)**. Subsequently, this section provides an overview of the proposed previously approved activity.

Seismic survey programmes comprise of data acquisition in either two-dimensional (2D) and/or three-dimensional (3D) scales, depending on information requirements. 2D surveys are typically applied to obtain regional data from widely spaced survey grids and provide a vertical profile through the subsurface, highlighting geophysical, geological information and features along the seismic line. Infill surveys on closer grids subsequently provide more detail over specific areas of interest. In contrast, 3D seismic surveys are conducted on a very tight survey grid spacing in specific target areas, often identified during 2D applications, providing a cube image of the subsurface geology within the survey volume. The current proposed seismic survey as discussed in this report is a 3D seismic survey and does not include any provision for exploration drilling.

During seismic surveys, low frequency sound pulses are generated by an acoustic instrument towed behind a survey vessel, just below the sea surface. The sounds are directed towards the seabed and the seismic signal is reflected by the geological interfaces below the seafloor. The reflected signals are received by an array of receivers or sets of hydrophones towed behind the vessel in a single streamer (2D) or in multiple streamers (3D) and are fed back to the recording instruments on board. The spacing between the hydrophone groups is commonly 25 m or shorter, depending on the purpose of the seismic survey. Each group contains many hydrophones, spaced less than 1 m apart. The hydrophone streamers must be towed at constant depth (6 – 10 m), with flotation usually achieved by filling the cables with solid filled gel or flexible polymer foam, so that they are neutrally buoyant. To compensate for minor adjustments, Automatic Cable Levellers, or "birds" are used. The ends of the hydrophone streamers are marked with tail buoys, to warn shipping about the presence of the cable in the water. The tail buoys also act as a platform for surface positioning systems so that the cable locations can be accurately monitored. Refer to **Figure 3**, **Figure 4** and **Figure 5** for illustrative examples of typical survey vessel, equipment and activities.

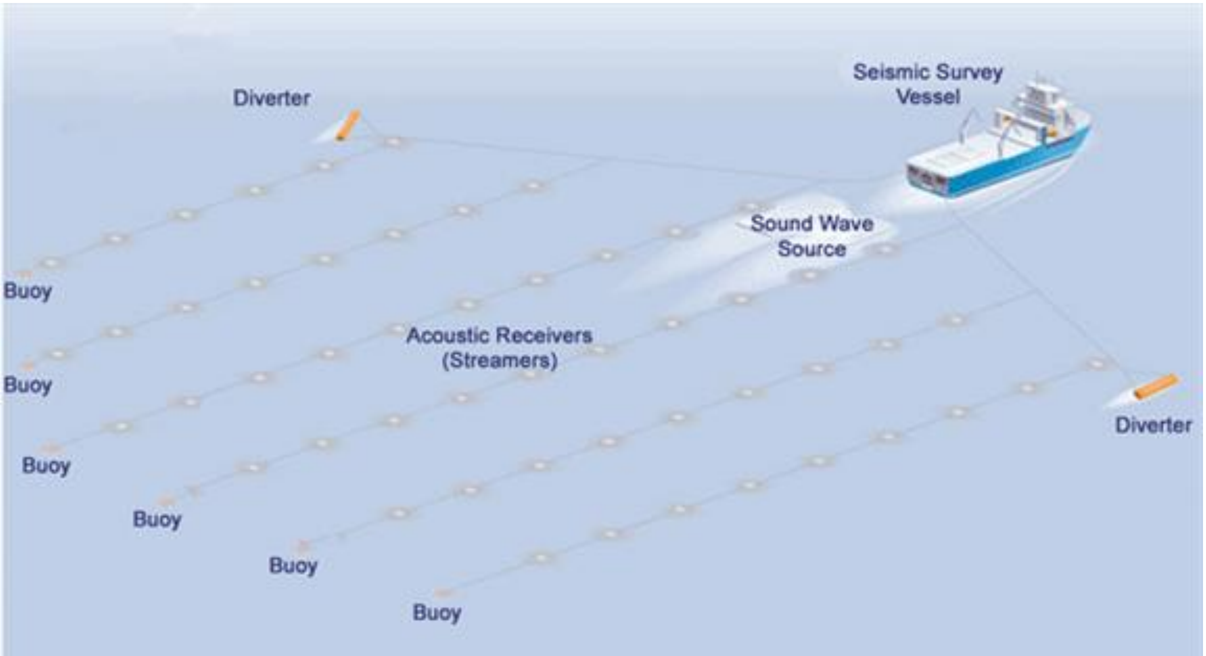

Figure 3: Example of seismic survey vessel and associated equipment (FishSAFE, 2021).

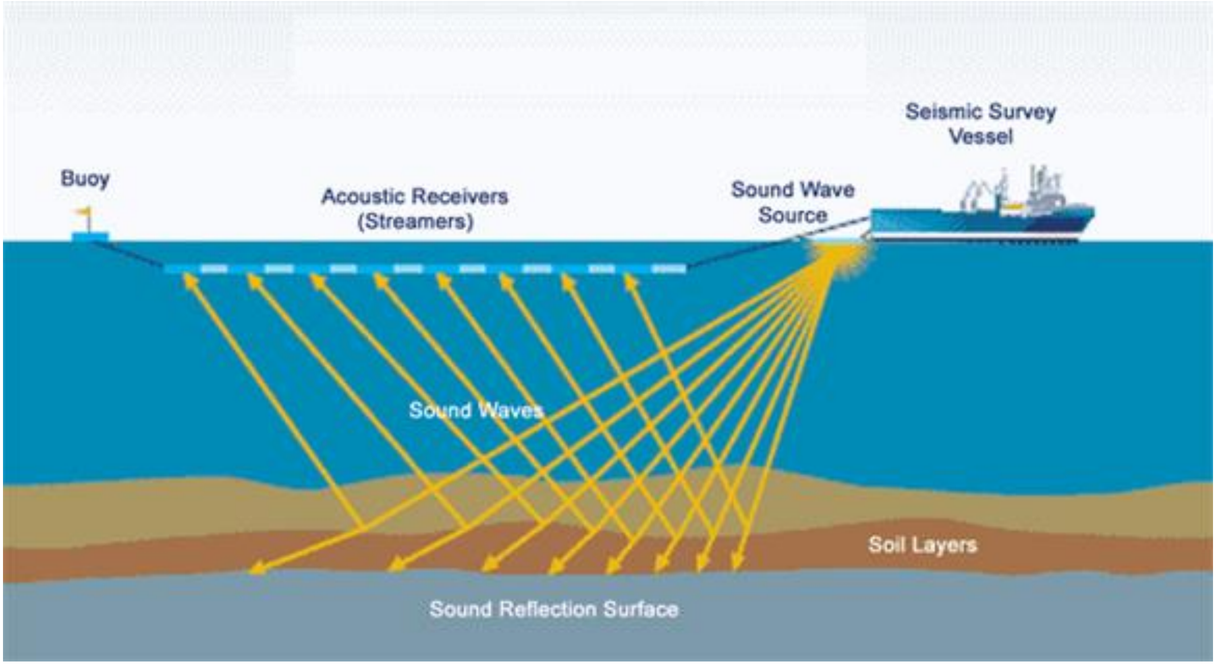

Figure 4: Example demonstration of seismic survey activities (Fish SAFE, 2021).

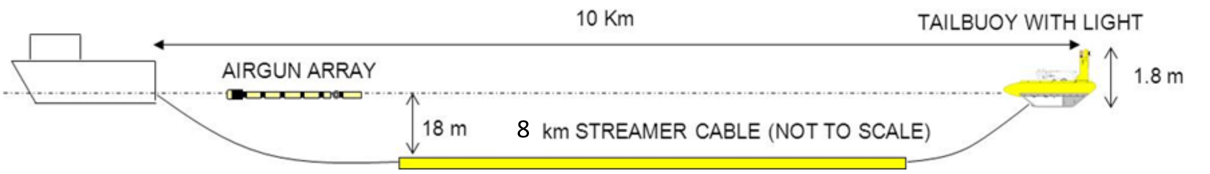

Figure 5: Schematic diagram showing side-view of the seismic source array and hydrophone cable ("streamer").

While acquiring the seismic data, the survey vessel would travel along transects of a prescribed grid within the survey area that have been chosen to cross any known or suspected geological structure in the area. The vessel typically travels at a speed of between four and six knots (i.e. 2 to 3 meters per second / 7.2 to 10.8 kilometres per hour) while surveying. The survey vessel length is approximately 100 m.

The proposed survey would involve a seismic sound source and multiple hydrophone streamers (up to 12), which would be up to 12 000 m long and 2 000 m wide. The streamers would be towed at a depth of 6-25 m below the surface and would not be visible, except for the tail-buoy at the terminal end of the cable. The array has an operating pressure of 2 000 pounds per square inch. However, it must be noted that the source array may have a total operating pressure between 2 820 to 3 390 cubic inches. The sound source would be towed behind the vessel at a depth of between 5 – 10 m below the surface. As the survey vessel would be restricted in manoeuvrability, other vessels should remain clear of it and therefore a support vessel usually assists in the operation of keeping other vessels at a safe distance.

Each triggering of a sound source is termed a seismic pulse, and these are discharged at intervals of 6 - 37.5 seconds (depending on water depth and other environmental characteristics). Each seismic pulse is usually only between 5 and 30 milliseconds in duration, and despite peak levels within each pulse being high, the total energy delivered into the water is low. Seismic sources have most of their energy in the 5-300 Hz frequency range, with the optimal frequency required for deep penetration seismic work being 50-80 Hz.

Sound levels from individual sound sources use today in the seismic industry range from 200 to 255 dB re 1 µPa at 1 m, for small to large individual seismic sources, respectively. For sound source arrays, sound levels range from 235 dB re 1 µPa at 1 m for a small array (500 cubic inches) to 260 dB re 1 µPa at 1 m for large arrays (7 900 cubic inches). The majority of the produced energy is below 250 Hz, with 90% of the energy between 70 to 140 Hz, although pulses do contain some higher frequencies up to 16 kHz. It must be noted, however, that the sound level specifications for sound source arrays refer to sound levels in the vertical direction directly beneath the sound source array, generally near its centre, with nominal sound levels in the horizontal direction being ~10-20 dB lower.

4 POLICY AND LEGISLATIVE CONTEXT

This section provides an overview of the governing legislation identified which relates to the proposed project. Additional legislation and other guidelines and policies are discussed in **Table 5** below.

4.1 CONSTITUTION OF THE REPUBLIC OF SOUTH AFRICA

The constitution of any country is the supreme law of that country. The Bill of Rights in chapter 2 section 24 of the Constitution of South Africa Act (Act No. 108 of 1996) makes provisions for environmental issues and declares that: *"Everyone has the right –*

a) to an environment that is not harmful to their health or well-being; and

b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that:

i. prevent pollution and ecological degradation;

ii. promote conservation; and

iii. secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development"

The BA and associated impact mitigation actions are conducted to fulfil the requirement of the Bill of Rights.

4.2 THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT

The aim of the MPRDA is to *"make provision for equitable access to and sustainable development of the nation's mineral and petroleum resources"*. The MPRDA outlines the procedural requirements that need to be met to acquire mining rights in South Africa. Further to an Acceptance Letter of Reconnaissance Permit (Ref: 12/1/048) dated 28th March 2024 from PASA, Searcher must now submit an application for Environmental Authorization in terms of NEMA for any activities requiring a reconnaissance permit as per Section 74 of the MPRDA.

Several amendments have been made to the MPRDA. These include, but are not limited to, the amendment of Section 102, concerning amendment of rights, permits, programmes and plans, to requiring the written permission of the Minister for any amendment or alteration; and the section 5AI requirement that landowners or land occupiers receive twenty-one (21) days' written notice prior to any activities taking place on their properties. One of the most recent amendments requires all mining related activities to follow the full NEMA process as per the EIA Regulations, 2014, which came into effect on 4 December 2014.

4.3 THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT

The main aim of the National Environmental Management Act, 1998 (Act 107 of 1998 – NEMA) is to provide for co-operative governance by establishing decision-making principles on matters affecting the environment. In terms of the NEMA EIA Regulations, the applicant is required to appoint an EAP to undertake the EIA process, as well as conduct the public participation process towards an application for EA. In South Africa, EIA's became a legal requirement in 1997 with the promulgation of regulations under the Environment Conservation Act (ECA). Subsequently, NEMA was passed in 1998. Section 24(2) of NEMA empowers the Minister and any MEC, with the concurrence of the Minister, to identify activities which must be considered, investigated, assessed and reported on to the competent authority responsible for granting the relevant EA. On 21 April 2006, the Minister of Environmental Affairs and Tourism (now Department of Environment, Forestry and Fisheries – DFFE) promulgated regulations in terms of Chapter 5 of the NEMA. These regulations, in terms of the NEMA, were amended in June 2010 and again in December 2014 as well as April 2017. The NEMA EIA Regulations, 2014, as amended, are applicable to this project. Exploration activities officially became governable under the NEMA EIA Regulations in December 2014 with the competent authority identified as the DMRE.

The objective of the EIA Regulations is to establish the procedures that must be followed in the consideration, investigation, assessment and reporting of the listed activities that are triggered by the proposed project. The purpose of these procedures is to provide the competent authority with adequate information to make informed decisions which ensure that activities which may impact negatively on the environment to an unacceptable degree are not authorised, and that activities which are authorised are undertaken in such a manner that the environmental impacts are managed to acceptable levels.

In accordance with the provisions of Sections 24(5) and Section 44 of the NEMA the Minister has published Regulations (GN R. 982) pertaining to the required process for conducting EIA's in order to apply for, and be considered for, the issuing of an EA. These EIA Regulations provide a detailed description of the EIA process to be followed when applying for EA for any listed activity.

In terms of these regulations a Basic Assessment process is required for the proposed project. The Table 4 below identifies the listed activities the proposed project triggers and consequently requires authorisation prior to commencement.

Table 4: NEMA listed activities to be authorised

Activity	Activity Description	Applicability
Listing Notice 1 Activity 21(b)	Any activity including the operation of that activity which requires a reconnaissance permit in terms of section 74 of the Mineral and Petroleum Resources Development Act, as well as any other applicable activity as contained in this Listing Notice or in Listing Notice 3 of 2014, required to exercise the reconnaissance permit, excluding- (a) any desktop study; and (b) any arial survey	The undertaking of 3D survey reconnaissance activities requires a reconnaissance permit in terms of section 74 of the Mineral and Petroleum Resources Development Act.

4.4 THE NATIONAL HERITAGE RESOURCES ACT

The National Heritage Resources Act (Act 25 of 1999 – NHRA) stipulates that cultural heritage resources may not be disturbed without authorisation from the relevant heritage authority. Section 34(1) of the NHRA states that, "*no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority…*" The NHRA is utilised as the basis for the identification, evaluation and management of heritage resources and in the case of Cultural Resource Management (CRM) those resources specifically impacted on by development as stipulated in Section 38 of NHRA, and those developments administered through the NEMA, MPRDA and the Development Facilitation Act (DFA) legislation. In the latter cases the feedback from the relevant heritage resources authority is required by the State and Provincial Departments managing these Acts before any authorisations are granted for a development. The last few years have seen a significant change towards the inclusion of heritage assessments as a major component of Environmental Impact Processes required by the NEMA and MPRDA. This change requires an evaluation of the Section of these Acts relevant to heritage.

The NHRA provides for the protection of South Africa's natural culture, including wrecks or associated debris or artefacts that may be found or disturbed on the seabed. Section 13 states that the South African Heritage Resources Agency (SAHRA) is the statutory organisation responsible for the protection of South Africa's cultural heritage. SAHRA thus has jurisdiction over any shipwrecks that may occur within the territorial waters and the maritime cultural zone fall. According to Section 35 of the NHRA, any person who discovers archaeological objects or material (including wrecks) in the course of a development must immediately report the find to SAHRA. No person may, without a permit issued by SAHRA, destroy, damage, excavate, alter, deface or otherwise disturb any archaeological site.

Furthermore, Section 38 deals with matters of Heritage Resource Management. Section 38(8) states that *"(8) The provisions of this section do not apply to a development as described in subsection (1) if an evaluation of the impact of such development on heritage resources is required in terms of the Environment Conservation Act, 1989 (Act No. 73 of 1989), or the integrated environmental management guidelines issued by the Department of Environment Affairs and Tourism, or the Minerals Act, 1991 (Act No. 50 of 1991), or any other legislation: Provided that the consenting authority must ensure that the evaluation fulfils the requirements of the relevant* *heritage resources authority in terms of subsection (3), and any comments and recommendations of the relevant heritage resources authority with regard to such development have been taken into account prior to the granting of the consent."*

In terms of the above, in terms of this section, the South African Heritage Resources Agency (SAHRA) would need to be notified regarding the proposed development and would act as a key commenting authority. In addition, A Heritage Impact Assessment Report was undertaken by PGS Heritage for this Basic Assessment Report (BAR). The findings of the study are provided in **Section 8**, specifically **Section 8.8**. The study found that a large section of the affected communities not only view them as small-scale fishers but also as indigenous people and, as such, are intrinsically linked to the ocean and the land they have lived on for centuries. The resurgence movement through which Khoi and San descendants are reclaiming their identity has, in recent decades, afforded these communities the ability to re-establish their cultural roots and grounding in an ancient landscape. The study emphasises that the ocean and its resources play an important part in their community's history and heritage.

At this stage, the study found that cumulative impacts are purely speculative. Still, the potential for the future increase in cumulative impacts due to current and future seismic surveys and the potential for future Oil and Gas production cannot be excluded but is not quantifiable at this stage for cultural heritage. Considering the assessment based on the findings of the fieldwork as well as the scientific studies relating to the impact on fisheries, the specialist is of the opinion that the impact of the proposed project on the cultural heritage resources can be mitigated through the implementation of the recommendations in the Heritage Assessment Report and reflected in this BAR.

4.5 NATIONAL ENVIRONMENTAL MANAGEMENT: PROTECTED AREAS ACT

The National Environmental Management Protected Areas Act (Act No. 57 of 2003 – NEMPAA) is intended to *"provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes"* and creating a *"national system of protected areas in South Africa as part of a strategy to manage and conserve its biodiversity".*

The NEMPAA defines various kinds of protected areas, namely: *"special nature reserves, national parks, nature reserves (including wilderness areas) and protected environments; world heritage sites; marine protected areas; specially protected forest areas, forest nature reserves and forest wilderness areas declared in terms of the National Forests Act, 1998 (Act 84 of 1998); and mountain catchment areas declared in terms of the Mountain Catchment Areas Act, 1970 (Act 63 of 1970)".*

There are six offshore Marine Protected Areas (MPAs) in the general project area, but none fall within the Survey area. The proposed 3D survey area lies well offshore of these MPAs. Although there is no overlap of the 3D survey area with Ecologically and Biologically Significant Areas (EBSAs), critical biodiversity areas (CBAs) within the Reconnaissance Permit and 3D survey areas include both CBA1: natural and CBA2: natural areas.

4.6 NATIONAL ENVIRONMENTAL MANAGEMENT: INTEGRATED COASTAL MANAGEMENT ACT

The National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008 - ICMA), serves to:

- establish a system of integrated coastal and estuarine management in the Republic, including norms, standards and policies, in order to promote the conservation of the coastal environment, and maintain the natural attributes of coastal landscapes and seascapes, and to ensure that development and the use of natural resources within the coastal zone is socially and economically justifiable and ecologically sustainable;
- define rights and duties in relation to coastal areas;
- determine the responsibilities of organs of state in relation to coastal areas;
- prohibit incineration at sea;

- control dumping at sea, pollution in the coastal zone, inappropriate development of the coastal environment and other adverse effects on the coastal environment;
- give effect to South Africa's international obligations in relation to coastal matters; and
- provide for matters connected therewith.

Section 2 of the ICMA states the Objects of the Act and include:

- to determine the coastal zone of the Republic;
- to provide, within the framework of the National Environmental Management Act, for the coordinated and integrated management of the coastal zone by all spheres of government in accordance with the principles of co-operative governance;
- to preserve, protect, extend and enhance the status of coastal public property as being held in trust by the State on behalf of all South Africans, including future generations;
- to secure equitable access to the opportunities and benefits of coastal public property;
- to provide for the establishment, use and management of the coastal protection zone; and
- to give effect to the Republic's obligations in terms of international law-regarding coastal management and the marine environment.

Section 3 of the ICMA places a duty on the State to fulfil the rights contained in Section 24 of the Constitution in that the State through its functionaries and institutions implementing the ICMA, must act as the trustee of the coastal zone; and must, in implementing this Act, take reasonable measures to achieve the progressive realization of those rights in the interests of every person.

Section 58 of the ICMA refers to the duty of care provided for in Section 28 of the NEMA, and confirms that such duty applies to any impact caused by any person and which has an adverse effect on the Coastal Environment.

Section 63 of the ICMA places an obligation on the Competent Authority to take into account all relevant factors when deciding on an Environmental Authorisation required for coastal activities, including:

- the representations made by the applicant and by interested and affected parties;
- the extent to which the applicant has in the past complied with similar authorisations;
- whether coastal public property, the coastal protection zone or coastal access land will be affected, and if so, the extent to which the proposed development or activity is consistent with the purpose for establishing and protecting those areas;
- the estuarine management plans, coastal management programmes, coastal management lines and coastal management objectives applicable in the area;
- the socio-economic impact if the activity is authorised or not;
- the likely impact of coastal environmental processes on the proposed activity;
- whether the development or activity is situated within:
    - coastal public property and is inconsistent with the objective of conserving and enhancing coastal public property for the benefit of current and future generations;
    - is situated within the coastal protection zone and is inconsistent with the purpose for which a coastal protection zone is established as set out in section 17;
    - is situated within coastal access land and is inconsistent with the purpose for which coastal access land is designated as set out in section 18;
    - is likely to cause irreversible or long-lasting adverse effects to any aspect of the coastal environment that cannot satisfactorily be mitigated;

- is likely to be significantly damaged or prejudiced by dynamic coastal processes;
- would substantially prejudice the achievement of any coastal management objective; or
- would be contrary to the interests of the whole community;

- whether the very nature of the proposed activity or development requires it to be located within coastal public property, the coastal protection zone or coastal access land;
- whether the proposed activity or development will provide important services to the public when using coastal public property, the coastal protection zone, coastal access land or a coastal protected area; and
- the objects of this Act, where applicable

Whilst the proposed activity does not specifically require authorisation under the ICMA, the Competent Authority must consider, where relevant the factors listed above when deciding on the EA application. It is expected that the Competent Authority will consider the relevant factors listed above and where relevant the findings of this environmental assessment (including but not limited to proximity to identified marine sensitive environments, impacts on marine environment, socio-economic impacts, potential pollution, the results of the public participation process, and the need and desirability of the proposed activity) when deciding on this application.

4.7 ADDITIONAL SOUTH AFRICAN LEGISLATION

Additional legislation may be applicable to the proposed project. These are presented in **Table 5** below.

Table 5: Applicable legislation and guidelines overview

Legislation / Guidelines	Description
Potentially Applicable Legislation	
Dumping at Sea Control Act (Act No. 73 of 1980)	This Act controls the dumping of substances at sea. The Act lists substances that are prohibited to be dumped at sea (Schedule 1) and substances that are restricted when dumping at sea (Schedule 2). The Director-General may on application grant a special permit authorising the dumping of substances listed in Schedule 1 or 2.
Environment Conservation Act (Act No. 73 of 1989)	The Environment Conservation Act (Act No. 73 of 1989 – ECA) was, prior to the promulgation of the NEMA, the backbone of environmental legislation in South Africa. To date the majority of the ECA has been repealed by various other Acts, however Section 25 of the Act and the Noise Regulations (GN R. 154 of 1992) promulgated under this section are still in effect. These Regulations serve to control noise and general prohibitions relating to noise impact and nuisance.
Hazardous Substances Act (Act No. 85 of 1983)	This Act provides for the control of substances which may cause injury or ill-health to or death of human. No person may, without a licence: (1) sell any Group I Hazardous Substance; (2) use, operate or apply any Group III Hazardous Substance (listed electronic products); and (3) install or keep any Group Ill Hazardous Substance.
Marine Living Resources Act (Act No. 18 of 1998)	This Act provides for the conservation of marine ecosystems, the long-term sustainable utilisation of marine living resources and the orderly access to exploitation, utilisation and protection of certain marine living resources. The Small Scale Fishers Policy was gazetted in May 2019 under the Marine Living Resources Act.

Legislation / Guidelines	Description
Marine Traffic Act (Act No. 2 of 1981)	This Act regulates marine traffic in South Africa's territorial waters. It regulates the entry and dropping of anchor within 500 m safety zone of installations.
Marine Pollution (Control and Civil Liability) Act (Act No. 6 of 1981)	The purpose of this Act is to provide protection of the marine environment from pollution by oil and other harmful substances, by giving power to South African Maritime Safety Authority (SAMSA) to take steps to prevent harmful substances being discharged from vessels. The applicant would have to disclose to SAMSA before the commencement of proposed activities the amounts and types of chemicals that would be used and disposed of during operations. No disposal of waste at sea is proposed.
Marine Pollution (Prevention of Pollution from Ships) Act (Act No. 2 of 1986)	This Act regulates pollution from ships, tankers and offshore installations, and for that purpose gives effect to MARPOL 73/78. In terms of the Act, it is an offence to discharge any oil from a ship, tanker or offshore installation within 12 miles (19 km) off the South African coast. The discharge of oily water or oil and any other substance which contains more than a hundred parts per million of oil is prohibited between 19 – 80 km offshore. No dumping at sea is proposed as part of this application.
Marine Pollution (Intervention) Act (Act No. 65 of 1987)	This Act gives effect to the international convention relating to the Intervention of the High Seas in cases of oil pollution casualties, and to the Protocol relating to Intervention of the High Seas in cases of Marine Pollution by substances other than Oil in South African Waters.
Maritime Safety Authority Act (Act No. 5 of 1998)	This Act provides for the establishment and functions of SAMSA. The objectives of the Act are to, inter alia: (1) ensure safety of life and property at sea; (2) prevent and combat pollution of the marine environment by ship; and (3) promote South Africa's maritime interests.
Maritime Safety Authority Levies Act (Act No. 6 of 1998)	This Act provides for the imposition of levies by SAMSA. SAMSA is permitted to raise and collect a levy on all vessels calling at South African ports and operating in South African waters.
Maritime Zones Act (Act No. 15 of 1994)	The Act defines the maritime zones, including territorial waters, contiguous zone, exclusive economic zone and continental shelf. Section 9(1) states that any law in force in South Africa shall also apply on and in respect of an installation.
National Environmental Management: Biodiversity Act (Act No. 10 of 2004)	This Act regulates the carrying out of restricted activities that may harm listed threatened or protected species or activities that encourage the spread of alien or invasive species subject to a permit.
Maritime Safety Authority Levies Act (Act No. 6 of 1998)	This Act provides for the imposition of levies by SAMSA. SAMSA is permitted to raise and collect a levy on all vessels calling at South African ports and operating in South African waters.
National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008)	This Act supports the authorisation requirements of NEMA but specifies additional criteria for regulating activities or developments (Section 63) and provides for pollution control within the coastal zone (Sections 69 to 73), where the coastal zone includes the Exclusive Economic Zone defined in the Maritime Zone Act.
National Ports Act (Act No. 12 of 2005)	This Act regulates and controls navigation within port limits and the approaches to ports, cargo handling, and the pollution and the protection of the environment within the port limits. The Act specifies a requirement

Legislation / Guidelines	Description
	for an agreement with or a licence from the National Ports Authority to operate a port facility or service.
Sea-Shore Act (Act No. 21 of 1935)	This Act declares the State President the owner of the seashore and the sea within the territorial waters of South Africa and provides for the grant of rights in respect of the seashore and the sea and for the alienation of portions of the seashore and the sea.
Applicable Guidelines	
Integrated Environmental Management Information Guidelines Series	The various guidelines will be considered throughout this environmental Scoping and Impact Assessment process. This series of guidelines was published by the Department of Environmental Affairs (DEA – now DFFE) and refers to various environmental aspects. Applicable guidelines in the series for the project include: Guideline 5: Companion to NEMA EIA Regulations (October 2012); Guideline 7: Public participation (October 2012); and Guideline 9: Need and desirability (October 2014). Additional guidelines published in terms of the NEMA EIA Regulations, 2014 (as amended), in particular: Guideline 3: General Guide to Environmental Impact Assessment Regulations, 2006; Guideline 4: Public Participation in support of the EIA Regulations, 2006; and Guideline 5: Assessment of alternatives and impacts in support of the EIA Regulations, 2006.

4.8 NATIONAL POLICY AND PLANNING CONTEXT

Various other national policy and planning may be of specific relevance to the needs and desirability of the project with respect to overarching energy and climate change policy and planning in South Africa. These are described below:

4.8.1 INTEGRATED RESOURCE PLAN 2019

The Minister of Mineral Resources and Energy (Minister) published the current Integrated Resource Plan (IRP 2019) as GN 1360 of 18 October 2019 in Government Gazette No. 4278. The Determination provides for various energy sources to be procured from Independent Power Producers (IPPs) through one or more IPP Procurement Programmes as contemplated in the Electricity Regulations on New Generation Capacity, 2011. The plan aimed to balance a number of objectives namely, to ensure security of supply, to minimize cost of electricity, to minimize negative environmental impact (emissions) and to minimize water usage. The IRP 2019 makes provision for gas from year 2024.

4.8.2 NATIONAL DEVELOPMENT PLAN 2030

The National Development Plan (NDP) aims to eliminate poverty and reduce inequality by 2030. According to the plan, South Africa can realise these goals by drawing on the energies of its people, growing an inclusive economy, building capabilities, enhancing the capacity of the state, and promoting leadership and partnerships throughout society. One of the key priorities is “faster and more inclusive economic growth”. To transform the economy and create sustainable expansion for job creation, an average economic growth exceeding 5% per annum is required. The NDP makes numerous mention of the need to act responsibly to mitigate the effects of climate change. Diversification of the 21st century mix away from fossil fuels will be key as energy generation makes up 48 percent of South Africa's GHG emissions. The NDP indicates that "the country will explore the use of natural gas as a less carbon intensive transitional fuel".

4.8.3 WHITE PAPER ON THE ENERGY POLICY OF THE REPUBLIC OF SOUTH AFRICA (1998)

The White Paper on the Energy Policy (1998) is the overarching policy document which guides future policy and planning in the energy sector. The policy objectives include the stimulation of economic development, management of energy related environmental and health impacts and diversification of the country's energy supply to ensure energy security. The paper states that the government will, inter alia, "promote the development of South Africa's oil and gas resources…" and "ensure private sector investment and expertise in the exploitation and 21st century's development of the country's oil and gas resources". The successful exploitation of these natural resources would contribute to the growth of the economy and relieve pressure on the balance of payments.

4.8.4 NATIONAL GAS INFRASTRUCTURE PLAN (2005)

The gas infrastructure plan is intended to be a strategy for the development of the natural gas industry in South Africa. Government wishes to promote the gas industry based on its energy policy objectives as set out in the White Paper on Energy (1998). These include:

- Increasing access to affordable energy services;
- Improving energy governance;
- Stimulating economic activity;
- Managing energy-related environmental impacts;
- Securing security of supply through diversity of supply;
- Competition within and between energy carriers; and
- Promoting New Partnership for African Development (NEPAD) cross-border type projects.

4.8.5 PARIS AGREEMENT – UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

The Paris Agreement is a legally binding international treaty on climate change. It was adopted by 196 Parties at the United Nations (UN) Climate Change Conference (COP21), on 12 December 2015 and entered into force on 4 November 2016. The Paris Agreement aims to limit the global temperature increase to below 2°C. Each individual country is responsible for determining their contribution (referred to as the "nationally determined contribution") in reaching this goal. As a signatory to the Agreement, South Africa will be required to adopt the agreement within its own legal systems, through ratification, acceptance, approval or accession. "As a signatory to the Paris Agreement, South Africa is required to investigate alternatives to existing industries which have high carbon-emissions. A shift away from coal-based energy production in South Africa within the energy sector and increased reliance on alternative energy sources is therefore anticipated and thus the natural gas explorations in line with the Paris Agreement.

4.8.6 NATIONAL CLIMATE CHANGE RESPONSE WHITE PAPER

The majority of South Africa's energy emissions arise from electricity generation. The Paper sets out South Africa's overall response strategy though strategic priorities, leading to a series of adaption, mitigation, response measures and priority flagship programmes. Policy decisions on new infrastructure investments must consider climate change impacts to avoid the lock-in of emissions intensive technologies into the future. In the medium-term, the Paper indicates that a mitigation option with the biggest potential includes a shift to lower-carbon electricity generation options.

4.9 INTERNATIONAL LEGISLATION

4.9.1 UNITED NATIONS CONVENTION ON THE LAW OF THE SEA

The United Nations Convention on the Law of the Sea 1982 sets out the roles and responsibilities of the signatory nations in the use of the oceans. The convention establishes guidelines for governments, businesses, and other organisations for the management of marine natural resources. The fundamental principle established in the Convention is that States should cooperate to ensure conservation and promote the objective of the optimum utilization of fisheries resources both within and beyond the exclusive economic zone.

The Agreement attempts to achieve this objective by providing a framework for cooperation in the conservation and management of those resources. It promotes the effective management and conservation of international marine resources by establishing, among other things, detailed minimum international standards for the conservation and management of straddling fish stocks and highly migratory fish stocks; ensuring that measures taken for the conservation and management of those stocks in areas under national jurisdiction and in the adjacent international waters are compatible and coherent; ensuring that there are effective mechanisms for compliance and enforcement of those measures in international waters; and recognizing the special requirements of developing States in relation to conservation and management as well as the development and participation in fisheries of straddling and highly migratory fish stocks.

4.9.2 INTERNATIONAL REGULATIONS FOR PREVENTING COLLISIONS AT SEA

Under the convention on the International Regulations for Preventing Collisions at Sea, a seismic survey vessel that is engaged in surveying is defined as a "vessel restricted in its ability to manoeuvre" and power-driven and sailing vessels are therefore required to give way to it. Vessels engaged in fishing shall, in so far as possible, keep out of the way of the seismic survey operation. Furthermore, under the Marine Traffic Act, 1981 (No. 2 of 1981), a seismic survey vessel and its array of sound sources and hydrophones fall under the definition of an "offshore installation" and as such it is protected by a 500 m horizontal safety zone. It is an offence for an unauthorised vessel to enter the safety zone. In addition to a statutory 500 m safety zone, seismic contractors generally request a safe operational limit (that is greater than the 500 m safety zone) that they would like other vessels to stay beyond. Support vehicles are usually commissioned as 'chase' boats to ensure that other vessels adhere to the safe operational limits.

4.9.3 INTERNATIONAL MARINE CONVENTIONS

The following international marine conventions may be applicable to the proposed survey activities:

- International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL);
- Amendment of the International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL) (Bulletin 567 – 2/08);
- International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 (OPRC Convention);
- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (the London Convention) and the 1996 Protocol (the Protocol);
- International Convention relating to Intervention on the High Seas in case of Oil Pollution Casualties (1969) and Protocol on the Intervention on the High Seas in Cases of Marine Pollution by substances other than oil (1973);
- Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal (1989);
- Convention on Biological Diversity (1992); and
- Benguela Current Convention (2013).

5 NEED AND DESIRABILITY OF THE PROPOSED ACTIVITY

The area proposed for the seismic survey is a large under-explored area with potential for both oil and gas. This section provides the need and desirability of the proposed activity. Based on the initial information review undertaken, Searcher has designed a 3D seismic survey to specifically target the area highlighted in **Figure 1**. Searcher undertook a similar seismic survey project over a larger area during 2021 and during that project, an Environmental Management Programme (EMPr) was compiled and submitted to the competent authorities in support of the Reconnaissance Permit Application. Ultimately the Reconnaissance Permit expired without the survey taking place. In 2022, Searcher then proposed to undertake 3D seismic surveys further offshore and over a smaller area offshore of the west coast of South Africa. Searcher then required an Environmental Authorization (EA) to meet with the new legislation under the amended National environmental Management Act (Act No. 107 of 1998 NEMA) EIA Regulations, 2014, including the required stakeholder consultation to undertake the seismic surveys as part of Reconnaissance Permit 12/1/043. An EA was then issued to Searcher by the Department of Mineral resources and Energy (DMRE) on the 20th of December 2022 (ref: 12/1/043). Due to the prolonged appeal phase, viable acquisition windows and vessel availability, Searcher was only able to undertake the 3D seismic surveys as part of the 12/1/043 Reconnaissance Permit and EA between January and April 2024. Subsequently, Searcher was not able to complete the intended survey during the 2023-2024 survey season.

Since a Reconnaissance Permit can only be valid for 1 year, the 12/1/043 permit will expire on the 10 November 2024. **Searcher has consequently applied for and received a new Reconnaissance Permit for the same previously approved activity over the same area (12/1/048)**. A new EA is required for Searcher to continue under the new 12/1/048 Reconnaissance Permit. Although the current EA application relates to a new Reconnaissance Permit application by Searcher and not a renewal of the previous permission, it is for the same activity over the same area.

5.1 GUIDELINE ON NEED AND DESIRABILITY IN TERMS OF THE EIA REGULATIONS

The needs and desirability analysis component of the "Guideline on need and desirability in terms of the EIA Regulations (Notice 819 of 2014)" includes, but is not limited to, describing the linkages and dependencies between human well-being, livelihoods and ecosystem services applicable to the area in question, and how the proposed development's ecological impacts will result in socio-economic impacts (e.g. on livelihoods, opportunity costs, etc.). **Table 6** present the needs and desirability analysis undertaken for the project.

Table 6: Needs and desirability analysis for the proposed project

Ref No.	Question	Answer
1	Securing ecological sustainable development and use of natural resources	
1.1	How were the ecological integrity considerations taken into account in terms of: Threatened Ecosystems, Sensitive and vulnerable ecosystems, Critical Biodiversity Areas, Ecological Support Systems, Conservation Targets, Ecological drivers of the ecosystem, Environmental Management Framework, Spatial Development Framework (SDF) and global and international responsibilities.	A number of specialist studies have informed this application and include: • Marine Ecological Impact Assessment; • Fisheries Impact Assessment; • Heritage Impact Assessment; • Social Impact Assessment; • Acoustic (Noise) Technical Report The summary, conclusions and recommendations of these studies are included in this report in **Section 11.1**.
1.2	How will this project disturb or enhance ecosystems and / or result in the loss or protection of biological diversity? What measures were explored to avoid these negative impacts, and where these negative impacts could not be avoided altogether, what measures were explored to minimise and remedy the impacts? What measures were explored to enhance positive impacts?	Refer to baseline marine ecological statement in **Section 8**, and the impact assessment in **Section 9** of this report.
1.3	How will this development pollute and / or degrade the biophysical environment? What measures were explored to either avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy the impacts? What measures were explored to enhance positive impacts?	
1.4	What waste will be generated by this development? What measures were explored to avoid waste, and where waste could not be avoided altogether, what measures were explored to minimise, reuse and / or recycle the waste? What measures have been explored to safely treat and/or dispose of unavoidable waste?	Waste will be generated during the operational phase. The types of waste generated include sewage waste, biodegradable galley wastes, and non-biodegradable solid waste. Waste has been identified as an impact and assessed in Section 9 below. However, it is anticipated that the following measures can be utilised to reduce the impact of the waste on the receiving environment: • Visual inspection that waste does not leave the vessel. • Waste must be securely stored.

Ref No.	Question	Answer
		• All hazardous waste such as oil must be stored separately and disposed of at a registered facility. • Proof of disposal must be kept by the Applicant.
1.5	How will this project disturb or enhance landscapes and / or sites that constitute the nation's cultural heritage? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy the impacts? What measures were explored to enhance positive impacts?	There are six offshore Marine Protected Areas (MPAs) in the general project area, but none fall within the Survey area. The proposed 3D survey area lies well offshore of these MPAs. Although there is no overlap of the 3D survey area with EBSAs, CBAs within the survey area include both CBA1: natural and CBA2: natural areas. It is recommended that post project, that Searcher re-assesses post-project the potential effects on the identified communities and their intangible cultural heritage. This will require consideration of the socio-economic baseline developed during the previous survey and this environmental impact process. Based on the outcomes resource provision and support for communities to develop and undertake safeguarding measures or plans to enhance the mitigation capacity of their intangible cultural heritage by fostering dialogue, mutual understanding and reconciliation between and within communities is recommended.
1.6	How will this project use and / or impact on non-renewable natural resources? What measures were explored to ensure responsible and equitable use of the resources? How have the consequences of the depletion of the non-renewable natural resources been considered? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy the impacts? What measures were explored to enhance positive impacts?	Refer to the impact assessment in **Section 9** of this report. As a result of the fact that this project entails a 3D seismic survey only it is anticipated that this project will not lead to a significant impact or depletion of non-renewable resources.
1.7	How will this project use and / or impact on renewable natural resources and the ecosystem of which they are part? Will the use of the resources and / or impacts on the ecosystem jeopardise the integrity of the resource and / or system taking into account carrying capacity restrictions, limits of acceptable change, and thresholds? What measures were explored to firstly avoid the use of resources, or if avoidance is not possible, to minimise the use of resources? What measures were taken to ensure responsible and equitable use of the resources? What measures were explored to enhance positive impacts?	Refer to the impact assessment in **Section 9** of this report. It is anticipated that the project will have a low impact on the localised marine ecology and fisheries.
1.7.1	Does the proposed project exacerbate the increased dependency on increased use of resources to maintain economic growth or does it reduce resource dependency (i.e. de-materialised growth)?	The proposed project aims to identify oil and gas resources to be used in the energy production and/ or processing or manufacturing of materials.

Ref No.	Question	Answer
1.7.2	Does the proposed use of natural resources constitute the best use thereof? Is the use justifiable when considering intra- and intergenerational equity, and are there more important priorities for which the resources should be used?	The proposed project aims to identify oil and gas resources and will not, at this stage, involve the use of the natural resources identified as part of the proposed survey project.
1.7.3	Do the proposed location, type and scale of development promote a reduced dependency on resources?	The proposed project aims to identify oil and gas resources and will not, at this stage, involve the use of the natural resources identified as part of the proposed survey project.
1.8	How were a risk-averse and cautious approach applied in terms of ecological impacts:	
1.8.1	What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	The limitations and/or gaps in knowledge are presented in **Section 12**.
1.8.2	What is the level of risk associated with the limits of current knowledge?	The level of risk is considered low at this stage.
1.8.3	Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	As a result of the fact that this project entails only survey activities, it is anticipated that this project will not lead to a significant impact on the receiving environment. Refer to the impact assessment in **Section 9** of this report. There is a deficiency in terms of local research in SA waters, but that international research is, in the view of the specialists, adequate for predicting risk- result ant risk has been identified as low. Recommendations have been included to take the opportunity presented by this project to enhance/ encourage site-specific local research.
1.9	How will the ecological impacts resulting from this development impact on people's environmental right in terms following?	
1.9.1	Negative impacts: e.g. access to resources, opportunity costs, loss of amenity (e.g. open space), air and water quality impacts, nuisance (noise, odour, etc.), health impacts, visual impacts, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	The proposed activities are anticipated to have low negative ecological impacts. Refer to the impact assessment in **Section 9** in this report.
1.9.2	Positive impacts: e.g. improved access to resources, improved amenity, improved air or water quality, etc. What measures were taken to enhance positive impacts?	
1.10	Describe the linkages and dependencies between human wellbeing, livelihoods and ecosystem services applicable to the area in question and how the	A medium to low impact on third party wellbeing, livelihoods and ecosystem services is foreseen. Refer to the impact assessment in **Section 9** of this report.

Ref No.	Question	Answer
	development's ecological impacts will result in socio-economic impacts (e.g. on livelihoods, loss of heritage site, opportunity costs, etc.)?	
1.11	Based on all of the above, how will this development positively or negatively impact on ecological integrity objectives / targets / considerations of the area?	The proposed survey activities are anticipated to have generally low negative marine ecological impacts. Refer to the impact assessment in **Section 9** in this report.
1.12	Considering the need to secure ecological integrity and a healthy biophysical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the "best practicable environmental option" in terms of ecological considerations?	Refer to **Section 6** for details of the alternatives considered.
1.13	Describe the positive and negative cumulative ecological / biophysical impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and existing and other planned developments in the area?	Refer to **Section 9** of this report.
2	Promoting justifiable economic and social development	
2.1	What is the socio-economic context of the area, based on, amongst other considerations, the following:	
2.1.1	The IDP (and its sector plans' vision, objectives, strategies, indicators and targets) and any other strategic plans, frameworks or policies applicable to the area	The offshore area of activity, as well as the Exclusive Economic Zone (EEZ) as a whole, do not fall within the borders of any municipality or province of South Africa. Thus, the related planning documentation, especially at the District and Local Municipality level, typically don't directly address offshore areas and activities in a significant level of detail. The survey area is located adjacent to the Namakwa District Municipality and the West Coast District Municipality. Refer to **Section 8.7** of this report for a breakdown of the demographics and social environment in these areas. The Namakwa IDP (2022 – 2027) aligns with the Nine Point Plan Identified by the National Government and identifies the Growing the Oceans Economy and Tourism – Small Harbour Development & Coastal and Marine Tourism. The IDP does not specifically mention offshore activities or exploration. The impact of the actual seismic survey activities on the local economy is anticipated to be limited. Spatial Development Goal 4 of the West Coast District Municipality IDP (2022 – 2027) states that the district should promote sustainable utilisation of the District's natural resource base to extract economic development opportunities. The impact of the seismic survey activities

Ref No.	Question	Answer
		on the local economy is anticipated to be limited however it will potentially allow significant economic growth in the future. More detail is provided in the Social Assessment report included in **Appendix C**.
2.1.2	Spatial priorities and desired spatial patterns (e.g. need for integrated of segregated communities, need to upgrade informal settlements, need for densification, etc.),	Survey activities typically require highly skilled employment. However, where feasible, it is anticipated that the use of local labour could be utilised, but it is anticipated that this will be extremely limited, if at all.
2.1.3	Spatial characteristics (e.g. existing land uses, planned land uses, cultural landscapes, etc.), and	Refer to the baseline environment in **Section 8** of this report.
2.1.4	Municipal Economic Development Strategy ("LED Strategy").	Considering the location of the activities, it is not anticipated to significantly promote or facilitate spatial transformation and sustainable urban development.
2.2	Considering the socio-economic context, what will the socio-economic impacts be of the development (and its separate elements/aspects), and specifically also on the socio-economic objectives of the area?	Refer to the impact assessment in **Section 9** in this report.
2.2.1	Will the development complement the local socio-economic initiatives (such as local economic development (LED) initiatives), or skills development programs?	Survey activities typically require highly skilled employment. However, where feasible, it is anticipated that the use of local labour could be utilised, but it is anticipated that this will be extremely limited, if at all. It is recommended that Searcher consult with communities on potential ways in which to make a positive contribution to the communities.
2.3	How will this development address the specific physical, psychological, developmental, cultural and social needs and interests of the relevant communities?	Refer to the public participation process and feedback contained in **Appendix B**.
2.4	Will the development result in equitable (intra- and inter-generational) impact distribution, in the short- and long-term? Will the impact be socially and economically sustainable in the short- and long-term?	Refer to the impact assessment and mitigation measures in **Section 9** of this report.
2.5	In terms of location, describe how the placement of the proposed development will:	
2.5.1	Result in the creation of residential and employment opportunities in close proximity to or integrated with each other.	Survey activities typically require highly skilled employment. However, where feasible, it is anticipated that the use of local labour could be utilised, but it is anticipated that this will be extremely limited, if at all.

Ref No.	Question	Answer
2.5.2	Reduce the need for transport of people and goods.	The activities are not anticipated to have an impact on the transportation of goods and people.
2.5.3	Result in access to public transport or enable non-motorised and pedestrian transport (e.g. will the development result in densification and the achievement of thresholds in terms of public transport),	The activities are not anticipated to have an impact on the public transport.
2.5.4	Compliment other uses in the area,	The offshore area has been subjected to a number of previous exploration activities as well as previous 2D and 3D surveys.
2.5.5	Be in line with the planning for the area.	Refer to item 2.1.1 of this table (above).
2.5.6	For urban related development, make use of underutilised land available with the urban edge.	Not applicable. The proposed project is not located in an urban area.
2.5.7	Optimise the use of existing resources and infrastructure,	Refer to **Section 3** of this report.
2.5.8	Opportunity costs in terms of bulk infrastructure expansions in non-priority areas (e.g. not aligned with the bulk infrastructure planning for the settlement that reflects the spatial reconstruction priorities of the settlement),	
2.5.9	Discourage “urban sprawl” and contribute to compaction / densification.	Not applicable. The proposed project is not located in an urban area.
2.5.10	Contribute to the correction of the historically distorted spatial patterns of settlements and to the optimum use of existing infrastructure in excess of current needs,	Refer to items 2.5.7 – 2.5.9 of this table (above).
2.5.11	Encourage environmentally sustainable land development practices and processes	As a result of the fact that this project does not directly entail the exploration for oil and gas, it is anticipated that this project will not lead to a highly significant impact on the receiving environment.
2.5.12	Take into account special locational factors that might favour the specific location (e.g. the location of a strategic mineral resource, access to the port, access to rail, etc.),	The proposed project aims to identify potentially strategic oil and gas resources.

Ref No.	Question	Answer
2.5.13	The investment in the settlement or area in question will generate the highest socio-economic returns (i.e. an area with high economic potential).	The proposed project aims to identify oil and gas resources. Given the location offshore, it is not anticipated that the survey activities will contribute to the significantly to settlements or areas in terms of socio-economic returns.
2.5.14	Impact on the sense of history, sense of place and heritage of the area and the socio-cultural and cultural-historic characteristics and sensitivities of the area, and	Refer to impact assessment in **Section 9** of this report.
2.5.15	In terms of the nature, scale and location of the development promote or act as a catalyst to create a more integrated settlement?	Given the location offshore, it is not anticipated that the activities will contribute to the significantly to settlements or areas in terms of socio-economic returns.
2.6	How was a risk-averse and cautious approach applied in terms of socio-economic impacts:	
2.6.1	What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	Refer to **Section 12** of this report.
2.6.2	What is the level of risk (note: related to inequality, social fabric, livelihoods, vulnerable communities, critical resources, economic vulnerability and sustainability) associated with the limits of current knowledge?	The level of risk is low as the project is not expected to have far reaching negative impacts on socio-economic conditions.
2.6.3	Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	The level of risk is low as the project is not expected to have far reaching highly negative impacts on socio-economic conditions. The survey area is located 250 km offshore, outside of the fisheries ringfence area. Since the survey activities will not include any drilling at this stage, a risk averse and cautious approach has been implemented to limit the impact on the surrounding environment.
2.7	How will the socio-economic impacts resulting from this development impact on people's environmental right in terms following:	
2.7.1	Negative impacts: e.g. health (e.g. HIV-Aids), safety, social ills, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	Refer to the impact assessment in **Section 9** of this report.
2.7.2	Positive impacts. What measures were taken to enhance positive impacts?	Refer to the impact assessment in **Section 9** of this report.
2.8	Considering the linkages and dependencies between human wellbeing, livelihoods and ecosystem services, describe the linkages and dependencies	Refer to the impact assessment in **Section 9** of this report.

Ref No.	Question	Answer
	applicable to the area in question and how the development's socioeconomic impacts will result in ecological impacts (e.g. over utilisation of natural resources, etc.)?	
2.9	What measures were taken to pursue the selection of the "best practicable environmental option" in terms of socio-economic considerations?	Refer to the impact assessment in **Section 9** of this report.
2.10	What measures were taken to pursue environmental justice so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons (who are the beneficiaries and is the development located appropriately)? Considering the need for social equity and justice, do the alternatives identified, allow the "best practicable environmental option" to be selected, or is there a need for other alternatives to be considered?	Refer to the impact assessment in **Section 9** of this report. The survey activities typically require highly skilled employment. However, where feasible, it is anticipated that the use of local labour could be utilised, but it is anticipated that this will be extremely limited, if at all.
2.11	What measures were taken to pursue equitable access to environmental resources, benefits and services to meet basic human needs and ensure human wellbeing, and what special measures were taken to ensure access thereto by categories of persons disadvantaged by unfair discrimination?	By conducting a Basic Assessment Process, the applicant ensures that equitable access has been considered. Refer to the impact assessment in **Section 9** of this report.
2.12	What measures were taken to ensure that the responsibility for the environmental health and safety consequences of the development has been addressed throughout the development's life cycle?	Refer to the impact assessment in Section 9 of this report. The EMPr will specify timeframes within which mitigation measures must be implemented.
2.13	What measures were taken to:	
2.13.1	Ensure the participation of all interested and affected parties.	Refer to **Section 7** of this report, describing the public participation process undertaken for the proposed project.
2.13.2	Provide all people with an opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation,	Refer to **Section 7** of this report, describing the public participation process undertaken for the proposed project. The BID, advertisement, notification letter and site notice have been made available in English, isiXhosa and Afrikaans to assist in understanding of the project. In addition, the BA report executive summary will be made available in all three of these languages. Further public consultation will be held during the review period of the BA report for the project.
2.13.3	Ensure participation by vulnerable and disadvantaged persons,	
2.13.4	Promote community wellbeing and empowerment through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means,	

Ref No.	Question	Answer
2.13.5	Ensure openness and transparency, and access to information in terms of the process,	
2.13.6	Ensure that the interests, needs and values of all interested and affected parties were taken into account, and that adequate recognition were given to all forms of knowledge, including traditional and ordinary knowledge,	
2.13.7	Ensure that the vital role of women and youth in environmental management and development were recognised and their full participation therein will be promoted?	
2.14	Considering the interests, needs and values of all the interested and affected parties, describe how the development will allow for opportunities for all the segments of the community (e.g. a mixture of low-, middle-, and high-income housing opportunities) that is consistent with the priority needs of the local area (or that is proportional to the needs of an area)?	Refer to **Section 7** of this report, describing the public participation process undertaken for the proposed project.
2.15	What measures have been taken to ensure that current and / or future workers will be informed of work that potentially might be harmful to human health or the environment or of dangers associated with the work, and what measures have been taken to ensure that the right of workers to refuse such work will be respected and protected?	Potential future workers will have to be educated on a regular basis as to the environmental and safety risks that may occur within their work environment. Furthermore, adequate measures will have to be taken to ensure that the appropriate personal protective equipment is issued to workers based on the conditions that they work in and the requirements of their job.
2.16	Describe how the development will impact on job creation in terms of, amongst other aspects:	
2.16.1	The number of temporary versus permanent jobs that will be created.	Reconnaissance and exploration activities typically require highly skilled employment. However, where feasible, it is anticipated that the use of local labour could be utilised, but it is anticipated that this will be extremely limited, if at all. The majority of the work will be done remotely through the acquisition and processing of existing information. However, should local labour be required during the possible 3D seismic survey, then travel will be from suitable ports.
2.16.2	Whether the labour available in the area will be able to take up the job opportunities (i.e. do the required skills match the skills available in the area).	
2.16.3	The distance from where labourers will have to travel.	
2.16.4	The location of jobs opportunities versus the location of impacts.	
2.16.5	The opportunity costs in terms of job creation.	

Ref No.	Question	Answer
2.17	What measures were taken to ensure:	
2.17.1	That there were intergovernmental coordination and harmonisation of policies, legislation and actions relating to the environment.	The EIA Process requires governmental departments to communicate regarding any application. In addition, all relevant departments are notified at various phases of the project by the EAP.
2.17.2	That actual or potential conflicts of interest between organs of state were resolved through conflict resolution procedures.	
2.18	What measures were taken to ensure that the environment will be held in public trust for the people, that the beneficial use of environmental resources will serve the public interest, and that the environment will be protected as the people's common heritage?	Refer to **Section 7** of this report, describing the public participation process implemented for the application, as well Section 8, the impact on any national estate.
2.19	Are the mitigation measures proposed realistic and what long-term environmental legacy and managed burden will be left?	Refer to the impact assessment and mitigation measures in **Section 9** of this report.
2.20	What measures were taken to ensure that the costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects will be paid for by those responsible for harming the environment?	The proposed survey activities are not anticipated to produce significant pollution, environmental damage or adverse health effects in the long term.
2.21	Considering the need to secure ecological integrity and a healthy bio-physical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the best practicable environmental option in terms of socio-economic considerations?	Refer to **Section 6**, description of the process followed to reach the proposed preferred site.
2.22	Describe the positive and negative cumulative socio-economic impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and other planned developments in the area?	Refer to the impact assessment and mitigation measures in **Section 9** of the BA Report.

5.2 NEED FOR SEISMIC DATA AND MOTIVATION FOR THE PROJECT

In addition to the information presented in **Table 6** above, a discussion of the needs and desirability of the project would not be complete without understanding the need for acquisition of the seismic data and possible oil and gas exploration and production that could potentially take place in the future as a result of the survey. It cannot be said with absolute certainty that exploration drilling, let alone production activities, will be undertaken in the future. As such, it is not currently possible to accurately assess the risks associated with these activities, given that the specific details of these potential future activities are not known. The proposed 3D seismic surveys, if approved, will allow the applicant to determine if there is an economically viable resource (natural gas including Helium) available in the area. It is important to note that the permission will not provide the required authorisation for production activities to be undertaken. As such, any future intention to undertake production of hydrocarbons within the exploration right area would require a further application, investigation and public consultation process. The environmental consequences applicable to the planned survey activities have been identified and assessed in this BA Report.

The fastest growing sector for the use of natural gas is for the generation of electric power. Natural gas power plants usually generate electricity in gas turbines, directly using the hot exhaust gases from the combustion of the gas. Of the three fossil fuels used for electric power generation (coal, oil and natural gas), natural gas emits the least carbon dioxide per unit of energy produced. Natural gas emits 30% and 45% less carbon dioxide than burning oil and coal, respectively. Burning natural gas also releases lower amounts of nitrogen oxides, sulphur dioxide, particulates and mercury when compared to coal and oil.

The increased use of natural gas can, in the short term, serve as a transition fuel on the path to the carbon-neutral goal of the Paris Agreement. In addition to gas as a key transitional fuel reducing reliance on coal, the benefits of oil and gas could include significant amount of job creation, especially if local beneficiation takes place. An increase in domestic natural gas reserves would enable South Africa to take steps to secure the countries' energy supply (through diversification), assist in reducing the emissions of greenhouse gases (by reducing the country's reliance on coal for electricity generation) and reduce the need for the importation of gas. As such, exploration for additional domestic hydrocarbon reserves is considered important and supported by national policy, and any discoveries would be well received by the local market and are consistent with the objectives stated in the 2019 IRP. Natural gas emits 30% and 45% less carbon dioxide than burning oil and coal, respectively, and 65% less carbon dioxide than coal when the increased efficiency of Combined Cycle Gas Turbines versus coal fired power stations is considered. Eskom produces over 200MtCO_2/yr, over 40% of South Africa's total. South Africa also has SASOL's Secunda coal to liquids plant, the biggest single source of CO_2 in the world at 57MtCO_2/yr (~12.5% of South Africa's total) to produce 160k barrels of products per day. Supplying these products from conventional oil production and refining would generate approximately 10% of those emissions, 5 to 6MtCO_2/yr.

Helium is a non-renewable natural resource that is mostly recovered from natural gas deposits. Thus, helium is typically a by-product of natural gas fields. It is important to note that helium is found in recoverable quantities in only a few locations around the world, many of which are being depleted. The importance of the demand for helium is that an economic need and desirability would be low if a sufficient demand now, or in the future, could not be established. In this regard, all indications are that the demand for helium is strong and sustainable, thus contributing strongly to the economic need and desirability of this expansion.

The White Paper on the Energy Policy (1998) is the overarching policy document that guides future policy and planning in the energy sector. It states that the government will, inter alia, "promote the development of South Africa's oil and gas resources…" and "ensure private sector investment and expertise in the exploitation and development of the country's oil and gas resources". The successful exploitation of these natural resources would contribute to the growth of the economy.

The National Development Plan (NDP) (2012) provides the context for all development in South Africa, with the overarching aim of eradicating poverty and inequality between people in South Africa. The NDP identifies the need to diversify the current energy mix and to reduce carbon emissions. Gas will play a more significant role in the energy mix and the exploration of gas as an alternative to coal for energy production has been recognised as a planning priority. The position of the NDP is reiterated in the Draft Integrated Energy Plan (IEP) (2013), which seeks to determine how current and future energy needs can be addressed efficiently. Main objectives outlined in the plan include security of supply, increased access to energy, diversity in supply sources and primary sources of energy and minimising emissions. The plan indicates that projected demand for natural gas between 2010 and 2050 would be second only to petroleum products, primarily due to increased growth in the industrial sector. It also identifies significant potential for natural gas in terms of power generation and direct thermal uses.

An increase in domestic natural gas reserves would also contribute to security of supply in the gas to liquids industry, which currently relies on feedstock from coal, oil and gas reserves. The Draft IEP points out the vulnerability of the liquid fuels industry and its economy to fluctuations in the global oil market, given that South Africa is a net importer of oil. Furthermore, existing gas stocks in the domestic offshore are declining, and new sources of feedstock are required to support and increase production in the gas to liquids industry (NDP, 2012). As such, exploration for additional domestic hydrocarbon reserves is considered important and any discoveries would be well received by the local market. The Department of Energy's Integrated Resource Plan (2010-2030) supports this view, stating that regional and domestic gas options should be pursued. The government's official position is that exploration and development of oil and gas fields should be encouraged.

According to the Integrated Resource Plan 2019, the availability of gas in the short to medium term is a risk as South Africa does not currently have gas resources. There is also a supply and foreign exchange risk associated with likely increase in gas volumes depending on the energy mix adopted post 2030 when a large number of coal fired power stations are decommissioned. South Africa's economic growth is dependent on the availability of energy, ensuring a sustainable and reliable supply of electricity with sufficient capacity is a key aspect to growing the economy of South Africa in the future. The electricity shortages experienced in South Africa over the past decade are a contributing factor to the significant slowdown in economic growth rate. To enable economic growth within the target rate of between 6% and 8% to be achieved, it will be necessary for Government to continue increasing electricity generating capacity in the country. The use of natural gas for electricity generation is identified in national policy, together with renewable energy technologies, as an alternative in diversifying the domestic energy supply away from its current reliance on coal. Gas is identified in the draft Integrated Resources Plan as significant contributor to South Africa's energy mix in the period up to 2030. Availability of gas also provides an opportunity to convert to Combined Cycle Gas Turbine and run open-cycle gas turbine plants at Ankerlig (Saldanha Bay), Gourikwa (Mossel Bay), Avon (Outside Durban) and Dedisa (Coega IDZ) on gas (IRP 2019).

From a climate change perspective, it is not currently possible to accurately assess the risks associated with oil and gas activities, given that the specific details of these potential future activities are not known and therefore climate change impacts would need to be assessed in detail during any subsequent Scoping and EIA processes for any potential subsequent oil and gas production projects.

The feasibility of using natural gas for domestic power generation is dependent on the extent of available domestic reserves of natural gas, as well as the financial cost of importing natural gas should those reserves be insufficient. The acquisition of seismic survey data is therefore considered important with respect to understanding the potential for future oil and gas production as part of the energy mix of the country going forward and the need and desirability of the project is therefore supported from an energy security perspective.

In addition to the above, seismic surveying is not only used for petroleum and natural gas exploration and development, it can in certain instances also be used for development of offshore wind, geothermal energy, and low-carbon solutions such as carbon capture and storage and also more generally for providing more insight and understanding into the regional geology of the area for scientific purposes.

This project can also provide an opportunity to conduct independent research on how fish species on the West Coast such as snoek respond to seismic surveying. Bearing in mind that the location of this particular survey is far offshore and impacts on the biophysical environment are expected to be relatively low this project is seen as a good opportunity to obtain local data and conduct local research which could be useful for similar projects and applications that may take place in the future.

6 PROJECT ALTERNATIVES

This section provides a description of the alternatives considered as part of this BA process.

6.1 LOCATION ALTERNATIVES

Searcher undertook a similar project over a larger area during 2021 and during this project an EMPr was compiled and submitted to the competent authorities in support of the Reconnaissance Permit Application. Ultimately the reconnaissance permit expired without the survey taking place. In 2022, Searcher then proposed to undertake 3D seismic surveys further offshore and over a smaller area offshore of the west coast of South Africa. Searcher then required an Environmental Authorization (EA) to meet with the new legislation under the amended National environmental Management Act (Act No. 107 of 1998 NEMA) EIA Regulations, 2014, including the required stakeholder consultation to undertake the seismic surveys as part of Reconnaissance Permit 12/1/043. An EA was then issued to Searcher by the Department of Mineral resources and Energy (DMRE) on the 20th of December 2022 (ref: 12/1/043). Due to the prolonged appeal phase, viable acquisition windows and vessel availability, Searcher was only able to undertake the 3D seismic surveys as part of the 12/1/043 Reconnaissance Permit and EA between January and April 2024. Subsequently, Searcher was not able to complete the intended survey during the 2023-2024 survey season.

Since a Reconnaissance Permit can only be valid for 1 year, the 12/1/043 permit will expire on the 10 November 2024. Searcher has consequently applied for and received a new Reconnaissance Permit for the same previously approved activity over the same area (12/1/048). A new EA is required for Searcher to continue under the new 12/1/048 Reconnaissance Permit. The application area is the same target area as the 2022 application. The Reconnaissance Permit area of interest for the proposed 3D seismic survey is approximately 30 000 km^2 in extent. However, an area of approximately 7 800 km^2 (largely in the northern section) was surveyed during the 2023-2024 survey season and will be excluded from full Power Source[f] data acquisition during the proposed second survey period. This area is considered as the optimal area for such a survey due to its location well offshore and well outside of the fisheries ring-fence area. In addition, the area has been carefully selected by Searcher due to the high likelihood of containing significant hydrocarbon reserves. As such no location alternatives are considered feasible for the project.

6.2 LAYOUT ALTERNATIVES

Most of the ecosystem types in the Reconnaissance Permit Area are either poorly protected or not protected. Although there is no overlap of the 3D survey area with Ecologically or Biologically Significant Marine Areas (EBSAs), Critical Biodiversity Areas (CBAs) within the survey areas include both CBA1: natural and CBA2: natural areas. CBA 1 indicates irreplaceable or near-irreplaceable sites that are required to meet biodiversity targets with limited, if any, option to meet targets elsewhere, whereas CBA 2 are “best design sites” and there are often alternative areas where feature targets can be met; however, these will be of higher cost to other sectors and / or will be larger areas. Activities within these management zones are classified into those that are “compatible”, those that are “not compatible”, and those that have “restricted compatibility”. Non-invasive (e.g. seismic surveys) and invasive (e.g. exploration wells) exploration activities are classified as having “restricted compatibility”. Activities with restricted compatibility require a detailed assessment to determine whether the recommendation is that they should be permitted (general), permitted subject to additional regulations (consent), or prohibited, depending on a variety of factors. Petroleum production is, however, classified as “not compatible” in CBAs, but may be compatible, subject to certain conditions, in ESAs. The CBA areas are not considered no-go areas for the purposes of seismic survey activities and Searcher would still want to survey these areas.

Seismic surveying is not only used for petroleum and natural gas exploration and development, it is also used for development of offshore wind, geothermal energy, and low-carbon solutions such as carbon capture and storage and also more generally for providing more insight and understanding into the regional geology of the area for scientific purposes therefore the CBA areas are not considered no-go areas for the purpose of the seismic survey. In addition, according to the National Coastal and Marine Spatial Biodiversity Plan for the coast and ocean around

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[f] Full Power Source: Where the source array is at full power (excludes non active vessel manoeuvring, line turns and soft starts).

the South African mainland states that petroleum production may be possible in CBAs using lateral drilling or other techniques that do not result in biodiversity impacts. According to the plan if significant petroleum resources are identified in these areas the selection of the site as a CBA could be re-evaluated, although this would require alternative CBAs to be identified to meet biodiversity targets.

No Marine Protected Areas (MPAs) is an area of coastline or ocean that is specially protected for the benefit of people and nature. MPAs help manage part of the marine environment to promote fisheries sustainability, keep marine ecosystems working properly, and protect the range of species living there, helping people to benefit from the ocean. In South Africa, MPAs are declared through the National Environmental Management: Protected Areas Act. No MPAs are located within the proposed survey area. No no-go areas within the proposed survey area have been identified in any of the specialist studies conducted. As such no layout alternatives or exclusion areas are considered applicable – refer to sensitivity map included as **Figure 88**.

6.3 TECHNOLOGY ALTERNATIVES

The activities proposed in this application require specialised technology and skills. The available technology alternatives are limited by most suitable technology for conducting seismic surveys. To this end, it was concluded by Weilgart (2010), that seismic source design can be optimized to reduce unwanted energy. Imaging deep geological targets requires an acoustic source outputting relatively low frequency content (200Hz) and in directions (both inline and horizontal to the plane of interest) that are not of use. During collection of seismic data for deep imaging purposes one should strive to reduce unnecessary acoustic energy (noise) through array, source, and receiver design optimization. Weilgart (2010), further concluded that that regardless of the imaging target, anyone collecting seismic data should strive to reduce unwanted energy or noise. It should be noted that even if unwanted frequencies (> 200 Hz) are removed, there will still be frequency overlap with several marine animals (including most baleen whales) that can and should be minimized. It was further concluded that, lower source levels could be achieved through better system optimization, i.e. a better pairing of source and receiver characteristics, and better system gain(s). For example, new receiver technologies, such as fibre optic receivers, may allow the use of lower amplitude sources through a higher receiver density and/or a lower system noise floor. Some evidence exists which indicates that re-engineered seismic sources with "mufflers" can be used to attenuate unwanted high frequency energy without affecting frequencies of interest. Searcher must define and enforce the use of the lowest practicable seismic source volume for production, and design arrays to maximise downward propagation, minimise horizontal propagation and minimise high frequencies in seismic source pulses.

It is by now widely recognised that noise reduction at the source is the most effective approach to reducing acoustic impacts from both continuous (e.g. shipping) and impulsive noise (e.g. pile driving, construction, explosions, and seismic survey) in the ocean. Seismic operators typically use a source level that applies to the most difficult conditions expected during a survey, which may be higher than required for the majority of the time. Given that geophysicists do not record or make use of any energy over about 200 Hz, a lot of energy is wasted and needlessly impacts marine fauna (Weilgart 2023). The high-frequency energy, in the tens of kHz and extending to over 100 kHz (Goold & Coats 2006) to which the MF and HF cetaceans are sensitive to, is a by-product of generating low frequency and can be suppressed. Weilgart (2023) suggests that "seismic operators should be required to develop a detailed plan describing how they will minimize sound levels, including calculations of the minimum required levels to meet the survey objectives, how these will change within the survey area and with different weather conditions, and how the survey equipment will be configured to ensure only the minimum sound level is generated".

Continued development and prioritised use of noise-reducing technologies is being recommended (Simmonds et al. 2014; Rische et al. 2020; Lee et al. 2023; Weilgart 2023) together with the establishment and enforcement of noise limits to encourage technological development for source level reduction of noise-producing activities. Alternative acoustic source technologies are those that have the potential to replace existing commonly used technologies under certain conditions. Some of the alternative technologies described by Weilgart (2023) are summarised below.

The alternative pneumatic marine seismic sources under development aim to limit bandwidth, increasing low-frequency content, while reducing the higher frequency output by controlling and slowing the release of air. This also slows the rise time and lowers the SEL. Arrays of pneumatic sources are generally 'tuned', by either separating or clustering source elements to produce a larger low-frequency output. Such methods can result in significant reductions in the signal strength at high frequencies (Weilgart 2023 and references therein).

There has also been evolution in the way in which seismic sources are configured and activated. Although most airgun arrays are designed to direct low-frequency energy downwards, they can produce sidelobes that project higher frequencies at more horizontal angles. Arrays can be designed to minimize more horizontal propagation, which would reduce environmental impacts. Techniques to reduce lateral noise emissions from airguns include the use of bubble curtains, parabolic reflectors, and airgun silencers. After initial evaluation, however, these noise abatement techniques were regarded as impractical and ineffective (Harding & Cousins 2022).

Seismic sources are traditionally made up of dual arrays, activated alternately ('flip-flop'), with an acoustic signal every ~10-12 seconds. There is, however, a shift toward using triple (3) and quintuple (5) sources, and the coded activation of multiple individual source elements in a randomised activation pattern. Such 'blended' or 'simultaneous' acquisition provides greater spatial resolution in the subsurface image and can increase efficiency through facilitating the deployment of larger receiver spreads, resulting in less line kilometres being sailed per square kilometre of data acquired. The use of multiple smaller sources reduces peak sound pressure levels and sound exposure levels, with reduced time between each acoustic signal. The effectiveness of these modifications, however, needs to be evaluated in terms of the reduction in SPL and possible extended pulse times (Weilgart 2023).

High-frequency output can also be reduced without affecting the low frequencies by desynchronizing or staggering airgun activation to reduce peak pressure and SEL. A small millisecond scatter in activation times acts like a high cut filter, reducing frequencies above a frequency defined by the distribution in firing times. A large scatter in firing times produces a continuous wavefield, sounding like white noise, with a decrease of 20 dB in peak amplitude but an increase in duty cycle (Weilgart 2023).

Many of the technologies under development are, however, proprietary to individual companies, and therefore not commercially available to all survey contractors, thereby presenting a problem for regulators.

Perhaps the most promising alternative technology under development are marine vibrator (MV) systems, which replace the short, high amplitude, wide frequency-bandwidth signal produced by an airgun array with a much longer, lower-amplitude signal, with the same acoustic energy in the frequency band required for the seismic survey (below 200 Hz and sometimes below 120 Hz). The frequency bands required for effective imaging have the same energy spread over a longer duration, thereby allowing for a lower source level and less wasted energy at frequencies that are not used. Such a quieter signal should reduce the risk of damage to an animal's hearing at short range. Being a scalable source, MV output level can be adjusted in real time to environmental and operational conditions, by 1) altering the number of vibrators used in the array, 2) changing the output level, and 3) changing the length of the sweep. The emitted frequency band, phase, amplitude (SPL), or energy over time (SEL) can be selected, which is largely impossible for airgun surveys (Weilgart 2023). Modelling studies have concluded that due to reduced SPLs and lower SELs potential injury to marine mammals was less likely from MV arrays, with benefits even at long ranges and even for animals with good low-frequency hearing (Duncan et al. 2017). MV surveys would be expected to cause less of an impact (behavioral, physiological, auditory) than airgun surveys in all habitats and environments regardless of water depth or environmental conditions (LGL & MAI 2011). A drawback of MV compared with airguns is the greater potential for masking, due to the longer duration, and higher duty cycle. This would impact mainly low-frequency hearing specialists (mysticetes and some fish). Slight masking effects could extend to a few tens of kilometers from the MV source. MV thus shows potential in providing an environmentally safer alternative to airguns without compromising effectiveness for seismic exploration and could at some stage in the future replace at least some, and perhaps eventually all, airguns. However, this change will need to be driven by regulation. Unfortunately, MV systems are not yet commercially widely available, although their development and pilot projects are being sponsored by numerous industry role players (Weilgart 2023).

From the above it is evident that the recommendations of the CMS and IWC to take action to reduce ocean noise is being addressed not only at policy level through the international standardisation of mitigation measures (see below), but also at technological levels through research and development into alternative technologies for seismic acquisition as well as abatement measures to reduce the noise generated during surveys. Merchant et al. (2022), however, point out that "while quieter alternative to seismic airgun surveys have been developed and tested successfully, none are available at commercial scale due to a lack of regulatory incentive to encourage their use".

Specifically, marine vibrator systems are expensive; if industry professionals were compensated for the switch, the switch would be more likely. Pneumatic alternatives to conventional airguns are available commercially, but their deployment would involve capital and operational expenses that are smaller than those of marine vibrators. Increased costs in implementing alternative seismic technologies are significant and in effect impede their deployment as replacements for conventional airguns (Harding & Cousins 2022).

The use of Best Available Techniques/Technologies (BAT) and Best Environmental Practice (BEP) is a requirement recognised and promoted in several international agreements and conventions (e.g. CMS and CBD), and several of these BATs and BEPs exist for noise sources already and should be made use of to reduce the effect of noise on marine fauna (Weilgart 2019; 2023). Those regularly applied as risk reduction measures for seismic surveys are discussed briefly below.

The **detection of cetaceans by real-time visual observation** is a standard measure for seismic surveys. Weir et al. (2006) point out that while not a mitigation measure per se, it is an essential component of marine mammal mitigation during seismic surveys. As many marine mammals and turtles are cryptic, elusive, and often underwater, and since survey activities continue during the night or during limited-visibility conditions, the use of MMOs results in only a limited risk reduction, particularly for deep-diving species (Barlow & Gisiner 2006; Parsons et al. 2009; Leaper et al. 2015). Given these constraints, the use of dedicated and experienced MMOs (as opposed to Fisheries Liaison Officers and/or ship's crew) is critical in achieving the most reliable results.

Real-time **Passive Acoustic Monitoring** (PAM) should be used as an additional mitigation measure in conjunction with visual observation, to maximize the probability of detection. Not only does PAM detect vocalising diving animals, it can also detect vocalising animals at night and in rough weather conditions (Gordon & Tyack, 2002). However, while having great potential for detecting cetacean species that vocalise frequently, those species that do not vocalise, or cease vocalising for some reason will remain undetected by PAM.

Other measures that attempt to reduce noise impacts associated with physical injuries rather than masking or disturbance include **increasing loud noises slowly** (e.g. 'soft-start' or 'ramp-up' procedures) or **shutting down** the noise sources when vulnerable species come within a specified range of the source.

Regulators remain heavily reliant on the use of safety zones (exclusion zones) as the primary means of noise mitigation. Although the extent of these exclusion zones has more recently been based on the impact zones for different faunal species as predicted by sound transmission loss modelling studies, their limitations are widely acknowledged (e.g. Weir & Dolman 2007; Lubchenco 2010; Wright 2014).

The most frequently implemented mitigation measure is **time-area closures**, which provide a way of keeping noise sources away from vulnerable (e.g. migrating) species. This, however, relies on sufficiently detailed temporal and spatial knowledge of the distribution patterns of the vulnerable species, but does not cater for resident species that are present year-round.

Refer to the detailed mitigation measures included in the EMPr **Appendix E** for recommendations regarding source design. The above optimisation techniques should be implemented including better seismic source design and system optimisation with the selected survey contractor. In addition, kerosene free hydro-streamers should be used. It is also important to ensure that 'turtle-friendly' tail buoys are used or that existing tail buoys are fitted with either exclusion or deflector 'turtle guards'.

6.4 NO GO ALTERNATIVE

The "No Go" or "No Action" alternative refers to the alternative of not embarking on the proposed project at all. This alternative would imply that the current status quo without the proposed 3D seismic surveys. It is important to note that the No Go alternative is the baseline against which all other alternatives and the development proposal are assessed. When considering the No Go alternative, the impacts (both positive and negative) associated with any other specific alternative, or the current project proposal would not occur and in effect the impacts of the No Go alternative are therefore inadvertently assessed by assessing the other alternatives. In addition to the direct implications of retaining the status quo, there are certain other indirect impacts, which may occur should the No Go alternative be followed. The no go alternative would imply that no seismic survey activities are undertaken. As a result, the opportunity to identify potential oil and gas resources within the survey area would not exist. This will negate the potential negative and positive impacts associated with the proposed survey activities.

7 STAKEHOLDER ENGAGEMENT

The Public Participation Process (PPP) is a requirement of several pieces of South African legislation and aims to ensure that all relevant Interested and Affected Parties (I&APs) are consulted, involved and their comments are considered, and a record included in the reports submitted to the Authorities. The process ensures that all stakeholders are provided this opportunity as part of a transparent process which allows for a robust and comprehensive environmental study. The PPP for the proposed project needs to be managed sensitively and according to best practises to ensure and promote:

- Compliance with international best practice options;
- Compliance with national legislation;
- Establishment and management of relationships with key stakeholder groups; and
- Involvement and participation in the environmental study and authorisation/approval process.

As such, the purpose of the PPP and stakeholder engagement process is to:

- Introduce the proposed project;
- Explain the authorisations required;
- Explain the environmental studies already completed and yet to be undertaken (where applicable);
- Solicit and record any issues, concerns, suggestions, and objections to the project;
- Provide opportunity for input and gathering of local knowledge;
- Establish and formalise lines of communication between the I&APs and the project team;
- Identify all significant issues for the project; and
- Identify possible mitigation measures or environmental management plans to minimise and/or prevent negative environmental impacts and maximize and/or promote positive environmental impacts associated with the project.

7.1 GENERAL APPROACH TO PUBLIC PARTICIPATION

The PPP for the proposed project is undertaken in accordance with the requirements of the NEMA EIA Regulations (2014), and in line with the principles of Integrated Environmental Management (IEM). IEM implies an open and transparent participatory process, whereby stakeholders and other I&APs are afforded an opportunity to comment on the project and have their views considered and included as part of project planning.

An initial I&AP database has been compiled based on known key I&AP's and stakeholder databases available from existing sources and from the previous I&AP database for the 2022 EA Application. The I&AP database includes amongst others, adjacent landowners, rights holders, communities, regulatory authorities and other special interest groups. It must be noted that this Public Participation Process is largely based on the previous public participation undertaken during the 2022 EA Application with additional measures / engagements to ensure all I&APs (as far as possible) are provided with detailed project description in a manner they can understand, they are consulted thoroughly, provided an opportunity to participate and provided feedback on the initial survey undertaken between January and April 2024 in parallel feedback session.

7.1.1 LIST OF PRE-IDENTIFIED ORGANS OF STATE/ KEY STAKEHOLDERS IDENTIFIED AND NOTIFIED

Pre-identified Key Stakeholders were notified of the proposed project and include:

- Abalobi
- Africa Conservation Trust
- Afriforum
- Agri Westcape
- Anglo American
- Aukotowa Fishing Co-Op
- Birdlife
- Centre for Environmental Rights
- Chapmans Peak Fisheries
- Cochoqua Tribal Authority
- Combined Fishing Enterprise cc
- Community Processors and Distributors (Pty) Ltd
- Conservation South Africa
- Council for Geoscience
- CSIR
- Dargle Conservancy
- De Beers Group of Companies
- Earth Life Africa
- Endangered Wildlife Trust
- Eskom Holdings SOC Ltd
- Federation for a Sustainable Environment
- Fisherman Development Organisation
- FishSA
- Frackfree SA
- Fresh Tuna Exporters Association
- Gansbaai Marine (Pty) Ltd
- Green Connection
- GroundWork SA
- Hicksons Fishing Company Ltd
- Hondeklip Bay Women's Group
- Hondeklipbaai Visserye Bpk.
- iAfrica
- iGas
- Ikamva Lethu Fishing Company (Pty) Ltd
- Imbiza
- Impact Oil and Gas
- Impala Fishing (Pty) Ltd
- Inert Gas Industries
- Ingwe Emnyama Fishing Enterprises (Pty) Ltd
- IRASA Khoisan
- Irvin & Johnson Limited
- Isinda Tient (Pty) Ltd
- Iziko Museums of South Africa
- Japan Marine Supplies & Services
- Jayfish cc
- Kernel Marine (Pty) Ltd
- Khulani Fishing (Pty) Ltd
- Kobush
- Local Ward Councillors
- Lucky Star
- Masifundise Development Trust
- NamaquaRIGHTS
- Natural Justice
- Nambian Government
- North Western Cape Mining Forum
- Observatory Civic Organisation
- Oceana Group Limited
- Oceans Not Oil
- Pescaluna
- PetroSA

- Port Nolloth Abalone
- Port Nolloth Fish Factory
- Port Nolloth Fisheries
- Port Nolloth Sea Farm Ranching
- Premier Fishing
- Premier Fishing (SA) (Pty) Ltd
- Protect the West Coast
- Quayside Fish Suppliers Cape (Pty) Ltd
- Reige Visserye cc
- Risar Fishing
- SA Foundation for the Conservation of Coastal Bird
- SA Tuna Association
- SA Tuna Longline Association
- South African National Biodiversity Institute
- South African Maritime Safety Association
- South African Pelagic Fishing Industry Association
- South African United Fishing Front
- Sunbird Energy
- Sungu Sungu Petroleum
- Thombo Petroleum/Africa Energy corp
- Transnet SOC Ltd
- We Are South Africans
- West Coast National Park
- World Wildlife Fund
- South African Navy Hydrographic Office

<u>Pre-identified authorities were notified of the proposed project and include:</u>

- Bergrivier Local Municipality
- Cape Nature
- Cederberg Local Municipality
- City of Cape Town Metropolitan
- Eskom SOC ltd
- Heritage Western Cape
- Kamiesberg Local Municipality
- Matzikama Local Municipality
- Nama Khoi Local Municipality
- Namakwa District Municipality
- National Department of Agriculture, Land Reform and Rural Development
- National Department of Forestry, Fisheries and the Environment
- National Department of Mineral Resources
- National Department of Public Works
- National Department of Social Development
- National Department of Transport
- National Department of Water and Sanitation; and
- National Energy Regulator of South Africa
- Northern Cape Department of Nature and Conservation
- Northern Cape Provincial Heritage Resource Agency
- Petroleum Agency of South Africa
- Ritchersveld Local Municipality
- Saldanha Bay Local Municipality
- SANPARKS
- South African Heritage Resources
- Swartland Local Municipality
- West Coast District Municipality
- West Coast Marine Conservation Society
- Western Cape Department of Environmental Affairs and Development Planning

7.1.2 INITIAL NOTIFICATION

The PPP commenced on 19 April 2024 with an initial notification and call to register for a period of 30 days. The initial notification was given in the following manner:

7.1.2.1 REGISTERED LETTERS, FAXES AND EMAILS

Notification letters (English, isiXhosa and Afrikaans), faxes, and emails were distributed to all pre-identified key I&APs including government organisations, NGOs, relevant municipalities, ward councillors, landowners and other organisations that might be affected.

The notification letters included the following information to I&APs:

- List of anticipated activities to be authorised;
- Scale and extent of activities to be authorised;
- Information on the intended reconnaissance operation to enable I&APs to assess/surmise what impact the activities will have on them or on the use of their land;
- The purpose of the proposed project;
- Details of the affected properties (including details of where a locality map could be obtained);
- Details of the relevant regulations;
- Initial registration period timeframes; and
- Contact details of the EAP.

7.1.2.2 NEWSPAPER ADVERTISEMENTS / GOVERNMENT GAZETTE

Advertisements describing the proposed project and EIA process were placed in newspapers with circulation in the vicinity of the study area. The initial advertisements were placed in Cape Times (English and IsiXhosa), Sentinel News (English and Afrikaans), Weslander (English and Afrikaans), Ons Kontrei (English and Afrikaans), Die Plattelander (English and Afrikaans) as well as in the National Gazette. The newspaper adverts included the following information:

- Project name;
- Applicant name;
- Project location;
- Nature of the activity and application; and
- Relevant EIMS contact person for the project.

It must be noted that during the initial call to register, an incorrect identified listed activity was mistakenly circulated only on the Newspapers and Gazette (Listing Notice 1 Activity 21a instead of the correct Listing Notice 1 Activity 21b). The newspapers adverts and Gazette will be re-circulated with the correct identified listed activity (Listing Notice 1 Activity 21b). This will form part of the second round of Newspaper Advertisements notifying I&APs of the availability of the BAR for public comment and review and details of public open days / meetings in the same newspapers and languages mentioned above.

7.1.2.3 SITE NOTICE PLACEMENT

A1 Correx site notices in English, Afrikaans and IsiXhosa were placed at 100 locations along the West Coast, stretching from Hout Bay to Port Nolloth on the 22nd - 26th of April 2023. The on-site notices included the following information:

- Project name;
- Applicant name;

- Project location;
- Map of proposed project area;
- Project description;
- Legislative requirements; and
- Relevant EIMS contact person for the project.

7.1.2.4 POSTER PLACEMENT

A3 posters in English, Afrikaans and IsiXhosa were placed at local public gathering places at various onshore locations, mainly in Cape Town. The notices and written notification afforded all pre-identified I&APs the opportunity to register for the project as well as to submit their issues/queries/concerns and indicate the contact details of any other potential I&APs that should be contacted. The contact person at EIMS, contact number, email and faxes were stated on the posters. Comments/concerns and queries were encouraged to be submitted in either of the following manners:

- Electronically (fax, email);
- Telephonically; and/or
- Written letters.

7.1.2.5 RADIO ADVERTS

An initial round of Radio advertisements was published in April 2024. The advertisements described the proposed project, and BA process, urging I&APs to register to receive notifications regarding opportunities to participate in the BA process. The radio advertisements and notice included the following information:

- Project name;
- Applicant name;
- Project location;
- Nature of the activity;
- Legislative requirements; and
- Relevant EIMS contact person for the project.

Radio adverts were aired notifying I&APs of the meetings on the following radio stations:

- KFM (English);
- Radio NFM (English, Afrikaans, IsiXhosa);
- Radio West Coast (English and isiXhosa); and
- Radio Namakwaland (English and Afrikaans).

7.1.3 AVAILABILITY OF BA REPORT

Notification regarding the availability of this BA Report for public review will be given in the following manner to all registered I&APs (which includes key stakeholders and landowners):

- Registered letters with details on where the report can be obtained and/or reviewed, public meeting date and time, EIMS contact details as well as the public review comment period;
- Facsimile notifications with information similar to that in the registered letter described above; and/or
- Email notifications with a letter attachment containing the information described above.

The BA report will be made available for public review from 21 June 2024 to 22 July 2024. Hard copies of the report will be made available at the following venues:

- The Hout Bay Public Library (Melkhout Crescent, Hout Bay, Cape Town, Western Cape)
- The Sea Point Public Library (Civic Centre, Cnr Three Anchor Bay and Main roads, Sea Point, Cape Town, Western Cape)
- The Vredenburg Public Library (2 Academy Street, (close to West Coast College), Vredenburg, West Coast, Western Cape)
- The Lamberts Bay Public Library (Church Street, Lamberts Bay, Western Cape)
- Kamiesburg Local Municipality in Hondeklip Bay (Wag Way street)
- J Bekeur Library (Robson St, Port Nolloth, Richtersveld, Northern Cape)

The report will also be available for review and download at https://www.eims.co.za/public-participation/.

7.1.4 PUBLIC MEETINGS

A series of public meetings with I&APs will be held at various locations along the West Coast. The public meetings will be held as Open Days, allowing all I&APs to review the BAR and share their comments and concerns. These contributions will be recorded in the meeting minutes. List of public meeting locations, venues, dates, and times during the Basic Assessment review period is as follows:

- **Luvuyo Drop-In Centre** (Monday 24 June 2024 at 09:00-17:00)
- **Hananja Lodge & Restaurant** (Tuesday 25 June 2024 at 09:00 -17:00)
- **Hananja Lodge & Restaurant** (Wednesday 26 June 2024 at 09:00 -17:00)
- **Maria Owies Hall** (Thursday 27 June 2024 at 09:00 -17:00)
- **Elands Bay Community Hall** (Friday 28 June 2024 at 09:00 -17:00)
- **Sandy Point Community Hall** (Monday 01 July 2024 at 09:00 -17:00)
- **Seebries Saal/Sea Breeze Hall** (Tuesday 02 July 2024 at 09:00 - 17:00)
- **Yzerfontein Community Hall** (Wednesday 03 July 2024 at 09:00 -17:00)
- **Hangberg Sports and Recreation Centre** (Thursday 04 July 2024 at 09:00 -13:00)
- **Alliance France** (Friday 05 July 2024 at 09:00 -17:00)
- **MS Teams Online** (Wednesday 10 July 2024 at 14:00 -15:00)

The aim of the first round of public meetings is to ensure as many concerns and issues were captured prior to release of the draft BA report. This is done in order to ensure that the BA report addresses as many of the potential concerns from the public and affected stakeholders as possible. It must be noted that there will be parallel feedback sessions on the initial survey undertaken by Abalobi Express Consulting and Project Management (Pty) Ltd on the same venues on an earlier timeslot (i.e. 08h00-09h00).

7.2 SUMMARY OF COMMENTS

Comments raised to date have been addressed in a transparent manner and included in the Public Participation Report (**Appendix B**). A high-level summary of the key comments and concerns raised to date are presented below.

- Concerns over stakeholder fatigue;
- I&AP registrations and deregistration;
- Notification/information document requests;
- Request for clarity on the nature of the project;
- Request for files related to the location and situation of the project site;

- Concern about the impact on marine ecology and climate change;
- Competent authority registration and notification of further comments upon receipt of further information;
- Request to be notified when draft BAR is released for comments;
- Concerns for fishing grounds as a result of the 3D seismic survey.

Seismic reconnaissance projects are controversial in South Africa and has been in the news frequently in the last year. For many stakeholders it is an emotional matter, for others the potential of impacting their livelihoods is the biggest fear. There are also stakeholders that feel that the exploration for fossil fuels is not in line with sustainable development and the fight against climate change. Other stakeholders feel that it is imperative for the growth and development of the South African economy to engage in these investigations. A list of relevant media and news articles relating to the project is included in **Appendix G**.

7.3 APPEAL PERIOD

After a decision has been reached by DMRE, Chapter 2 of the National Appeal Regulations 2014 makes provision for any affected person to appeal against the decision. Within 20 days of being notified of the decision by the competent authority, the appellant must submit the appeal to the appeal administrator. An appeal panel may be appointed at the discretion of the delegated or organ of state to handle the case and it would then submit its recommendations to that organ of state for a final decision on the appeal to be reached. EIMS will communicate the decision of the Competent Authority and the way appeals should be submitted to the Minister and to all I&APs as soon as reasonably possible after the final decision has been received.

8 ENVIRONMENTAL ATTRIBUTES AND BASELINE ENVIRONMENT

This section of the BA Report provides a description of the environment that may be affected by the proposed project. Aspects of the biophysical, social and economic environment that could be directly or indirectly affected by, or could affect, the proposed development have been described. This information has been sourced from existing information available for the area and specialist baseline assessments.

8.1 LOCATION

The proposed project area is located between approximately 256 km offshore of St Helena Bay, extending north along the western coastline to approximately 220 km offshore of Hondeklip Bay over a number of petroleum licence blocks. The survey area at the closest point is approximately 218 km offshore of the coast of the Western and Northern Cape. The locality of the proposed survey area is shown in **Figure 1**.

8.2 GEOPHYSICAL CHARACTERISTICS

This section provides a description of the geophysical characteristics of the application area. The information has been sourced from the Marine Ecological Study undertaken by Pisces Environmental Services (Pty) Ltd included in **Appendix C**.

8.2.1 BATHYMETRY

The continental shelf along the West Coast is generally wide and deep, although large variations in both depth and width occur. The shelf maintains a general NNW trend, widening north of Cape Columbine and reaching its widest off the Orange River (180 km) (see **Figure 6**). The nature of the shelf break varies off the South African West Coast. Between Cape Columbine and the Orange River, there is usually a double shelf break, with the distinct inner and outer slopes, separated by a gently sloping ledge. The immediate inshore area consists mainly of a narrow (about 8 km wide) rugged rocky zone and slopes steeply seawards to a depth of around 80 m. The middle (-50 to 150 m) and outer shelf (-150 to -350 m) normally lacks relief and slopes gently seawards reaching the shelf edge at a depth of between -350 to -500 m. The three shelf zones characterising the West Coast are recognised following both abiotic and biotic patterns.

Banks on the continental shelf include the Orange Bank (Shelf or Cone), a shallow (160 – 190 m) zone that reaches maximal widths (180 km) offshore of the Orange River, and Child's Bank, situated ~150 km offshore at about 31°S, and within the northern portion of the project target area. Child's Bank is a major feature on the West Coast margin and is the only known submarine bank within South Africa's Exclusive Economic Zone (EEZ), rising from a depth of 350 – 400 m water to less than -200 m at its shallowest point. It is a rounded, flat topped, sandy plateau, which lies at the edge of the continental shelf. The bank has a gentle northern, eastern and southern margin but a steep, slump-generated outer face. At its southwestern edge, the continental slope drops down steeply from -350 to -1 500 m over a distance of less than 60 km creating precipitous cliffs at least 150 m high. The bank consists of resistant, horizontal beds of Pliocene sediments, similar to that of the Orange Banks, and represents another perched erosional outlier formed by post-Pliocene erosion. The top of this feature has been estimated to cover some 1 450 km^2. Tripp Seamount is a geological feature ~25 km to the north of the survey area, which rises from the seabed at ~1 000 m to a depth of 150 m. It is a roughly circular feature with a flat apex that drops steeply on all sides.

Further underwater features in the vicinity of the survey area include the Cape Canyon and Cape Valley, which lie over 200 km to the southeast of the southern boundary of the survey area. The Cape Canyon was discovered in the 1960s. The canyon head forms a well-developed trench on the continental shelf, 100 m deep and 4 km wide. South of Cape Columbine the canyon becomes progressively narrower and deeper. Adjacent to Cape Town in a water depth of 1 500 m, the canyon has a local relief in the order of 500–800 m. The Cape Canyon has a longitudinal extent of at least 200 km and can be traced to a water depth of at least 3 600 m, where the topography of the distal end is rugged and complex. Sediments in the canyon are predominately unconsolidated sands and muds. The canyon serves as an upwelling feature funnelling cold, nutrient-rich South Atlantic Central Water up the canyon slope, providing highly productive surface waters which in turn power feeding grounds for cetaceans and seabirds.

The Cape Point Valley, which lies about 70 km south of the Cape Peninsula, is another large canyon breaching the shelf. This canyon has sustained the highest fishing effort and catches in the South African demersal trawl fishery for almost a century.

Using high-resolution bathymetry collected between 315 – 3 125 m depth, Palan (2017) identified numerous new and previously undocumented submarine canyon systems, most of which are less extensive than the Cape Canyon and Cape Point Valley and do not incise the shelf (**Figure 7**). Canyon morphology was highly variable and included linear, sinuous, hooked and shelf-indenting types. Large fluid seep/pockmark fields of varying morphologies were similarly revealed situated in close proximity to the sinuous, hooked and shelf-indenting canyon types thereby providing the first evidence of seafloor fluid venting and escape features from the South African margin. These pockmarks represent the terminus of stratigraphic fluid migration from an Aptian gas reservoir, evidenced in the form of blowout pipes and brightened reflectors. This area lies well to the southeast of the Survey area.

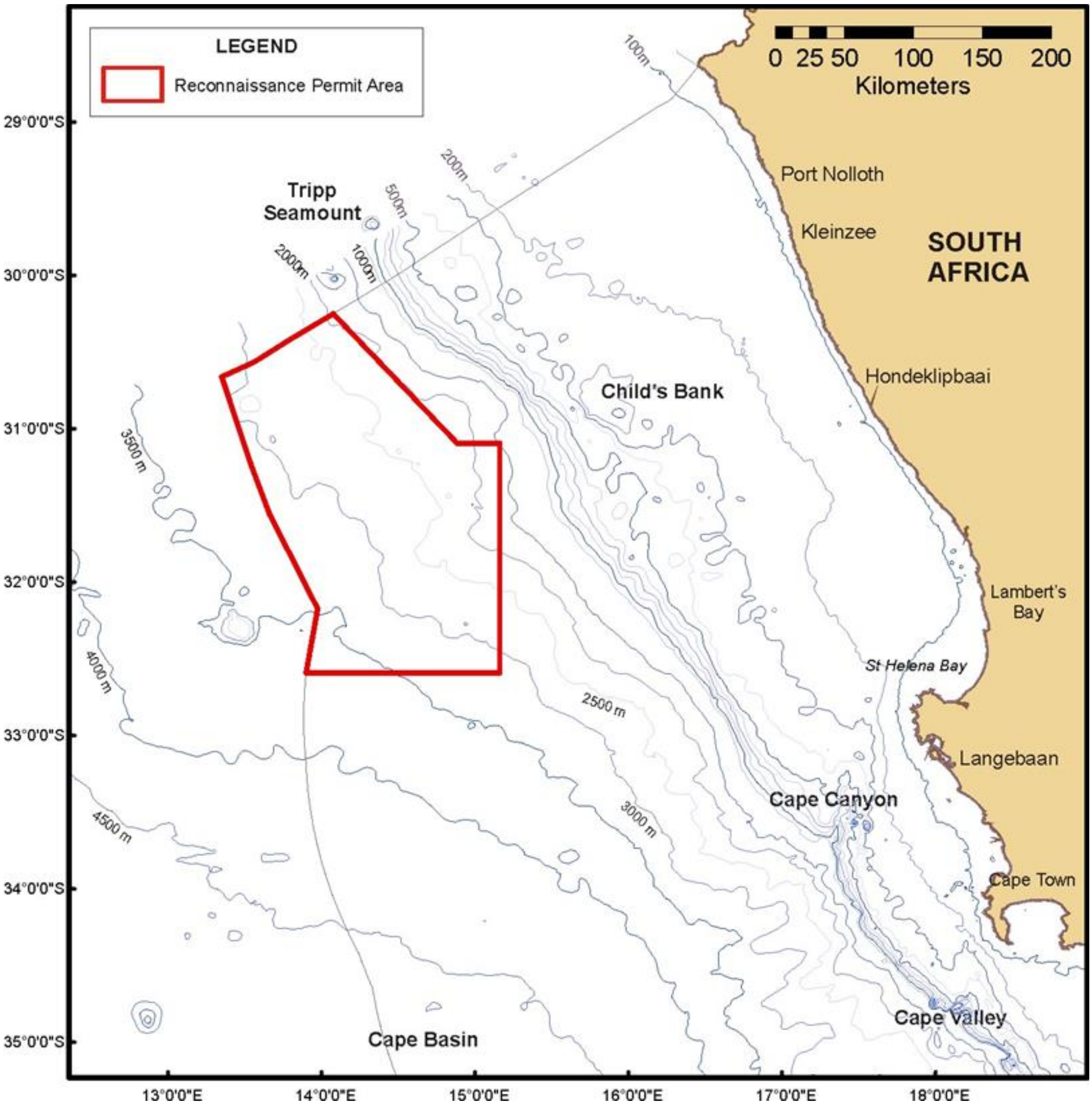


Figure 6: Map indicating location of the survey area in relation to bathymetric features off the West Coast.

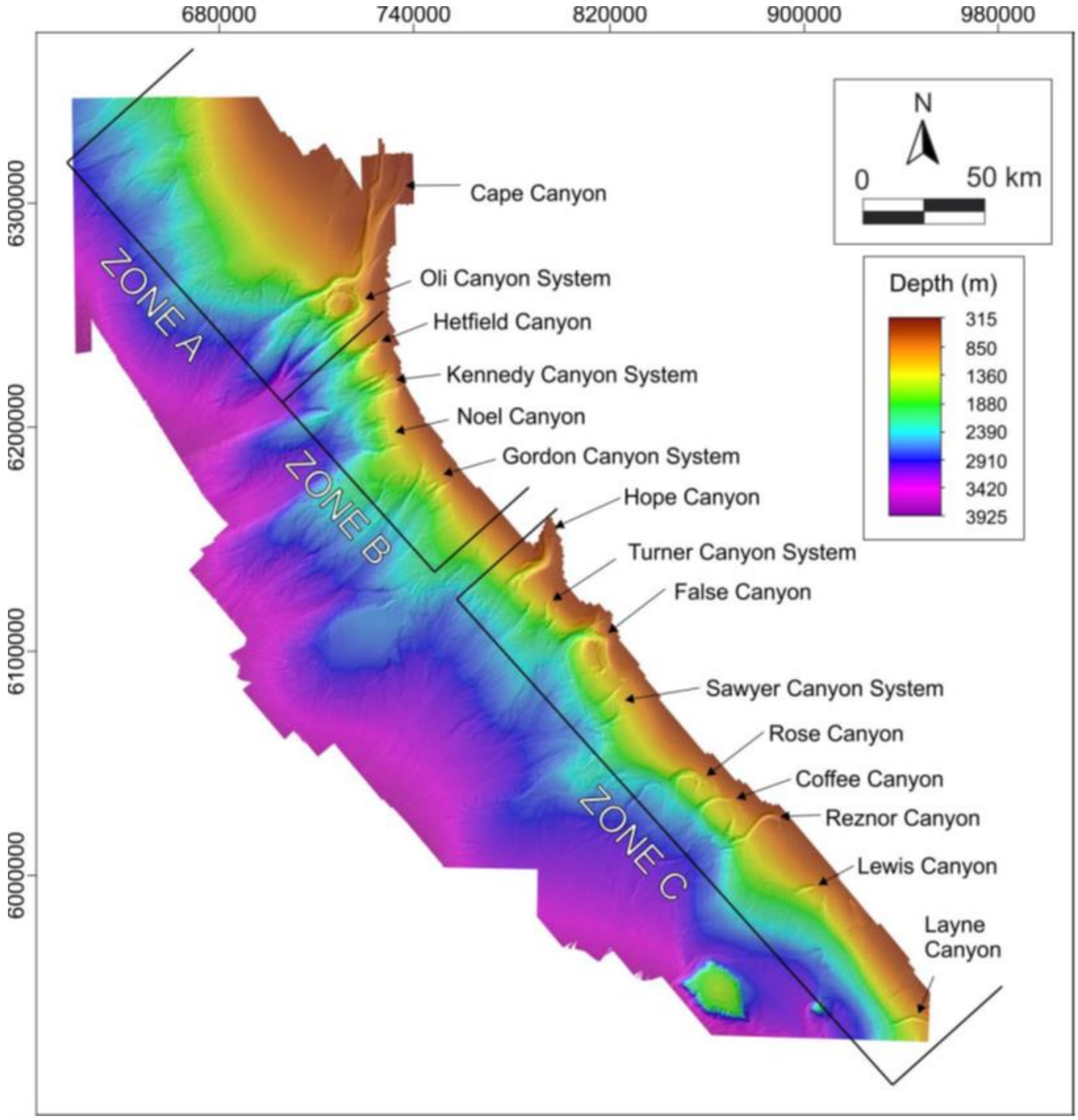


Figure 7: Submarine canyon domains of the southwestern Cape continental margin.

8.2.2 COASTAL AND INNER-SHELF GEOLOGY AND SEABED GEOMORPHOLOGY

Figure 8 illustrates the distribution of seabed surface sediment types off the South African north-western coast. The inner shelf is underlain by Precambrian bedrock (Pre-Mesozoic basement), whilst the middle and outer shelf areas are composed of Cretaceous and Tertiary sediments. As a result of erosion on the continental shelf, the unconsolidated sediment cover is generally thin, often less than 1 m. Sediments are finer seawards, changing from sand on the inner and outer shelves to muddy sand and sandy mud in deeper water. However, this general pattern has been modified considerably by biological deposition (large areas of shelf sediments contain high levels of calcium carbonate) and localised river input. An ~500-km long mud belt (up to 40 km wide, and of 15 m average thickness) is situated over the inner shelf between the Orange River and St Helena Bay. Further offshore and within the Survey area, sediment is dominated by muds and sandy muds. The continental slope, seaward of the shelf break, has a smooth seafloor, underlain by calcareous ooze.

Present day sedimentation is limited to input from the Orange River. This sediment is generally transported northward. Most of the sediment in the area is therefore considered to be relict deposits by now ephemeral rivers active during wetter climates in the past. The Orange River, when in flood, still contributes largely to the mud belt as suspended sediment is carried southward by poleward flow. In this context, the absence of large sediment bodies on the inner shelf reflects on the paucity of terrigenous sediment being introduced by the few rivers that presently drain the South African West Coast coastal plain.

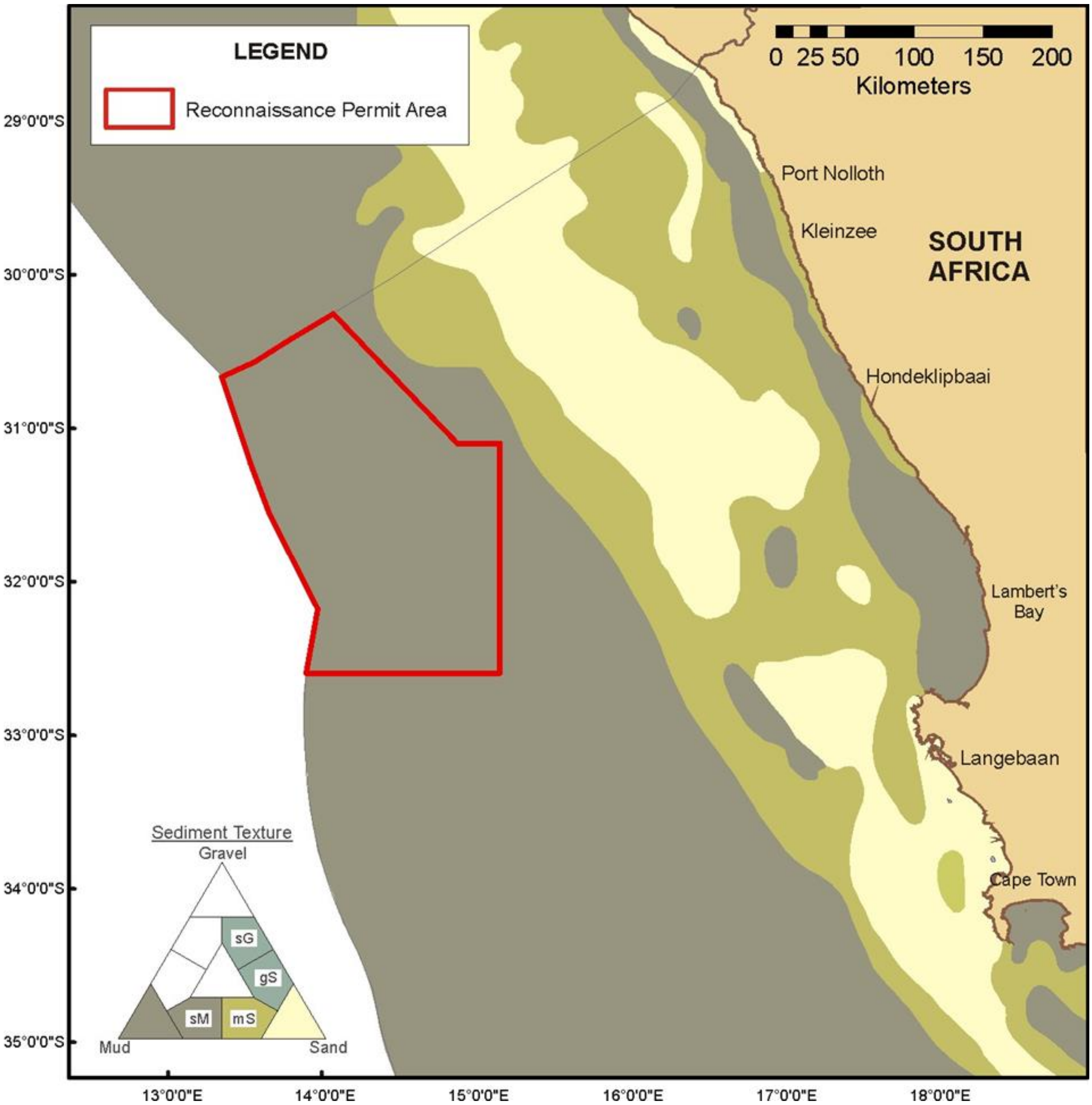


Figure 8: The survey area in relation to sediment distribution on the continental shelf of the South African West Coast.

The benthic habitat types of the West Coast were classified and mapped in detail through the 2011 National Biodiversity Assessment (NBA). These were refined in the 2018 NBA to provide substratum types (**Figure 9**). In the survey area the water depth ranges from approximately 1 000 m to over 3 500 m. The Southeast Atlantic Unclassified Slopes and Southeast Atlantic Unclassified Abyss substrata dominate across the area. The shelf inshore of the survey area boasts a diversity of substrata.

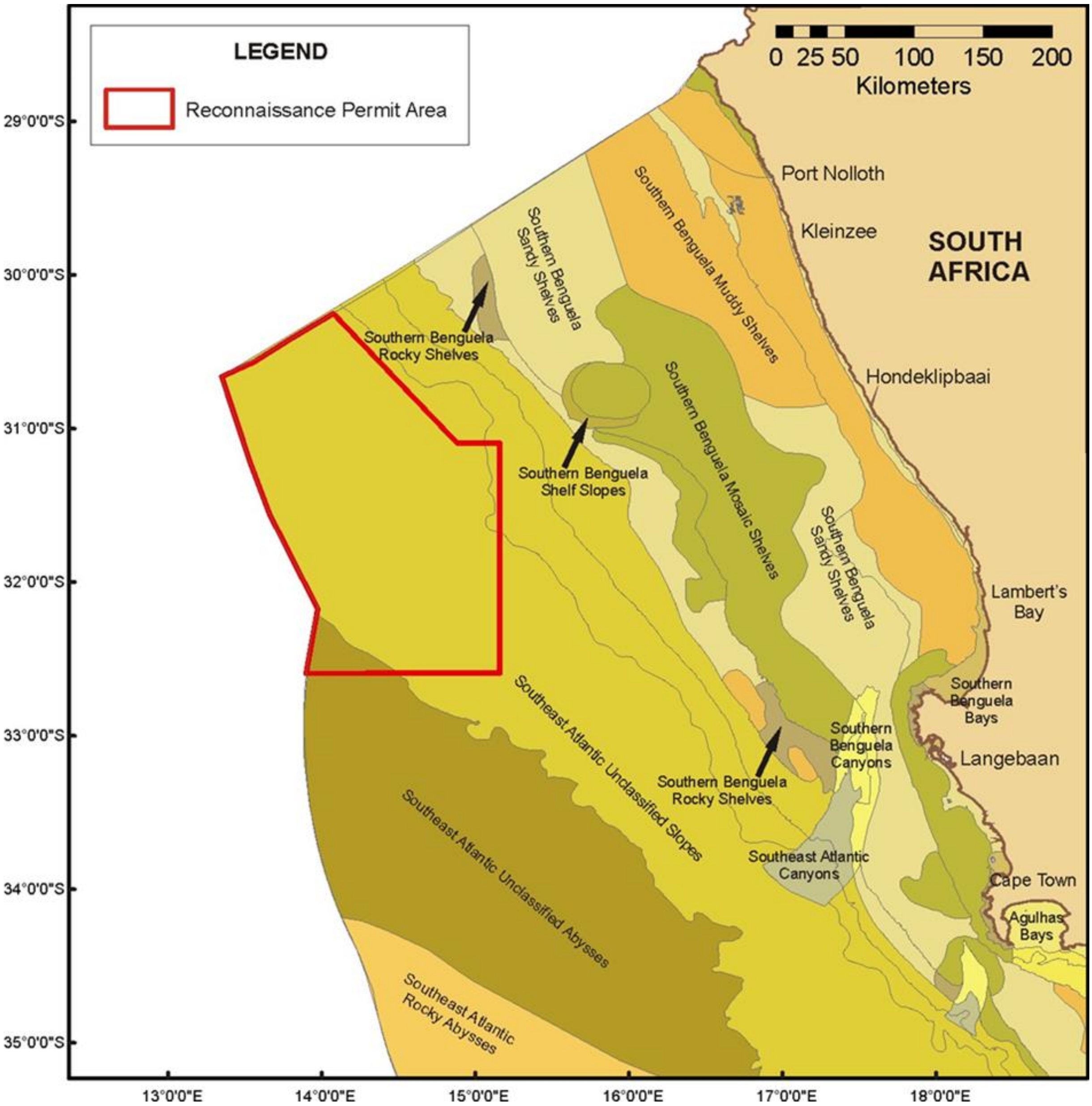


Figure 9: The survey area in relation to the distribution of seabed substratum types along the West Coast.

8.3 BIOPHYSICAL CHARACTERISTICS

This section provides a description of the biophysical characteristics of the application area. The information has been sourced from the Marine Ecological Study undertaken by Pisces Environmental Services (Pty) Ltd included in **Appendix C**.

8.3.1 WIND PATTERNS

Winds are one of the main physical drivers of the nearshore Benguela region, both on an oceanic scale, generating the heavy and consistent south-westerly swells that impact this coast, and locally, contributing to the northward-flowing longshore currents, and being the prime mover of sediments in the terrestrial environment. Consequently, physical processes are characterised by the average seasonal wind patterns, and substantial episodic changes in these wind patterns have strong effects on the entire Benguela region.

The prevailing winds in the Benguela region are controlled by the South Atlantic subtropical anticyclone, the eastward moving mid-latitude cyclones south of southern Africa, and the seasonal atmospheric pressure field over the subcontinent. The south Atlantic anticyclone is a perennial feature that forms part of a discontinuous belt of high-pressure systems which encircle the subtropical southern hemisphere. This undergoes seasonal variations, being strongest in the austral summer, when it also attains its southernmost extension, lying southwest and south of the subcontinent. In winter, the south Atlantic anticyclone weakens and migrates north-westwards.

These seasonal changes result in substantial differences between the typical summer and winter wind patterns in the region, as the southern hemisphere anti-cyclonic high-pressures system, and the associated series of cold fronts, moves northwards in winter, and southwards in summer. The strongest winds occur in summer (October to March), during which winds blow 98% of the time, with a total of 226 gales (winds exceeding 18 m/s or 35 knots (kts)) being recorded over the period. Virtually all winds in summer come from the south to south-southeast (**Figure 10**). These southerlies occur over 40% of the time, averaging 20 – 30 kts and reaching speeds in excess of 60 kts, bringing cool, moist air into the coastal region and driving the massive offshore movements of surface water, and the resultant strong upwelling of nutrient-rich bottom waters, which characterise this region in summer. The winds also play an important role in the loss of sediment from beaches. These strong equator-wards winds are interrupted by the passing of coastal lows with which are associated periods of calm or north or northwest wind conditions. These northerlies occur throughout the year but are more frequent in winter.

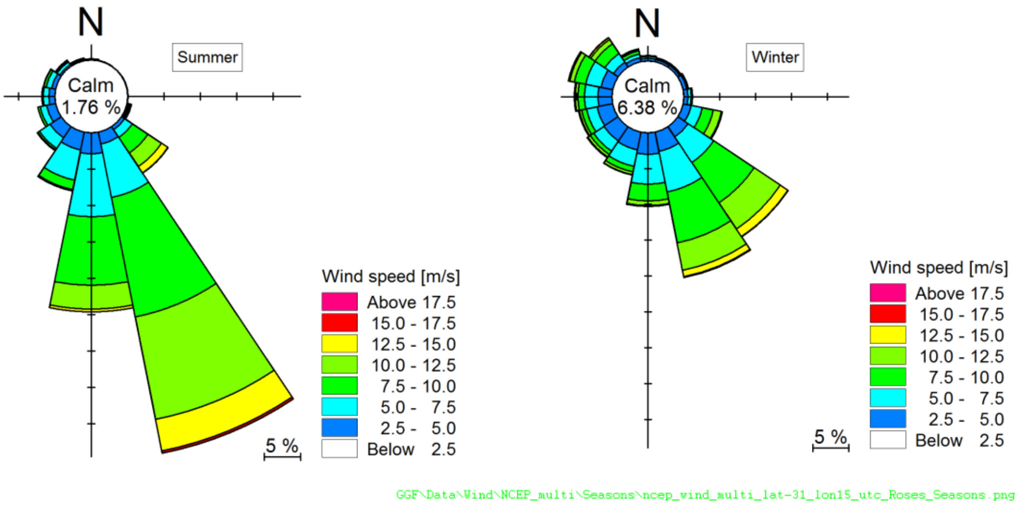


Figure 10: Wind Speed vs. Wind Direction for NCEP hind cast data at location 15°E, 31°S (From PRDW 2013).

8.3.1.1 LARGE-SCALE CIRCULATION AND COASTAL CURRENTS

The southern African West Coast is strongly influenced by the Benguela Current. Current velocities in continental shelf areas generally range between 10–30 cm/s (Boyd & Oberholster 1994), although localised flows in excess of 50 cm/s occur associated with eddies. On its western side, flow is more transient and characterised by large eddies shed from the retroflection of the Agulhas Current. This results in considerable variation in current speed and direction over the domain. In the south the Benguela current has a width of 200 km, widening rapidly northwards to 750 km. The surface flows are predominantly wind-forced, barotropic and fluctuate between poleward and equatorward flow (**Figure 11b**). Fluctuation periods of these flows are 3 – 10 days, although the long-term mean current residual is in an approximate northwest (alongshore) direction. Current speeds decrease with depth, while directions rotate from predominantly north-westerly at the surface to south-easterly near the seabed. Near bottom shelf flow is mainly poleward with low velocities of typically <5 cm/s. The poleward flow becomes more consistent in the southern Benguela. The major feature of the Benguela Current is coastal upwelling and the consequent high nutrient supply to surface waters leads to high biological production and large fish stocks. The prevailing longshore, equatorward winds move nearshore surface water northwards and offshore. To balance the displaced water, cold, deeper water wells up inshore. Although the rate and intensity of upwelling fluctuates with seasonal variations in wind patterns, the most intense upwelling tends to occur where the shelf is narrowest and the wind strongest. There are three upwelling centres in the southern Benguela, namely the Namaqua (30°S), Cape Columbine (33°S) and Cape Point (34°S) upwelling cells (Figure 11a). Upwelling in these cells is seasonal, with maximum upwelling occurring between September and March. The proposed 3D survey area is located offshore of these upwelling events.

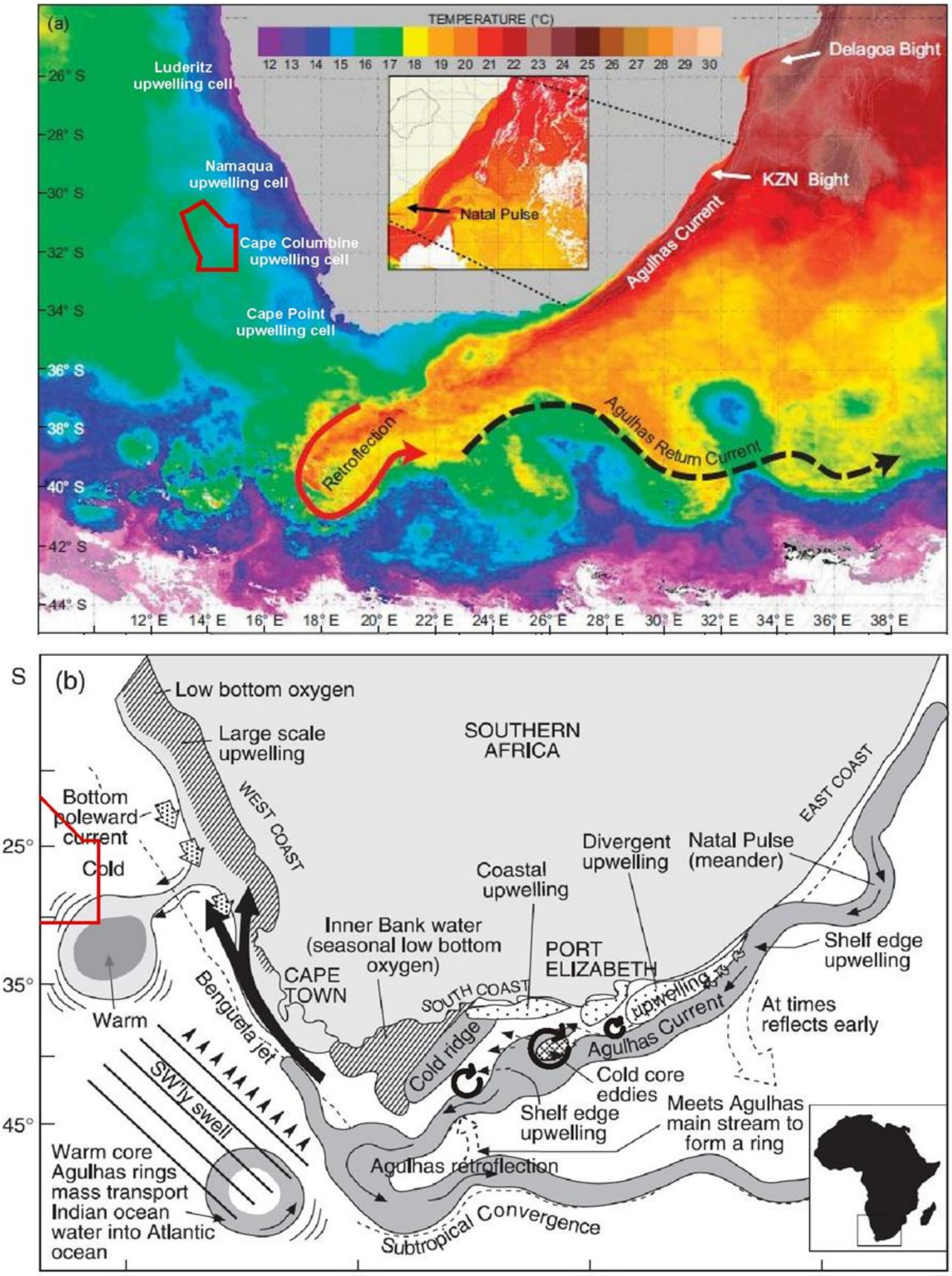


Figure 11: (a) Satellite sea-surface temperature image showing the predominance of the warm Agulhas Current along the South African south coast and the colder upwelled water on the west coast, and (b) physical processes and features associated with the Southwest Coast in relation to the 3D survey area.

Where the Agulhas Current passes the southern tip of the Agulhas Bank (Agulhas Retroflection area), it may shed a filament of warm surface water that moves north-westward along the shelf edge towards Cape Point, and Agulhas Rings, which similarly move north-westwards into the South Atlantic Ocean. These rings may extend to the seafloor and west of Cape Town may split, disperse or join with other rings. During the process of ring formation, intrusions of cold subantarctic water moves into the South Atlantic. The contrast in warm (nutrient-poor) and cold (nutrient-rich) water is thought to be reflected in the presence of cetaceans and large migratory pelagic fish species (Best, 2007). The survey area lies offshore of 15°E on the outer edge of these features.

8.3.2 WAVES AND TIDES

Most of the west coast of southern Africa is classified as exposed, experiencing strong wave action, rating between 13-17 on the 20-point exposure scale. Much of the coastline is therefore impacted by heavy south-westerly swells generated in the roaring forties, as well as significant sea waves generated locally by the prevailing moderate to strong southerly winds characteristic of the region (**Figure 12** below). The peak wave energy periods fall in the range 9.7 – 15.5 seconds.

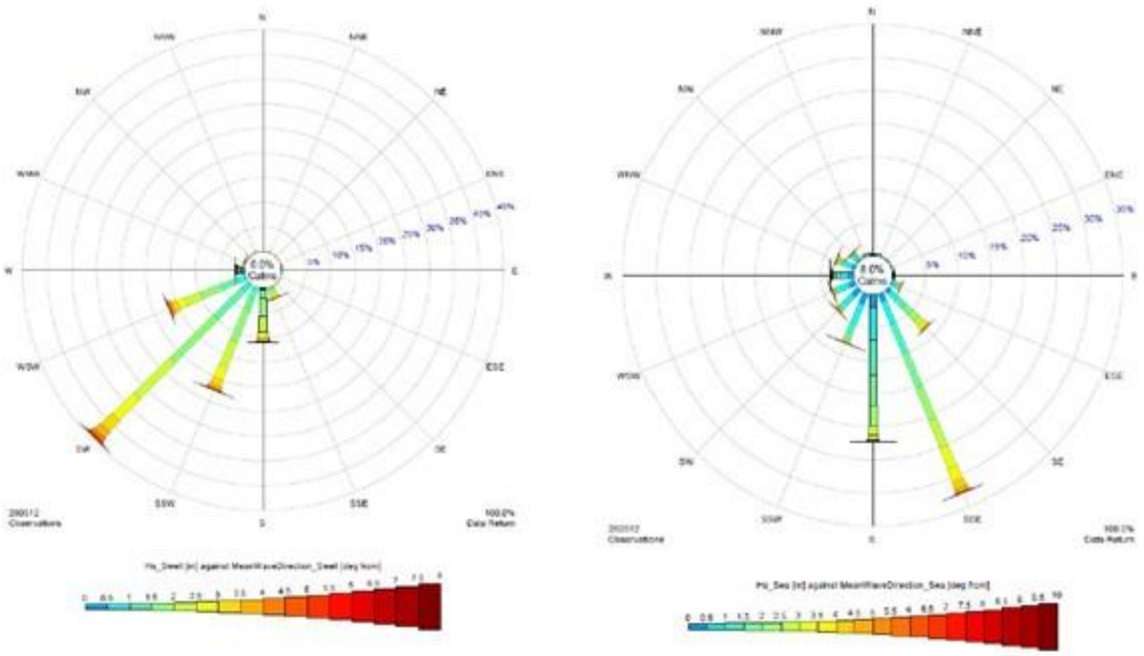


Figure 12: Annual rose plots of significant wave height partitions of swell (left) and wind-sea (right) for GROW1012 hind cast data at location 15°E, 31°S.

The wave regime along the southern African west coast shows only moderate seasonal variation in direction, with virtually all swells throughout the year coming from the S and SSW direction. Winter swells are strongly dominated by those from the S and SSW, which occur almost 80% of the time, and typically exceed 2 m in height, averaging about 3 m, and often attaining over 5 m. With wind speeds capable of reaching 100 km/h during heavy winter south-westerly storms, winter swell heights can exceed 10 m.

In comparison, summer swells tend to be smaller on average, typically around 2 m, not reaching the maximum swell heights of winter. There is also a slightly more pronounced southerly swell component in summer. These southerly swells tend to be wind-induced, with shorter wave periods (~8 seconds), and are generally steeper than swell waves. These wind-induced southerly waves are relatively local and, although less powerful, tend to work together with the strong southerly winds of summer to cause the northward-flowing nearshore surface currents, and result in substantial nearshore sediment mobilisation, and northwards transport, by the combined action of currents, wind and waves. In common with the rest of the southern African coast, tides are semi-diurnal, with a total range of some 1.5 m at spring tide, but only 0.6 m during neap tide periods.

8.3.3 WATER

South Atlantic Central Water (SACW) comprises the bulk of the seawater in the study area, either in its pure form in the deeper regions, or mixed with previously upwelled water of the same origin on the continental shelf. Salinities range between 34.5‰ and 35.5‰.

Seawater temperatures on the continental shelf of the southern Benguela typically vary between 6°C and 16°C. Well-developed thermal fronts exist, demarcating the seaward boundary of the upwelled water. Upwelling filaments are characteristic of these offshore thermal fronts, occurring as surface streamers of cold water, typically 50 km wide and extending beyond the normal offshore extent of the upwelling cell. Such fronts typically have a lifespan of a few days to a few weeks, with the filamentous mixing area extending up to 625 km offshore.

The continental shelf waters of the Benguela system are characterised by low oxygen concentrations, especially on the bottom. SACW itself has depressed oxygen concentrations (~80% saturation value), but lower oxygen concentrations (<40% saturation) frequently occur. Nutrient concentrations of upwelled water of the Benguela system attain 20 µM nitrate-nitrogen, 1.5 µM phosphate and 15-20 µM silicate, indicating nutrient enrichment. This is mediated by nutrient regeneration from biogenic material in the sediments. Modification of these peak concentrations depends upon phytoplankton uptake, which varies according to phytoplankton biomass and production rate. The range of nutrient concentrations can thus be large but, in general, concentrations are high.

8.3.4 UPWELLING AND PLANKTON PRODUCTION

The cold, upwelled water is rich in inorganic nutrients, the major contributors being various forms of nitrates, phosphates and silicates. During upwelling the comparatively nutrient-poor surface waters are displaced by enriched deep water, supporting substantial seasonal primary phytoplankton production. This, in turn, serves as the basis for a rich food chain up through zooplankton, pelagic baitfish (anchovy, pilchard, round-herring and others), to predatory fish (hake and snoek), mammals (primarily seals and dolphins) and seabirds (jackass penguins, cormorants, pelicans, terns and others). High phytoplankton productivity in the upper layers again depletes the nutrients in these surface waters. This results in a wind-related cycle of plankton production, mortality, sinking of plankton detritus and eventual nutrient re-enrichment occurring below the thermocline as the phytoplankton decays. The eastern boundary of the survey area is located to the west of the offshore influence of these coastal upwelling events and although waters are expected to be comparatively warm and nutrient poor, seasonal upwelling inshore of the Reconnaissance Permit Area can be expected.

8.3.5 ORGANIC INPUTS

The Benguela upwelling region is an area of particularly high natural productivity, with extremely high seasonal production of phytoplankton and zooplankton. These plankton blooms in turn serve as the basis for a rich food chain up through pelagic baitfish (anchovy, pilchard, round-herring and others), to predatory fish (snoek), mammals (primarily seals and dolphins) and seabirds (jackass penguins, cormorants, pelicans, terns and others). All of these species are subject to natural mortality, and a proportion of the annual production of all these trophic levels, particularly the plankton communities, die naturally and sink to the seabed.

Balanced multispecies ecosystem models have estimated that during the 1990s the Benguela region supported biomasses of 76.9 tons/km^2 of phytoplankton and 31.5 tons/km^2 of zooplankton alone. Thirty six percent of the phytoplankton and 5% of the zooplankton are estimated to be lost to the seabed annually. This natural annual input of millions of tons of organic material onto the seabed off the southern African West Coast has a substantial effect on the ecosystems of the Benguela region. It provides most of the food requirements of the particulate and filter-feeding benthic communities that inhabit the sandy-muds of this area, and results in the high organic content of the muds in the region. As most of the organic detritus is not directly consumed, it enters the seabed decomposition cycle, resulting in subsequent depletion of oxygen in deeper waters.

An associated phenomenon ubiquitous to the Benguela system are red tides (dinoflagellate and/or ciliate blooms). Also referred to as Harmful Algal Blooms (HABs), these red tides can reach very large proportions, extending over several square kilometres of ocean. Toxic dinoflagellate species can cause extensive mortalities of fish and shellfish through direct poisoning, while degradation of organic-rich material derived from both toxic and non-toxic blooms results in oxygen depletion of subsurface water. Being associated primarily with upwelling cells, HABs may occur in inshore of the survey area but would not be expected in the proposed 3D survey area.

8.3.6 LOW OXYGEN EVENTS

The continental shelf waters of the Benguela system are characterised by low oxygen concentrations with <40% saturation occurring frequently. The low oxygen concentrations are attributed to nutrient remineralisation in the bottom waters of the system. The absolute rate of this is dependent upon the net organic material build-up in the sediments, with the carbon rich mud deposits playing an important role. As the mud on the shelf is distributed in discrete patches (refer to Figure 8), there are corresponding preferential areas for the formation of oxygen-poor water. The two main areas of low-oxygen water formation in the southern Benguela region are in the Orange River Bight and St Helena Bay. The spatial distribution of oxygen-poor water in each of the areas is subject to short- and medium-term variability in the volume of hypoxic water that develops. De Decker (1970) showed that the occurrence of low oxygen water off Lambert's Bay is seasonal, with highest development in summer/autumn. Bailey & Chapman (1991), on the other hand, demonstrated that in the St Helena Bay area daily variability exists as a result of downward flux of oxygen through thermoclines and short-term variations in upwelling intensity. Subsequent upwelling processes can move this low-oxygen water up onto the inner shelf, and into nearshore waters, often with devastating effects on marine communities.

Periodic low oxygen events in the nearshore region can have catastrophic effects on the marine communities leading to large-scale stranding of rock lobsters, and mass mortalities of marine biota and fish. The development of anoxic conditions as a result of the decomposition of huge amounts of organic matter generated by phytoplankton blooms is the main cause for these mortalities and walkouts. The blooms develop over a period of unusually calm wind conditions when sea surface temperatures where high. Algal blooms usually occur during summer-autumn (February to April) but can also develop in winter during the 'berg' wind periods, when similar warm windless conditions occur for extended periods.

8.3.7 TURBIDITY

Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particulate matter. Total Suspended Particulate Matter (TSPM) can be divided into Particulate Organic Matter (POM) and Particulate Inorganic Matter (PIM), the ratios between them varying considerably. The POM usually consists of detritus, bacteria, phytoplankton and zooplankton, and serves as a source of food for filter-feeders. Seasonal microphyte production associated with upwelling events will play an important role in determining the concentrations of POM in coastal waters. PIM, on the other hand, is primarily of geological origin consisting of fine sands, silts and clays. Off Namaqualand, the PIM loading in nearshore waters is strongly related to natural inputs from the Orange River or from 'berg' wind events. Although highly variable, annual discharge rates of sediments by the Orange River is estimated to vary from 8 – 26 million tons/year. 'Berg' wind events can potentially contribute the same order of magnitude of sediment input as the annual estimated input of sediment by the Orange River. For example, a 'berg' wind event in May 1979 described by Shannon and Anderson (1982) was estimated to have transported in the order of 50 million tons of sand out to sea, affecting an area of 20 000 km^2.

Concentrations of suspended particulate matter in shallow coastal waters can vary both spatially and temporally, typically ranging from a few mg/ℓ to several tens of mg/ℓ. Field measurements of TSPM and PIM concentrations in the Benguela current system have indicated that outside of major flood events, background concentrations of coastal and continental shelf suspended sediments are generally <12 mg/ℓ, showing significant long-shore variation. Considerably higher concentrations of PIM have, however, been reported from southern African West Coast waters under stronger wave conditions associated with high tides and storms, or under flood conditions. In the vicinity of the Orange River mouth, where river outflow strongly influences the turbidity of coastal waters, measured concentrations ranged from 14.3 mg/ℓ at Alexander Bay just south of the mouth to peak values of 7 400 mg/ℓ immediately upstream of the river mouth during the 1988 Orange River flood.

The major source of turbidity in the swell-influenced nearshore areas off the West Coast is the redistribution of fine inner shelf sediments by long-period Southern Ocean swells. The current velocities typical of the Benguela (10-30 cm/s) are capable of resuspending and transporting considerable quantities of sediment equatorward.

Under relatively calm wind conditions, however, much of the suspended fraction (silt and clay) that remains in suspension for longer periods becomes entrained in the slow poleward undercurrent.

Superimposed on the suspended fine fraction, is the northward littoral drift of coarser bedload sediments, parallel to the coastline. This northward, nearshore transport is generated by the predominantly south-westerly swell and wind-induced waves. Longshore sediment transport varies considerably in the shore-perpendicular dimension, being substantially higher in the surf-zone than at depth, due to high turbulence and convective flows associated with breaking waves, which suspend and mobilise sediment.

On the inner and middle continental shelf, the ambient currents are insufficient to transport coarse sediments typical of those depths, and re-suspension and shoreward movement of these by wave-induced currents occur primarily under storm conditions. Data from a Waverider buoy at Port Nolloth have indicated that 2-m waves are capable of re-suspending medium sands (200 µm diameter) at ~10 m depth, whilst 6-m waves achieve this at ~42 m depth. Low-amplitude, long-period waves will, however, penetrate even deeper. Most of the sediment shallower than 90 m can therefore be subject to re-suspension and transport by heavy swells. Offshore of the continental shelf, the oceanic waters are typically clear as they are beyond the influence of aeolian and riverine inputs.

8.4 BIOLOGICAL ENVIRONMENT

This section provides a description of the biological characteristics of the application area. The information has been sourced from the Marine Ecological Study undertaken by Pisces Environmental Services (Pty) Ltd included in **Appendix C**.

Biogeographically, the study area falls into the cold temperate Namaqua Bioregion, which extends from Sylvia Hill, north of Lüderitz in Namibia to Cape Columbine. The survey area and proposed 3D survey area fall into the Southeast Atlantic Deep Ocean Ecoregion (**Figure 13**). The coastal, wind-induced upwelling characterising the western Cape coastline, is the principle physical process which shapes the marine ecology of the southern Benguela region. The Benguela system is characterised by the presence of cold surface water, high biological productivity, and highly variable physical, chemical and biological conditions.

Communities within marine habitats are largely ubiquitous throughout the southern African West Coast region, being particular only to substrate type or depth zone. These biological communities consist of many hundreds of species, often displaying considerable temporal and spatial variability (even at small scales). The offshore marine ecosystems comprise a limited range of habitats, namely unconsolidated seabed sediments, deep water reefs and the water column. The biological communities 'typical' of these habitats are described briefly below, focussing both on dominant, commercially important and conspicuous species, as well as potentially threatened or sensitive species, which may be affected by the proposed survey activities.

8.4.1 DEMERSAL[g] COMMUNITIES

8.4.1.1 BENTHIC INVERTEBRATE MACROFAUNA

The seabed communities in the survey area lie within the Namaqua sub-photic and continental slope biozones, which extend from a 30 m depth to the shelf edge, and beyond to the lower deepsea slope, respectively. The benthic habitats of South Africa were mapped as part of the 2018 National Biodiversity Assessment to develop assessments of the ecosystem threat status and ecosystem protection level. The benthic ecosystem types were subsequently mapped (**Figure 14**) and assigned an ecosystem threat status based on their level of protection. The 3D survey area is characterised by a limited variety of ecosystem types covering the mid- and lower shelves, the Southeast Atlantic continental slope and the Cape Basin Abyss.

The benthic biota of unconsolidated marine sediments constitute invertebrates that live on (epifauna) or burrow within (infauna) the sediments, and are generally divided into macrofauna (animals >1 mm) and meiofauna (<1 mm). Numerous studies have been conducted on southern African West Coast continental shelf benthos, mostly focused on mining, pollution or demersal trawling impacts. These studies, however, concentrated on the

[g] Fish living close to the floor of the sea

continental shelf and nearshore regions, and consequently the benthic fauna of the outer shelf and continental slope (beyond ~450 m depth) are very poorly known. This is primarily due to limited opportunities for sampling as well as the lack of access to Remote Operated Vehicles (ROVs) for visual sampling of hard substrata.

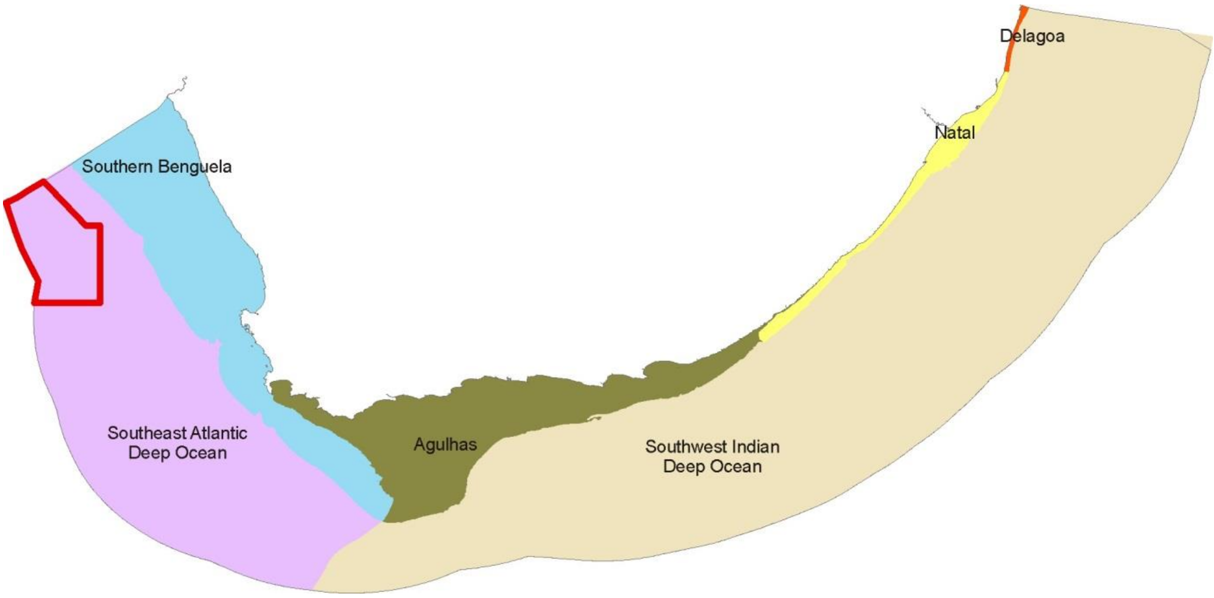


Figure 13: Proposed 3D survey area in relation to the inshore and offshore ecoregions of the South African West Coast.

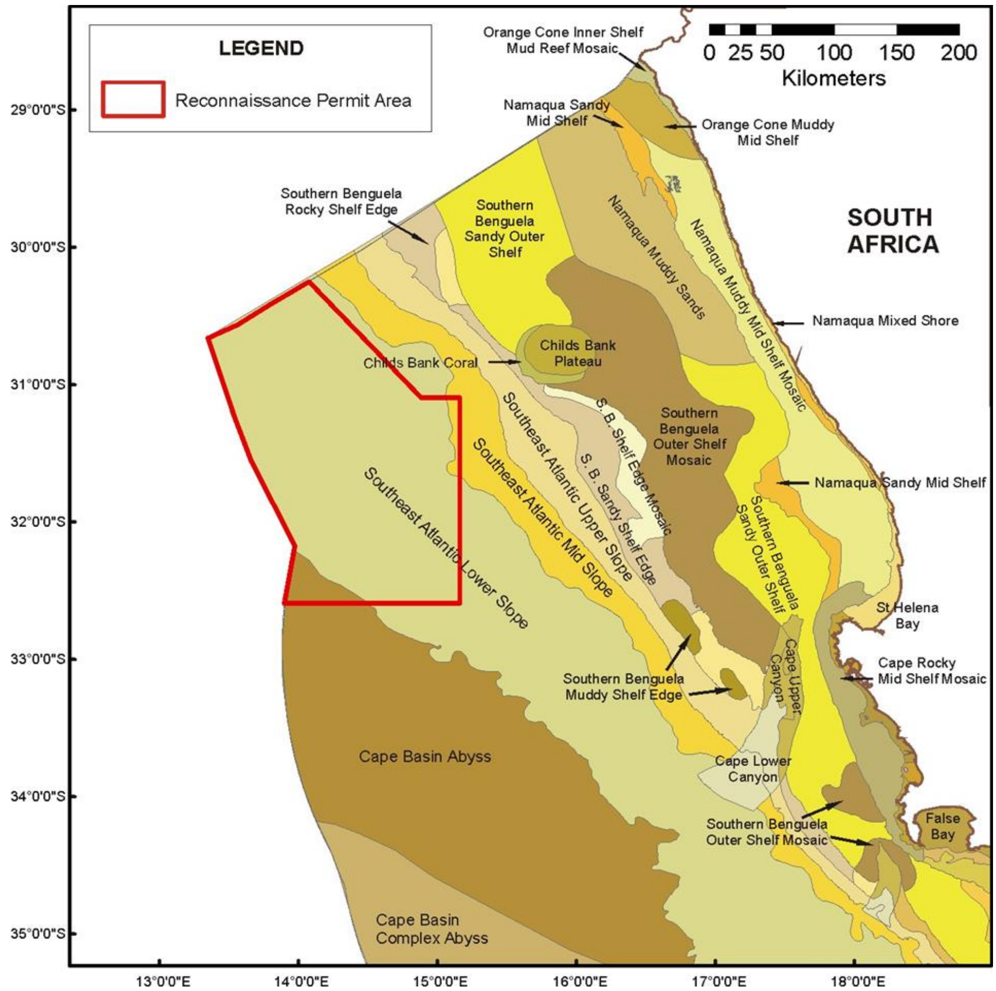


Figure 14: Proposed 3D survey area in relation to the distribution of ecosystem types along the West Coast.

To date very few areas on the continental slope off the West Coast have been biologically surveyed. Although sediment distribution studies suggest that the outer shelf is characterised by unconsolidated sediments (see **Figure 8**), recent surveys conducted between 180 m and 480 m depth revealed high proportions of hard ground rather than unconsolidated sediment, although this requires further verification. To date there have been no studies examining connectivity between slope, plateau or abyssal ecosystems in South Africa and there is thus limited knowledge on the benthic biodiversity of all three of these broad ecosystem groups in South African waters. There is no quantitative data describing bathyal ecosystems in South Africa and hence limited understanding of ecosystem functioning and sensitivity. Due to the lack of information on benthic macrofaunal communities beyond the shelf break, no description can be provided for the offshore portions of the proposed 3D survey area.

Three macro-infauna communities have been identified on the inner- (0-30 m depth) and mid-shelf (30-150 m depth). Polychaetes, crustaceans and molluscs make up the largest proportion of individuals, biomass and species on the west coast. The inner-shelf community, which is affected by wave action, is characterised by various mobile gastropod and polychaete predators and sedentary polychaetes and isopods. The mid-shelf community inhabits the mudbelt and is characterised by mud prawns. A second mid-shelf community occurring in sandy sediments, is characterised by various deposit-feeding polychaetes. The distribution of species within these communities are inherently patchy reflecting the high natural spatial and temporal variability associated with macro-infauna of unconsolidated sediments, with evidence of mass mortalities and substantial recruitments recorded on the South African West Coast.

Despite the current lack of knowledge of the community structure and endemicity of South African macro-infauna off the edge of the continental shelf, the marine component of the 2018 National Biodiversity Assessment, rated the South Atlantic bathyal and abyssal unconsolidated habitat types that characterise depths beyond 500 m, as being of 'Least concern' (**Figure 15**), with only those communities occurring along the shelf edge (-500 m) being considered 'Vulnerable'. This primarily reflects the great extent of these habitats in the EEZ.

Generally, species richness increases from the inner-shelf across the mid-shelf and is influenced by sediment type. The highest total abundance and species diversity was measured in sandy sediments of the mid-shelf. Biomass is highest in the inshore (± 50 g/m^2 wet weight) and decreases across the mid-shelf averaging around 30 g/m^2 wet weight. This is contrary to Christie (1974) who found that biomass was greatest in the mudbelt at 80 m depth off Lamberts Bay, where the sediment characteristics and the impact of environmental stressors (such as low oxygen events) are likely to differ from those off the northern Namaqualand coast.

Benthic communities are structured by the complex interplay of a large array of environmental factors. Water depth and sediment grain size are considered the two major factors that determine benthic community structure and distribution on the South African west coast and elsewhere in the world. However, studies have shown that shear bed stress – a measure of the impact of current velocity on sediment – oxygen concentration, productivity, organic carbon and seafloor temperature may also strongly influence the structure of benthic communities. There are clearly other natural processes operating in the deep-water shelf areas of the West Coast that can over-ride the suitability of sediments in determining benthic community structure, and it is likely that periodic intrusion of low oxygen water masses is a major cause of this variability. In areas of frequent oxygen deficiency, benthic communities will be characterised either by species able to survive chronic low oxygen conditions or colonising and fast-growing species able to rapidly recruit into areas that have suffered oxygen depletion. The combination of local, episodic hydrodynamic conditions and patchy settlement of larvae will tend to generate the observed small-scale variability in benthic community structure.

Information on the benthic fauna of the lower continental slope and abyss (beyond 1 800 m depth) is largely lacking due to limited opportunities for sampling. However, deep water benthic sampling was undertaken as part of the Environmental Baseline Survey for Total E&P Namibia's Block 2913B just to the north of the survey area. This provided valuable information on the benthic infaunal communities of the lower continental slope. As conditions in such deep-water habitats tend to be more uniform (low temperatures and low oxygen concentrations characterising the SACW that comprises the bulk of the water in the area), similar communities may be expected in the survey area.

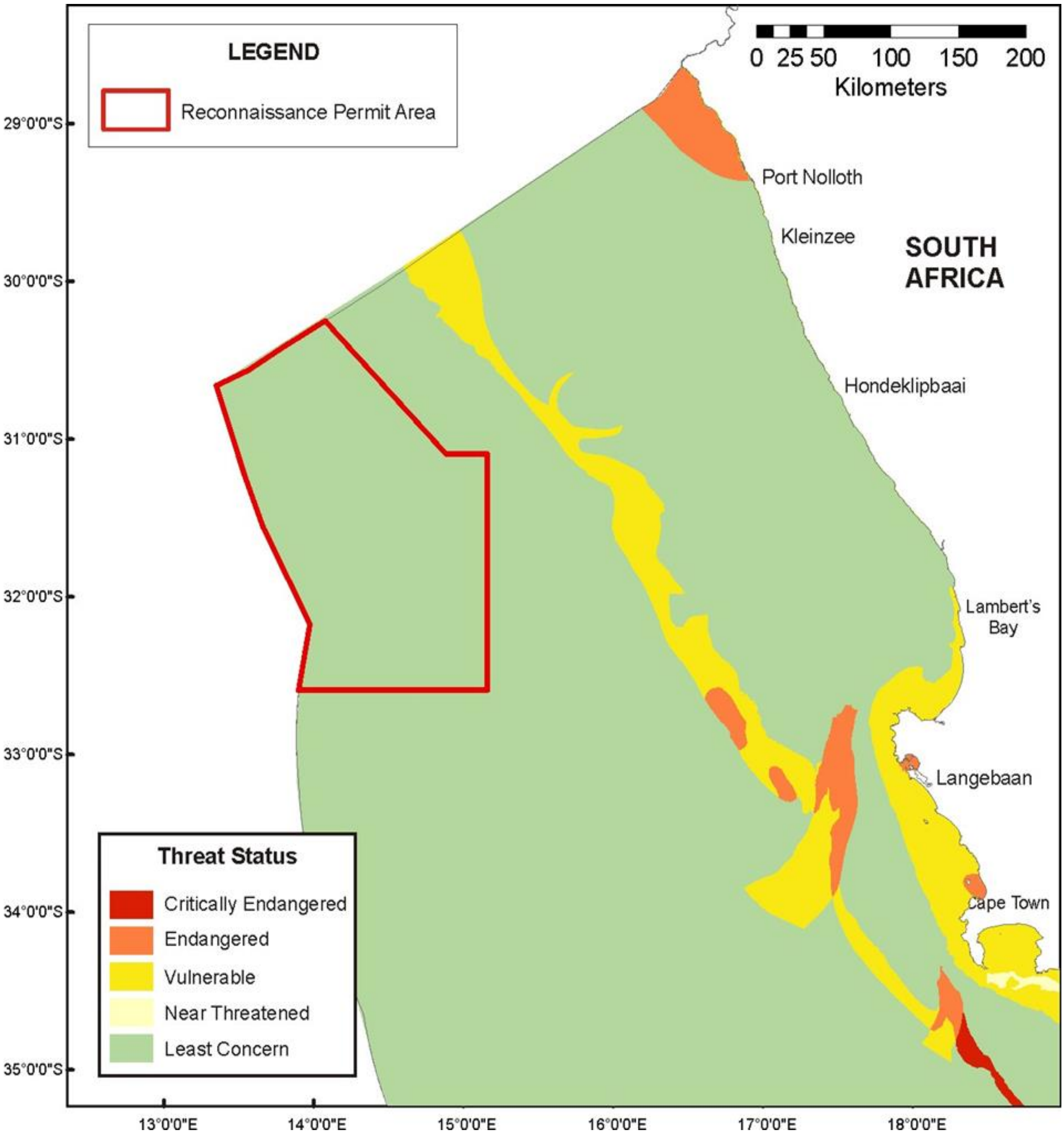


Figure 15: The survey area in relation to the ecosystem threat status for coastal and offshore benthic and pelagic habitat types on the South African West Coast

The macrofauna in Block 2913B were generally impoverished but fairly consistent, which is typical for deep water sediments. The 105 species recorded, were dominated by polychaetes, which accounted for 64.1% of the total individuals. Molluscs were represented by 11 species (19.6% of total individuals), whilst 20 species of crustaceans were recorded (contributing to only 9.8% of total individuals). Echinoderms were represented by only 3 species (5.8% of total individuals), whilst all other groups (Actiniaria, Nemertea, Nematoda, Ascidiacea and Priapulida) accounted for the remaining 5.9% of individuals. The deposit-feeding polychaete *Spiophanes sp*. Was the most abundant species recorded. This small bristleworm can either be a passive suspension feeder or a surface deposit feeder, living off sediment particles, planktonic organisms and meiobenthic organisms. The bivalve mollusc *Microgloma mirmidina* was the second most common species, with the polychaete tentatively identified as a Leiocapitellide being the third most abundant. With the exception of the carnivorous polychaete *Glycera capitata*, most species were suspension or deposit feeders typical of soft unconsolidated sediments.

Examples of the macroinvertebrate infauna of the Block 2913B area are illustrated in **Figure 16**. A wide diversity of macroinvertebrates has been recorded inshore of the 1 000 m depth contour. The 2018 National Biodiversity Assessment for the marine environment points out that very few national IUCN Red List assessments have been conducted for marine invertebrate species to date owing to inadequate taxonomic knowledge, limited distribution data, a lack of systematic surveys and limited capacity to advance species red listing for these groups.

8.4.1.2 DEEP-WATER CORAL COMMUNITIES

There has been increasing interest in deep-water corals in recent years because of their likely sensitivity to disturbance and their long generation times. These benthic filter-feeders generally occur at depths in below 150 m with some species being recorded from as deep as 3 000 m. Some species form reefs while others are smaller and remain solitary. Corals add structural complexity to otherwise uniform seabed habitats thereby creating areas of high biological diversity. Deep water corals establish themselves below the thermocline where there is a continuous and regular supply of concentrated particulate organic matter, caused by the flow of a relatively strong current over special topographical formations which cause eddies to form. Nutrient seepage from the substratum might also promote a location for settlement. In the productive Benguela region, substantial areas on and off the edge of the shelf should thus potentially be capable of supporting rich, cold water, benthic, filter-feeding communities, and various species of scleractine and stylastrine corals have been reported from depths beyond -200 m in the Orange Basin.

Such communities would also be expected with topographic features such as seamounts located adjacent to the northern and western boundary of the survey area. Nonetheless, our understanding of the invertebrate fauna of the sub-photic zone is relatively poor and the conservation status of the majority of invertebrates in this bioregion is not known.

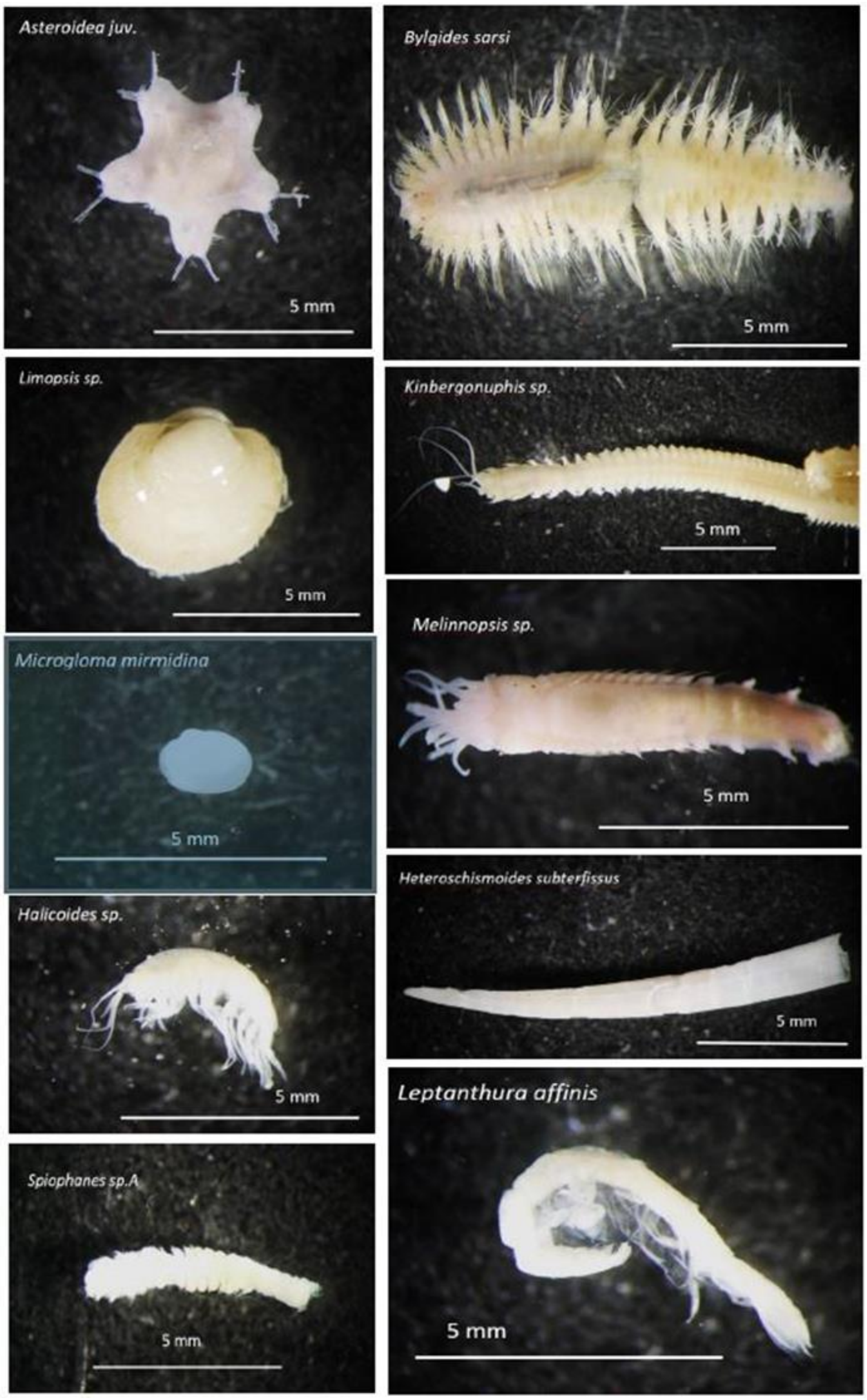


Figure 16: Examples of macroinvertebrates recorded in Block 2913B to the north of the survey area.

8.4.1.3 DEMERSAL FISH SPECIES

Demersal fish are those species that live and feed on or near the seabed. As many as 110 species of bony and cartilaginous fish have been identified in the demersal communities on the continental shelf of the West Coast. Changes in fish communities occur both latitudinally and with increasing depth, with the most substantial change in species composition occurring in the shelf break region between 300 m and 400 m depth. The shelf community (<380 m) is dominated by the Cape hake *M. capensis*, and includes *jacopever Helicolenus dactylopterus*, Izak catshark *Holohalaelurus regain*, soupfin shark *Galeorhinus galeus* and whitespotted houndshark *Mustelus palumbes*. The more diverse deeper water community is dominated by the deepwater hake *Merluccius paradoxus*, monkfish *Lophius vomerinus*, kingklip *Genypterus capensis*, bronze whiptail *Lucigadus ori* and hairy conger *Bassanago albescens* and various squalid shark species. There is some degree of species overlap between the depth zones.

Roel (1987) showed seasonal variations in the distribution ranges shelf communities, with species such as the pelagic goby *Sufflogobius bibarbatus*, and West Coast sole *Austroglossus microlepis* occurring in shallow water north of Cape Point during summer only. The deep-sea community was found to be homogenous both spatially and temporally. In a more recent study, however, Atkinson (2009) identified two long-term community shifts in demersal fish communities; the first (early to mid-1990s) being associated with an overall increase in density of many species, whilst many species decreased in density during the second shift (mid-2000s). These community shifts correspond temporally with regime shifts detected in environmental forcing variables (Sea Surface Temperatures and upwelling anomalies and with the eastward shifts observed in small pelagic fish species and rock lobster populations. The species that may occur in the general project area and on the continental shelf inshore thereof, and their approximate depth range, are listed in **Table 7**.

Table 7: Demersal cartilaginous species found on the continental shelf along the West Coast, with approximate depth range at which the species occurs.

Common Name	Scientific name	Depth Range (m)	IUCN Conservation Status
Frilled shark	*Chlamydoselachus anguineus*	200-1 000	LC
Six gill cowshark	*Hexanchus griseus*	150-600	NT
Gulper shark	*Centrophorus granulosus*	480	EN
Leafscale gulper shark	*Centrophorus squamosus*	370-800	EN
Bramble shark	*Echinorhinus brucus*	55-285	EN
Black dogfish	*Centroscyllium fabricii*	>700	LC
Portuguese shark	*Centroscymnus coelolepis*	>700	NT
Longnose velvet dogfish	*Centroscymnus crepidater*	400-700	NT
Birdbeak dogfish	*Deania calcea*	400-800	NT
Arrowhead dogfish	*Deania profundorum*	200-500	NT
Longsnout dogfish	*Deania quadrispinosum*	200-650	VU
Sculpted lanternshark	*Etmopterus brachyurus*	450-900	DD
Brown lanternshark	*Etmopterus compagnoi*	450-925	LC
Giant lanternshark	*Etmopterus granulosus*	>700	LC
Smooth lanternshark	*Etmopterus pusillus*	400-500	LC
Spotted spiny dogfish	*Squalus acanthias*	100-400	VU
Shortnose spiny dogfish	*Squalus megalops*	75-460	LC
Shortspine spiny dogfish	*Squalus mitsukurii*	150-600	EN
Sixgill sawshark	*Pliotrema warreni*	60-500	LC
Goblin shark	*Mitsukurina owstoni*	270-960	LC
Smalleye catshark	*Apristurus microps*	700-1 000	LC
Saldanha catshark	*Apristurus saldanha*	450-765	LC
“grey/black wonder” catsharks	*Apristurus spp.*	670-1 005	LC
Tigar catshark	*Halaelurus natalensis*	50-100	VU
Izak catshark	*Holohalaelurus regani*	100-500	LC
Yellowspotted catshark	*Scyliorhinus capensis*	150-500	NT

Common Name	Scientific name	Depth Range (m)	IUCN Conservation Status
Soupfin shark/Vaalhaai	*Galeorhinus galeus*	<10-300	CR (EN)
Houndshark	*Mustelus mustelus*	<100	EN (DD)
Whitespotted houndshark	*Mustelus palumbes*	>350	LC
Little guitarfish	*Rhinobatos annulatus*	>100	VU (LC)
Atlantic electric ray	*Torpedo nobiliana*	120-450	LC
African softnose skate	*Bathyraja smithii*	400-1 020	LC
Smoothnose legskate	*Cruriraja durbanensis*	>1 000	DD
Roughnose legskate	*Crurirajaparcomaculata*	150-620	LC
African dwarf skate	*Neoraja stehmanni*	290-1 025	LC
Thorny skate	*Raja radiata*	50-600	VU
Bigmouth skate	*Raja robertsi*	>1 000	LC
Slime skate	*Raja pullopunctatus*	15-460	LC
Rough-belly skate	*Raja springeri*	85-500	LC
Yellowspot skate	*Raja wallacei*	70-500	VU
Roughskin skate	*Raja spinacidermis*	1 000-1 350	EN
Biscuit skate	*Raja clavata*	25-500	NT
Munchkin skate	*Raja caudaspinosa*	300-520	LC
Bigthorn skate	*Raja confundens*	100-800	LC
Ghost skate	*Raja dissimilis*	420-1 005	LC
Leopard skate	*Raja leopardus*	300-1 000	LC
Smoothback skate	*Raja ravidula*	500-1 000	LC
Spearnose skate	*Raja alba*	75-260	EN
St Joseph	*Callorhinchus capensis*	30-380	LC (LC)
Cape chimaera	*Chimaera sp.*	680-1 000	LC
Brown chimaera	*Hydrolagus sp.*	420-850	LC
Spearnose chimaera	*Rhinochimaera atlantica*	650-960	LC
LC – Least Concern	**VU – Vulnerable**	**NT – Near Threatened**	
EN – Endangered	**CR – Critically Endangered**	**DD – Data Deficient**	

8.4.1.4 SEAMOUNT COMMUNITIES

Features such as banks, knolls and seamounts (referred to collectively here as “seamounts”), which protrude into the water column, are subject to, and interact with, the water currents surrounding them. The effects of such seabed features on the surrounding water masses can include the up-welling of relatively cool, nutrient-rich water into nutrient-poor surface water thereby resulting in higher productivity, which can in turn strongly influences the distribution of organisms on and around seamounts. Evidence of enrichment of bottom-associated communities and high abundances of demersal fishes has been regularly reported over such seabed features.

The enhanced fluxes of detritus and plankton that develop in response to the complex current regimes lead to the development of detritivore-based food-webs, which in turn lead to the presence of seamount scavengers and predators. Seamounts provide an important habitat for commercial deepwater fish stocks such as orange roughy, oreos, alfonsino and Patagonian toothfish, which aggregate around these features for either spawning or feeding.

Such complex benthic ecosystems in turn enhance foraging opportunities for many other predators, serving as mid-ocean focal points for a variety of pelagic species with large ranges (turtles, tunas and billfish, pelagic sharks, cetaceans and pelagic seabirds) that may migrate large distances in search of food or may only congregate on seamounts at certain times. Seamounts thus serve as feeding grounds, spawning and nursery grounds and possibly navigational markers for a large number of species.

Enhanced currents, steep slopes and volcanic rocky substrata, in combination with locally generated detritus, favour the development of suspension feeders in the benthic communities characterising seamounts. Deep- and cold-water corals (including stony corals, black corals and soft corals) are a prominent component of the suspension-feeding fauna of many seamounts, accompanied by barnacles, bryozoans, polychaetes, molluscs, sponges, sea squirts, basket stars, brittle stars and crinoids. There is also associated mobile benthic fauna that includes echinoderms (sea urchins and sea cucumbers) and crustaceans (crabs and lobsters). Some of the smaller cnidarians species remain solitary while others form reefs thereby adding structural complexity to otherwise uniform seabed habitats.

Consequently, the fauna of seamounts is usually highly unique and may have a limited distribution restricted to a single geographic region, a seamount chain or even a single seamount location. As a result of conservative life histories (i.e. very slow growing, slow to mature, high longevity, low fecundity and unpredictable recruitment) and sensitivity to changes in environmental conditions, such biological communities have been identified as Vulnerable Marine Ecosystems (VMEs). They are recognised as being particularly sensitive to anthropogenic disturbance (primarily deep-water trawl fisheries and mining), and once damaged are very slow to recover, or may never recover.

Geological features of note within the broader project area are Child’s Bank and Tripp Seamount, with an unnamed seamount located in ~3 500 m at ~32°20’S; 13°30’E, as well as the Cape Canyon and Cape Point Valley. Child’s Bank, which is situated at about 31°S, was described by Dingle et al. (1987) to be a carbonate mound (bioherm). The top of this feature is a sandy plateau with dense aggregations of brittle stars, while the steeper slopes have dense invertebrate assemblages including unidentified cold-water corals/rugged limestone feature, bounded at outer edges by precipitous cliffs at least 150 m high. Composed of sediments and the calcareous deposits from an accumulation of carbonate skeletons of sessile organisms (e.g. cold-water coral, foraminifera or marl), such features typically have topographic relief, forming isolated seabed knolls in otherwise low profile homogenous seabed habitats. Tripp Seamount situated at about 29°40’S, lies ~30 km north of the northern boundary of the survey area. It rises from the seabed at ~1 000 m to a depth of 150 m and roughly circular with a flat apex that drops steeply on all sides. There is reference to decapods crustaceans from Tripp Seamount and exploratory deep-water trawl fishing, but otherwise knowledge of benthic communities characterising this seamount is lacking.

The Cape Rise comprises a group of NE-SW trending seamounts – the Southeast Atlantic Seamounts – which include Argentina and Protea Seamounts and the recently discovered Mount Marek. These rise up from over -2 500 m depth in the Cape Basin abyss to 700 m deep. Other than a geoscience survey conducted in 1986 using a deep-water camera to sample the lower bathyal and abyssal zones, including the seamount flanks, of the Cape Basin no biodiversity surveys are known to have been conducted at Protea and Argentina seamounts. Southern Africa’s seamounts and their associated benthic communities have not been sampled by either geologists or biologists and little is known about the benthic and neritic communities associated with them.

A recent study reporting on the megabenthos and benthopelagic fish on the Southeast Atlantic Seamounts, provides descriptions of the Erica and Schmitt-Ott Seamounts that lie approximately 450 – 500 km southwest of the Argentina Seamount and rise from the surrounding abyss to depths of 770 m and 920 m, respectively (Bergstad et al., 2019). Corals were the most frequent and widespread sessile invertebrate recorded on video transects, dominated by gorgonians whose abundance increased towards the seamount summits. Scleractinian and hydrocorals were also observed as was a diversity of sponges, echinoderms and crustaceans. Fish associated with the seamount included oreo dories, grenadiers and lanternshark. Similar communities might therefore be expected from the Protea and Argentina Seamounts.

During 2016-2018 the Department of Environmental Affairs: Oceans and Coast Branch (DEA: O&C) undertook research cruises to explore some of the undocumented areas of seabed off the West Coast, among them the

Cape Canyon. Using tow-cameras, benthic grabs and dredges, the biota of the canyon head to -500 m depth were sampled. A diversity of echinoderms, molluscs, and crustaceans were reported to dominate the canyon head, while scavengers such as ophuiroidea and decapoda were prevalent within habitats, ranging from sandy areas, to patches of inshore and offshore mud belts. At depths of <100 m inshore of the canyon head, boulder beds hosted gorgonian and stylasterine corals.

Figure 17: Deep water benthic macrofauna from various depths in the Cape Canyon.

The concept of a 'Vulnerable Marine Ecosystem' centres upon the presence of distinct, diverse benthic assemblages that are limited and fragmented in their spatial extent, and dominated (in terms of biomass and/or spatial cover) by rare, endangered or endemic component species that are physically fragile and vulnerable to damage (or structural/biological alteration) by human activities.

VMEs are known to be associated with higher biodiversity levels and indicator species that add structural complexity, resulting in greater species abundance, richness, biomass and diversity compared to surrounding uniform seabed habitats. Compared to the surrounding deep-sea environment, VMEs typically form biological hotspots with a distinct, abundant and diverse fauna, many species of which remain unidentified. Levels of endemism on VMEs are also relatively high compared to the deep sea. The coral frameworks offer refugia for a great variety of invertebrates and fish (including commercially important species) within, or in association with, the living and dead coral framework thereby creating spatially fragmented areas of high biological diversity. The skeletal remains of Scleractinia coral rubble and Hexactinellid poriferans can also represent another important deep-sea habitat, acting to stabilise seafloor sediments allowing for colonisation by distinct infaunal taxa that show elevated abundance and biomass in such localised habitats.

VMEs are also thought to contribute toward the long-term viability of a stock through providing an important source of habitat for commercial species. They can provide a wide range of ecosystem services ranging from provision of aggregation- and spawning sites to providing shelter from predation and adverse hydrological conditions. Indicator taxa for VMEs are also known to provide increased access to food sources, both directly to associated benthic fauna, and indirectly to other pelagic species such as fish and other predators due to the high abundance and biomass of associated fauna.

VME frameworks are typically elevated from the seabed, increasing turbulence and raising supply of suspended particles to suspension feeders. Poriferans and cold-water corals have further been shown to provide a strong link between pelagic and benthic food webs. VMEs are increasingly being recognised as providers of important ecosystem services due to associated increased biodiversity and levels of ecosystem functioning.

It is not always the case that seamount habitats are VMEs, as some seamounts may not host communities of fragile animals or be associated with high levels of endemism. Evidence from video footage taken on hard-substrate habitats in 100 – 120 m depth off southern Namibia and to the south-east of Child's Bank (**Figure 18**), and in 190-527 m depth on Child's Bank suggest that vulnerable communities including gorgonians, octocorals and reef-building sponges and hard-corals do occur on the continental shelf, some of which are thought to be Vulnerable Marine Ecosystem (VME) indicator species (**Table 8).** The distribution of 22 potential VME indicator taxa for the South African EEZ was recently mapped, with those from the West Coast listed in **Table 8**.

As sampling beyond 1 000 m depth has not taken place it is not known whether similar communities may be expected in the survey area. The distribution of known and potential Vulnerable Marine Ecosystem habitat based on potential VME features, DFFE and South African Environmental Observation Network (SAEON) trawl survey data, and many visual surveys indicating the presence of indicator taxa were mapped by Harris *et al*. 2022. Some sites need more research to determine their status. The location of the survey area is well offshore of these known and potential VMEs emphasising the gaps in our knowledge specific to the vulnerability of marine communities of abyssal habitats. Sediment samples collected at the base of Norwegian cold-water coral reefs revealed high interstitial concentrations of light hydrocarbons (methane, propane, ethane and higher hydrocarbons C4+), which are typically considered indicative of localised light hydrocarbon micro-seepage through the seabed. Bacteria and other micro-organisms thrive on such hydrocarbon pore-water seepages, thereby providing suspension-feeders, including corals and gorgonians, with a substantial nutrient source. Some scientists believe there is a strong correlation between the occurrence of deep-water coral reefs and the relatively high values of light hydrocarbons (methane, ethane, propane and n-butane) in near-surface sediments. A recent study by January (2018) identified that hydrocarbon seeps and gas escape structures have been identified in the Orange Basin area. Large fluid seep/pockmark fields of varying morphologies were also reported to the south of the survey area.

Figure 18: Gorgonians and bryozoans communities recorded on deep-water reefs (100-120 m) off the southern African West Coast.

Table 8: Table of Potential VME species from the continental shelf and shelf edge on the West Coast

Phylum	Name	Common Name
Porifera	*Suberites dandelenae*	Amorphous solid sponge
	Rossella cf. antarctica	Glass sponge
Cnidaria	*Melithaea spp.*	Colourful sea fan

Phylum	Name	Common Name
	Thouarella spp.	Bottlebrush sea fan
Family: Isididae		Bamboo coral
	Anthoptilum grandiflorum	Large sea pen*
	Lophelia pertusa	Reef-building cold water coral
	Stylaster spp.	Fine-branching hydrocoral
Bryozoa	*Adeonella spp.*	Sabre bryozoan
	Phidoloporidae spp.	Honeycomb false lace coral
Hemichordata	*Cephalodiscus gilchristi*	Agar animal

8.4.2 PELAGIC COMMUNITIES

In contrast to demersal and benthic biota that are associated with the seabed, pelagic species live and feed in the open water column. The pelagic communities are typically divided into plankton and fish, and their main predators, marine mammals (seals, dolphins and whales), seabirds and turtles. These are discussed separately below.

8.4.2.1 PLANKTON

Plankton is particularly abundant in the shelf waters off the West Coast, being associated with the upwelling characteristic of the area. Plankton range from single-celled bacteria to jellyfish of 2-m diameter, and include bacterio-plankton, phytoplankton, zooplankton, and ichthyoplankton (**Figure 19** below).

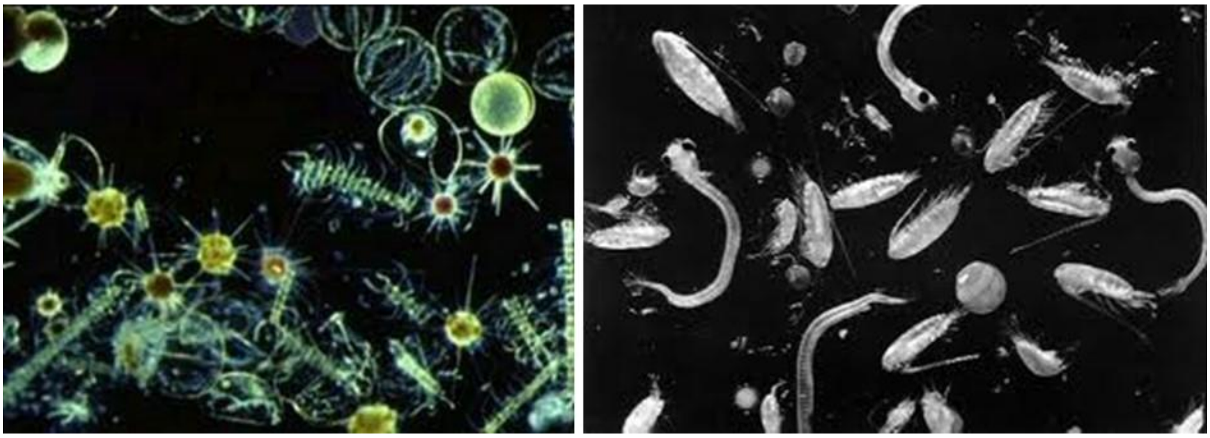


Figure 19: Phytoplankton (left) and zooplankton (right) is associated with upwelling cells.

Phytoplankton are the principle primary producers with mean productivity ranging from 2.5 – 3.5 g C/m^2/day for the midshelf region and decreasing to 1 g C/m^2/day inshore of 130 m. The phytoplankton is dominated by large-celled organisms, which are adapted to the turbulent sea conditions. The most common diatom genera are *Chaetoceros, Nitschia, Thalassiosira, Skeletonema, Rhizosolenia, Coscinodiscus and Asterionella*. Diatom blooms occur after upwelling events, whereas dinoflagellates (e.g. *Prorocentrum, Ceratium and Peridinium*) are more common in blooms that occur during quiescent periods, since they can grow rapidly at low nutrient concentrations. In the surf zone, diatoms and dinoflagellates are nearly equally important members of the phytoplankton, and some silicoflagellates are also present.

Red-tides are ubiquitous features of the Benguela system. The most common species associated with red tides (dinoflagellate and/or ciliate blooms) are *Noctiluca scintillans, Gonyaulax tamarensis, G. polygramma* and the ciliate *Mesodinium rubrum*. *Gonyaulax* and *Mesodinium* have been linked with toxic red tides. Most of these red-tide events occur quite close inshore although Hutchings et al., (1983), have recorded red-tides 30 km offshore.

The mesozooplankton (≥200 µm) is dominated by copepods, which are overall the most dominant and diverse group in southern African zooplankton. Important species are Ce*ntropages brachiatus, Calanoides carinatus,* *Metridia lucens, Nannocalanus minor, Clausocalanus arcuicornis, Paracalanus parvus, P. crassirostris* and *Ctenocalanus vanus*. All of the above species typically occur in the phytoplankton rich upper mixed layer of the water column, with the exception of *M. lucens* which undertakes considerable vertical migration.

The macrozooplankton (≥1 600 µm) are dominated by euphausiids of which 18 species occur in the area. The dominant species occurring in the nearshore are *Euphausia lucens* and *Nyctiphanes capensis*, although neither species appears to survive well in waters seaward of oceanic fronts over the continental shelf.

Standing stock estimates of mesozooplankton for the southern Benguela area range from 0.2 – 2.0 g C/m^2, with maximum values recorded during upwelling periods. Macrozooplankton biomass ranges from 0.1-1.0 g C/m^2, with production increasing north of Cape Columbine. Although it shows no appreciable onshore-offshore gradients, standing stock is highest over the shelf, with accumulation of some mobile zooplanktors (euphausiids) known to occur at oceanographic fronts. Beyond the continental slope biomass decreases markedly. Localised peaks in biomass may, however, occur in the vicinity of Child's Bank and Tripp seamount in response to topographically steered upwelling around such seabed features.

Zooplankton biomass varies with phytoplankton abundance and, accordingly, seasonal minima will exist during non-upwelling periods when primary production is lower, and during winter when predation by recruiting anchovy is high. More intense variation will occur in relation to the upwelling cycle; newly upwelled water supporting low zooplankton biomass due to paucity of food, whilst high biomasses develop in aged, upwelled water after significant development of phytoplankton. Irregular pulsing of the upwelling system, combined with seasonal recruitment of pelagic fish species into West Coast shelf waters during winter, thus results in a highly variable and dynamic balance between plankton replenishment and food availability for pelagic fish species.

Although ichthyoplankton (fish eggs and larvae) comprise a minor component of the overall plankton, it remains significant due to the commercial importance of the overall fishery in the region. Various pelagic and demersal fish species are known to spawn in the inshore regions of the southern Benguela, (including pilchard, round herring, chub mackerel lanternfish and hakes, and their eggs and larvae form an important contribution to the ichthyoplankton in the region. Spawning of key species is presented below.

- Hake, snoek and round herring move to the western Agulhas Bank and southern west coast to spawn in late winter and early spring (key period), when offshore Ekman losses are at a minimum and their eggs and larvae drift northwards and inshore to the west coast nursery grounds. **Figure 23** highlights the temporal variation in hake eggs and larvae with there being a greater concentration of eggs and larvae between September – October compared to March – April. However, hake are reported to spawn throughout the year. Snoek spawn along the shelf break (150 – 400 m) of the western Agulhas Bank and the West coast between June and October.
- Horse mackerel spawn over the east/central Agulhas Bank during winter months.
- Sardines spawn on the whole Agulhas Bank during November, but generally have two spawning peaks, in early spring and autumn, on either side of the peak anchovy spawning period (**Figure 24** left). There is also sardine spawning on the east coast and even off KwaZulu-Natal, where sardine eggs are found during July–November.
- Anchovies spawn on the whole Agulhas Bank (**Figure 24** right), with spawning peaking during mid-summer (November–December) and some shifts to the west coast in years when Agulhas Bank water intrudes strongly north of Cape Point.

The eggs and larvae are carried around Cape Point and up the coast in northward flowing surface waters. At the start of winter every year, the juveniles recruit in large numbers into coastal waters across broad stretches of the shelf between the Orange River and Cape Columbine to utilise the shallow shelf region as nursery grounds before gradually moving southwards in the inshore southerly flowing surface current, towards the major spawning grounds east of Cape Point. Following spawning, the eggs and larvae of snoek are transported to inshore (<150 m) nursery grounds north of Cape Columbine and east of Danger Point, where the juveniles remain until maturity. There is no overlap of the survey area with the northward egg and larval drift of commercially important species, and the return migration of recruits. In the offshore oceanic waters of the proposed 3D survey area, ichthyoplankton abundance is, therefore, expected to be low.

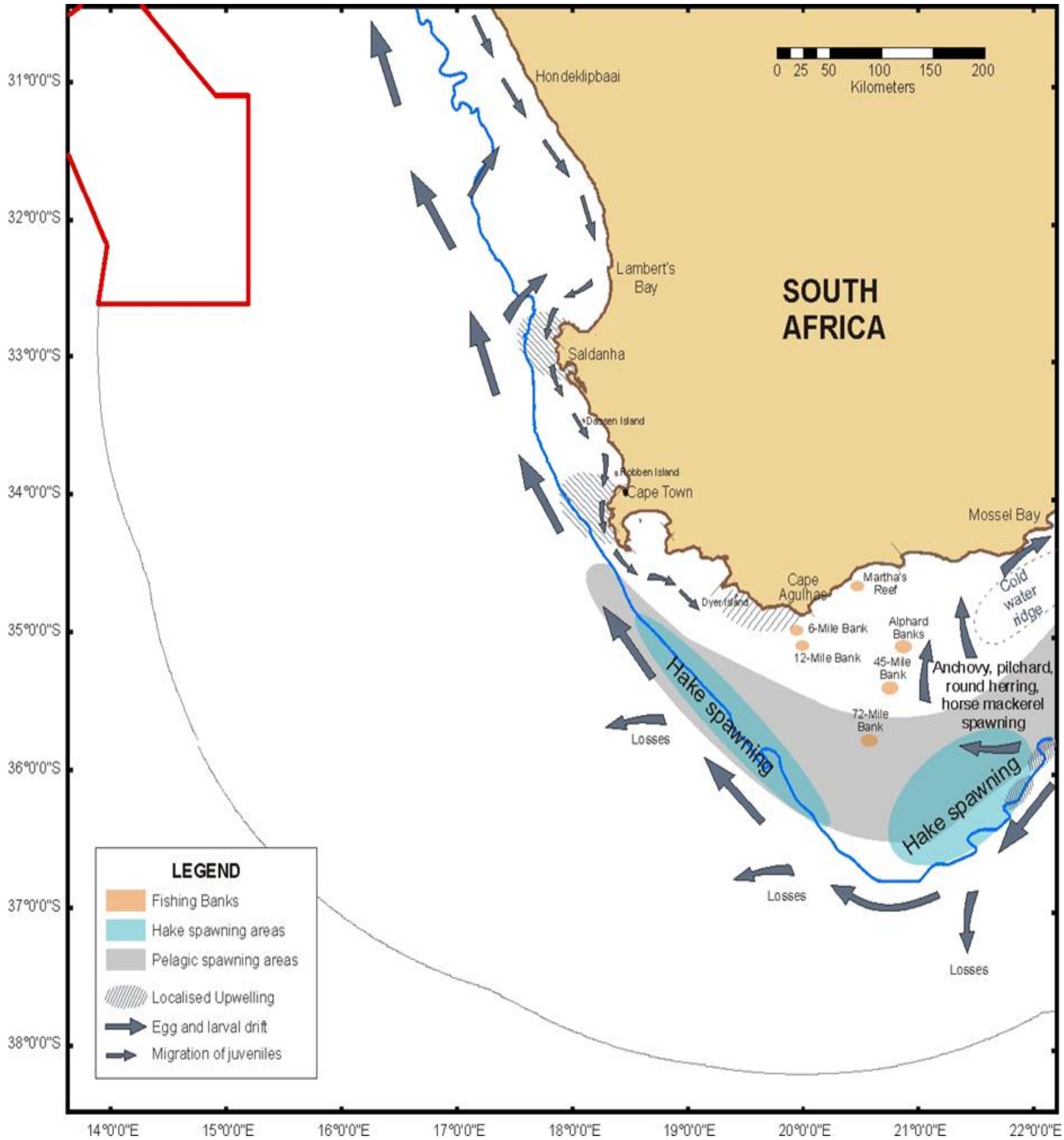


Figure 20: The survey area in relation to major spawning, recruitment and nursery areas in the southern Benguela region.

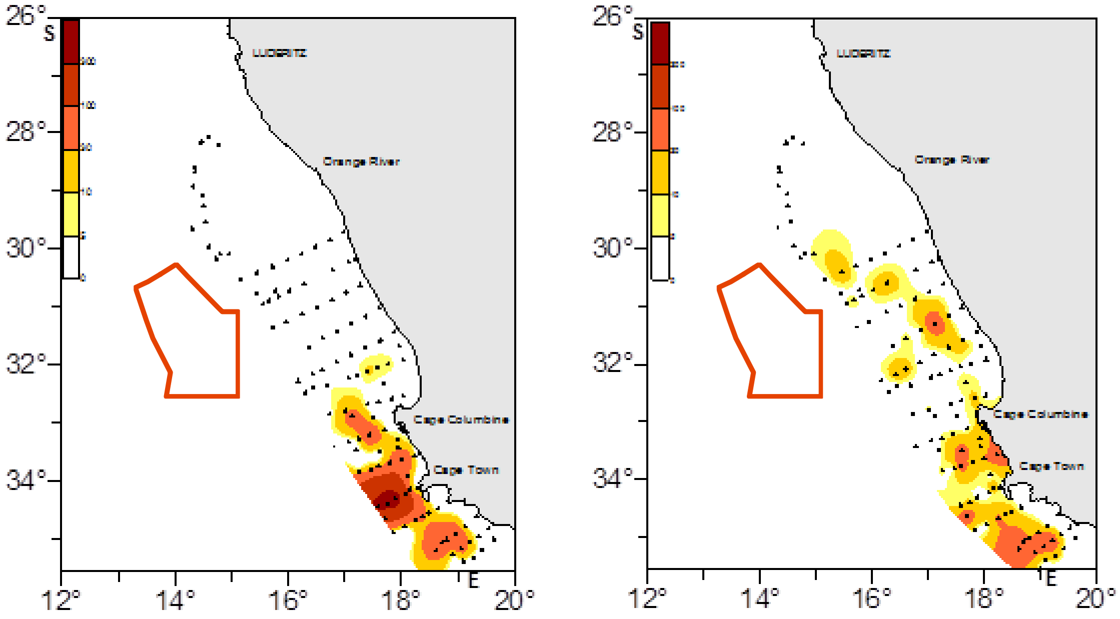


Figure 21a: Distribution of hake eggs (left) and larvae (right) off the West Coast of South Africa between September and October 2005.

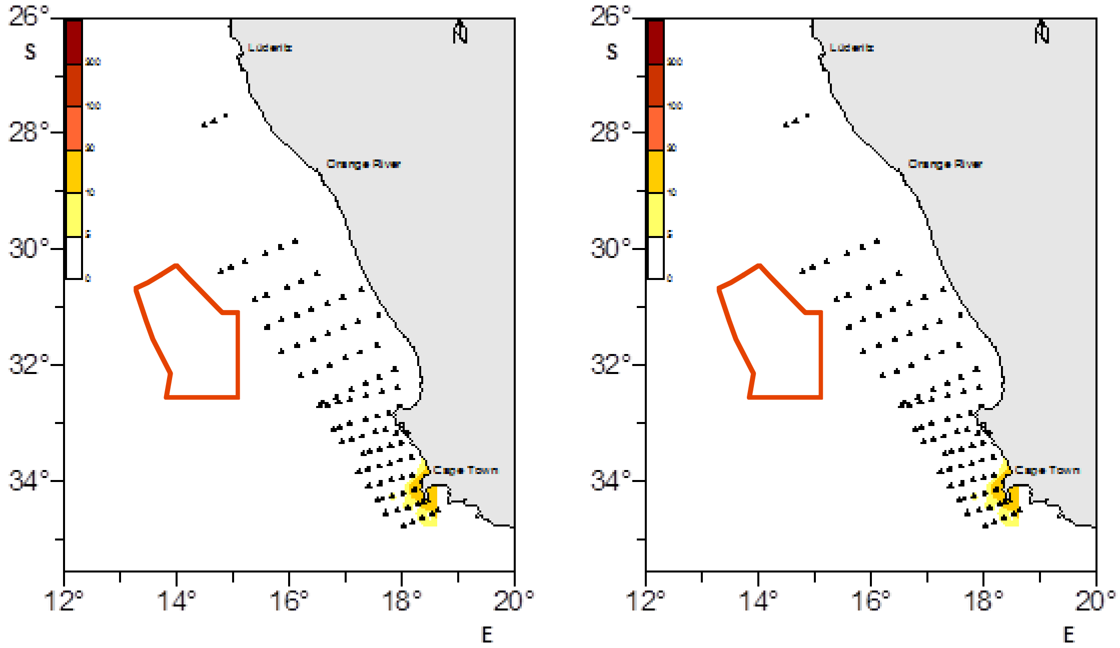


Figure 21b: Distribution of hake eggs (left) and larvae (right) off the West Coast of South Africa between March and April 2007.

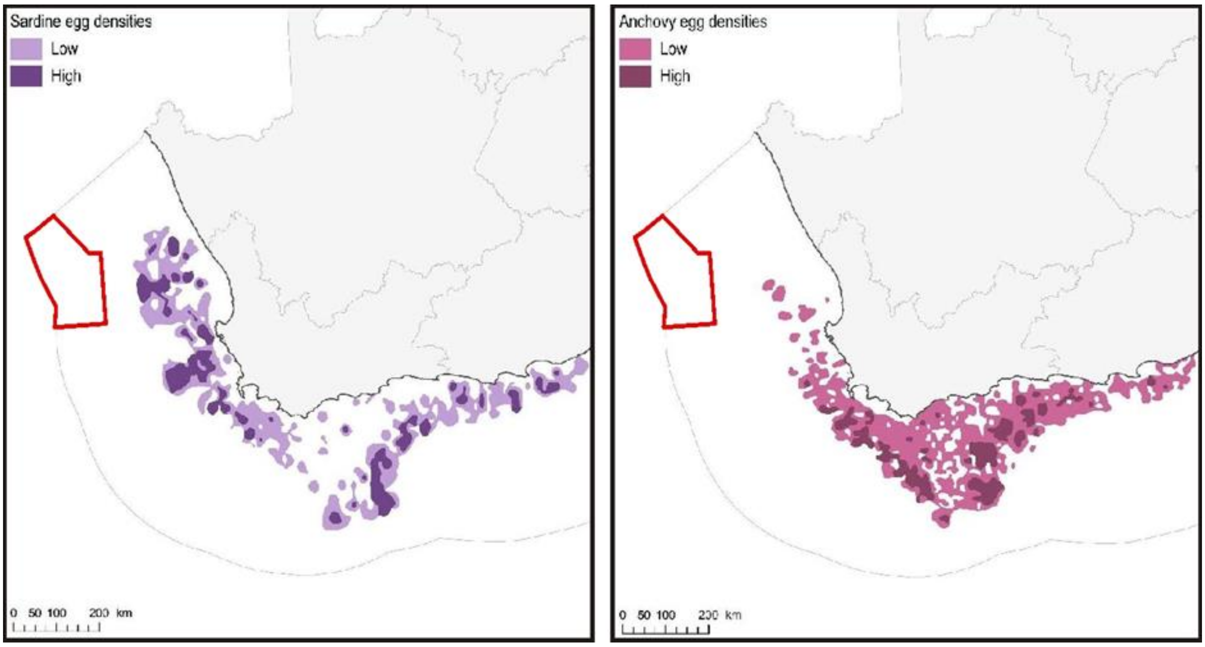


Figure 22: Distribution of sardine (left) and anchovy (right) spawning areas, as measured by egg densities, in relation to the survey area.

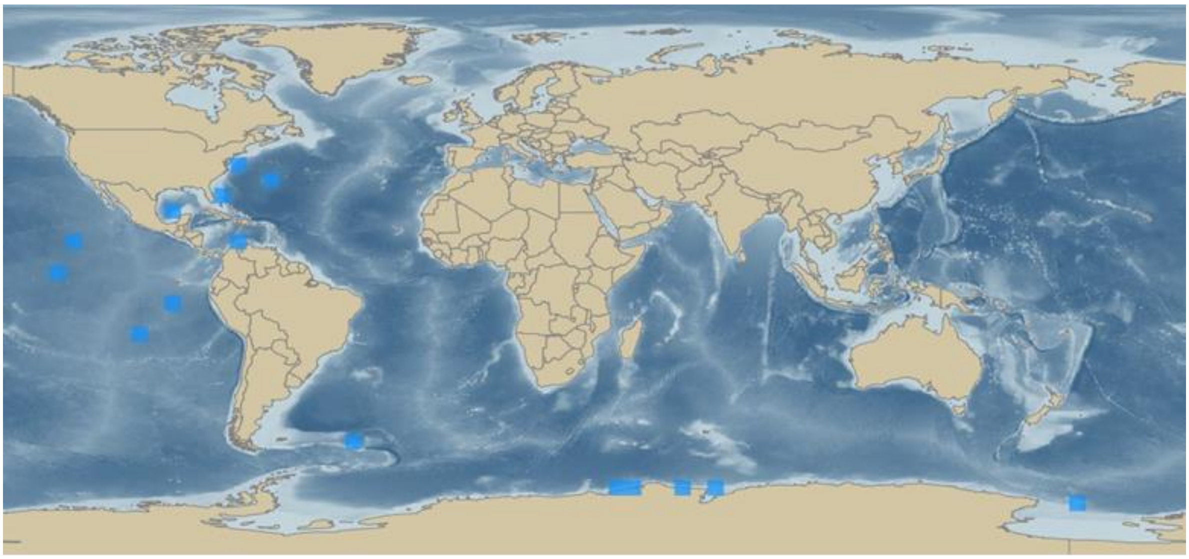
8.4.2.2 CEPHALOPODS

Fourteen species of 67uture67t676767 have been recorded in the southern Benguela, the majority of which are sepiods/cuttlefish. Most of the cephalopod resource is distributed on the mid-shelf with *Sepia australis* being most abundant at depths between 60-190 m, whereas *S. hieronis* densities were higher at depths between 110-250 m. *Rossia enigmatica* occurs more commonly on the edge of the shelf to depths of 500 m. Biomass of these species was generally higher in the summer than in winter.

Cuttlefish are largely epi-benthic and occur on mud and fine sediments in association with their major prey item; mantis shrimps. They form an important food item for demersal fish.

The colossal squid *Mesonychoteuthis hamiltoni* and the giant squid *Architeuthis sp*. May also be encountered in the project area. Both are deep dwelling species, with the colossal squid's distribution confined to the entire circum-antarctic Southern Ocean (**Figure 23**, top) while the giant squid is usually found near continental and island slopes all around the world's oceans (Figure 23, bottom). Both species could thus potentially occur in the pelagic habitats of the project area, although the likelihood of encounter is extremely low.

Growing to in excess of 10 m in length, they are the principal prey of the sperm whale, and are also taken by beaked whaled, pilot whales, elephant seals and sleeper sharks. Nothing is known of their vertical distribution, but data from trawled specimens and sperm whale diving behaviour suggest they may span a depth range of 300 – 1 000 m. They lack gas-filled swim bladders and maintain neutral buoyancy through an ammonium chloride solution occurring throughout their bodies.



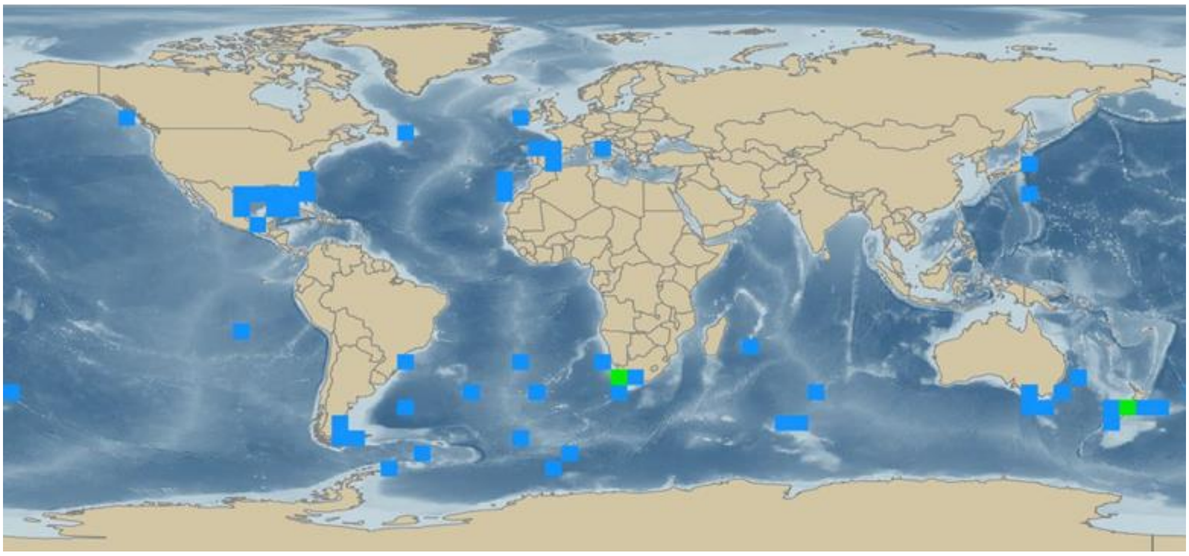


Figure 23: Distribution of the colossal squid (top) and the giant squid (bottom). Blue squares <5 records, green squares 5-10 records

8.4.2.3 PELAGIC FISH

Small pelagic species include the sardine/pilchard (*Sadinops ocellatus*) (Figure 24 below, left), anchovy (*Engraulis capensis*), chub mackerel (*Scomber japonicus*), horse mackerel (*Trachurus capensis*) (**Figure 24** below, right) and round herring (*Etrumeus whiteheadi*). These species typically occur in mixed shoals of various sizes, and generally occur within the 200 m contour. Most of the pelagic species exhibit similar life history patterns involving seasonal migrations between the west and south coasts. The spawning areas of the major pelagic species are distributed on the continental shelf and along the shelf edge extending from south of St Helena Bay to Mossel Bay on the South Coast. They spawn downstream of major upwelling centres in spring and summer, and their eggs and larvae are subsequently carried around Cape Point and up the coast in northward flowing surface waters.

At the start of winter every year, juveniles of most small pelagic shoaling species recruit into coastal waters in large numbers between the Orange River and Cape Columbine. They recruit in the pelagic stage, across broad stretches of the shelf, to utilise the shallow shelf region as nursery grounds before gradually moving southwards in the inshore southerly flowing surface current, towards the major spawning grounds east of Cape Point. Recruitment success relies on the interaction of oceanographic events and is thus subject to spatial and temporal variability. Consequently, the abundance of adults and juveniles of these small, short-lived (1-3 years) pelagic fish is highly variable both within and between species.

Figure 24: Cape fur seal preying on a shoal of pilchards (left). School of horse mackerel (right).

Two species that migrate along the West Coast following the shoals of anchovy and pilchards are snoek *Thyrsites atun* and chub mackerel *Scomber japonicas*. Both these species have been rated as 'Least concern' on the national assessment. While the appearance of chub mackerel along the West and South-West coasts is highly seasonal, adult snoek are found throughout their distribution range and longshore movement are random and without a seasonal basis. Initially postulated to be a single stock that undergoes a seasonal longshore migration from southern Angola through Namibia to the South African West Coast, Benguela snoek are now recognised as two separate sub-populations separated by the Lüderitz upwelling cell. On the West Coast, snoek move offshore to spawn and there is some southward dispersion as the spawning season progresses, with females on the West Coast moving inshore to feed between spawning events as spawning progresses. In contrast, those found further south along the western Agulhas Bank remain on the spawning grounds throughout the spawning season (**Figure 25**). They are voracious predators occurring throughout the water column, feeding on both demersal and pelagic invertebrates and fish. Chub mackerel similarly migrate along the southern African West Coast reaching South-Western Cape waters between April and August. They move inshore in June and July to spawn before starting the return northwards offshore migration later in the year. Their abundance and seasonal migrations are thought to be related to the availability of their shoaling prey species. The distribution of snoek and chub mackerel therefore lies well inshore of the Survey area.

The fish most likely to be encountered on the shelf and in the offshore waters within the reconnaissance area are the large migratory pelagic species, including various tunas, billfish and sharks, many of which are considered threatened by the International Union for the Conservation of Nature (IUCN), primarily due to overfishing (**Table 9**). Tuna and swordfish are targeted by high seas fishing fleets and illegal overfishing has severely damaged the stocks of many of these species. Similarly, pelagic sharks, are either caught as bycatch in the pelagic tuna longline fisheries, or are specifically targeted for their fins, where the fins are removed and the remainder of the body discarded.

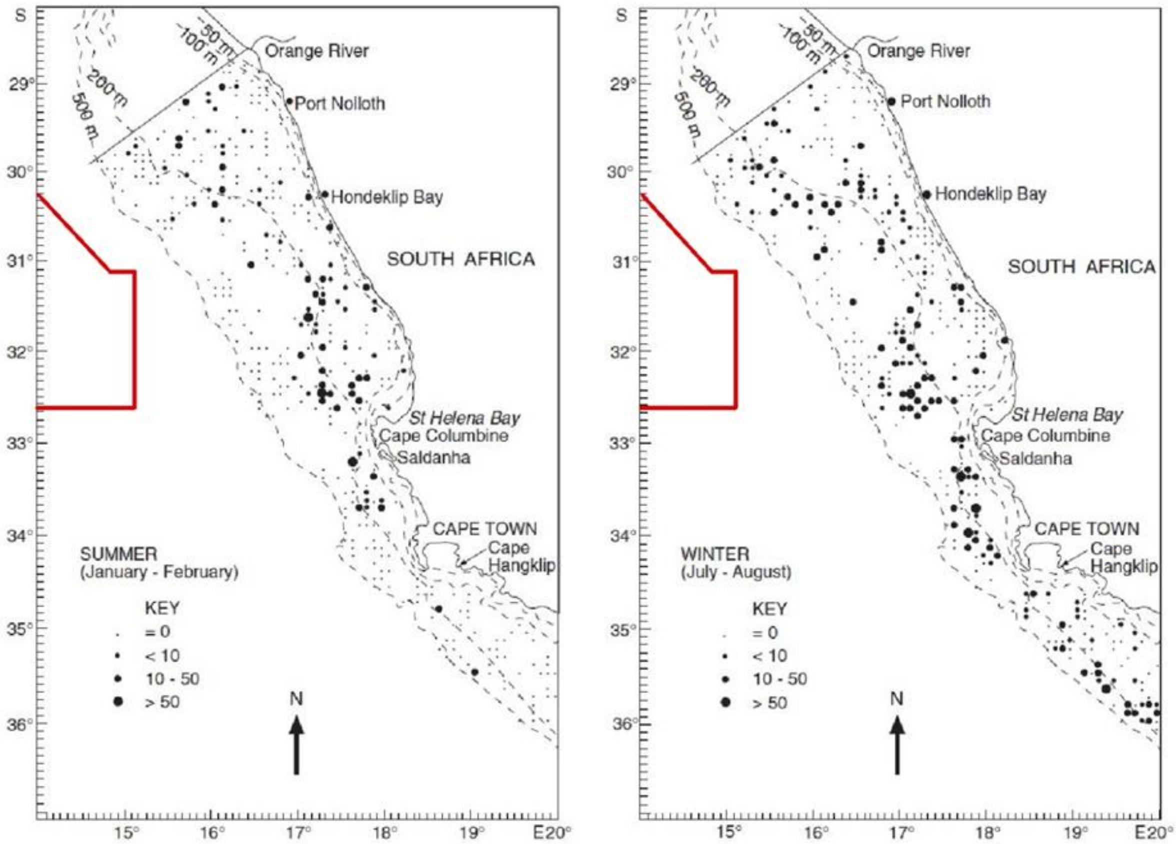


Figure 25 Mean amount of snoek per demersal trawl per grid block (5 × 5 Nm) by season for (A) the west coast (July 1985–Jan 1991) and (B) the south coast in relation to the survey area.

Table 9: Some of the more important large migratory pelagic fish likely to occur in the offshore regions of the West Coast. The National and Global IUCN Conservation Status are also provided.

Common Name	Species	National Assessment	IUCN Conservation Status
Tunas			
Southern Bluefin Tuna	*Thunnus maccoyii*		Critically Endangered
Bigeye Tuna	*Thunnus obesus*	Vulnerable	Vulnerable
Longfin Tuna/Albacore	*Thunnus alalunga*	Near Threatened	Near Threatened
Yellowfin Tuna	*Thunnus albacares*	Near Threatened	Near Threatened
Frigate Tuna	*Auxis thazard*		Least concern
Eastern Little Tuna	*Euthynnus affinis*	Least concern	Least concern
Skipjack Tuna	*Katsuwonus pelamis*	Least concern	Least concern
Billfish			
Black Marlin	*Istiompax indica*	Data deficient	Data deficient
Blue Marlin	*Makaira nigricans*	Vulnerable	Vulnerable
Striped Marlin	*Kajikia audax*	Near Threatened	Near Threatened
Sailfish	*Istiophorus platypterus*	Least concern	Least concern

Common Name	Species	National Assessment	IUCN Conservation Status
Swordfish	*Xiphias gladius*	Data deficient	Least concern
Pelagic Sharks			
Oceanic Whitetip Shark	*Carcharhinus longimanus*		Vulnerable
Dusky Shark	*Carcharhinus obscurus*	Data deficient	Vulnerable
Great White Shark	*Carcharodon carcharias*	Least concern	Vulnerable
Shortfin Mako	*Isurus oxyrinchus*	Vulnerable	Endangered
Longfin Mako	*Isurus paucus*		Vulnerable
Whale Shark	*Rhincodon typus*		Endangered
Blue Shark	*Prionace glauca*	Least concern	Near Threatened

These large pelagic species migrate throughout the southern oceans, between surface and deep waters (>300 m) and have a highly seasonal abundance in the Benguela. Species occurring off western southern Africa include the albacore/longfin tuna *Thunnus alalunga* (**Figure 26** below, right), yellowfin *T. albacares*, bigeye *T. obesus*, and skipjack Katsuwonus pelamis tunas, as well as the Atlantic blue marlin Makaira nigricans (**Figure 26** below, left), the white marlin *Tetrapturus albidus* and the broadbill swordfish *Xiphias gladius*. The distributions of these species are dependent on food availability in the mixed boundary layer between the Benguela and warm central Atlantic waters. Concentrations of large pelagic species are also known to occur associated with underwater feature such as canyons and seamounts as well as meteorologically induced oceanic fronts. Seasonal association with Child's Bank and Tripp Seamount occurs between October and June, with commercial catches often peaking in March and April.

A number of species of pelagic sharks are also known to occur on the West and South-West Coast, including blue *Prionace glauca*, short-fin mako *Isurus oxyrinchus* and oceanic whitetip sharks *Carcharhinus longimanus*. Occurring throughout the world in warm temperate waters, these species are usually found further offshore on the West Coast. Great whites *Carcharodon carcharias* and whale sharks *Rhincodon typus* may also be encountered in coastal and offshore areas, although the latter occurs more frequently along the South and East coasts.

Figure 26: Large migratory pelagic fish such as blue marlin (left) and longfin tuna (right) occur in offshore waters.

Whale sharks are regarded as a broad ranging species typically occurring in offshore epipelagic areas with sea surface temperatures of 18–32°C. Adult whale sharks reach an average size of 9.7 m and 9 tonnes, making them the largest non-cetacean animal in the world. They are slow-moving filter-feeders and therefore particularly vulnerable to ship strikes. Although primarily solitary animals, seasonal feeding aggregations occur at several coastal sites all over the world, those closest to the project area being off Sodwana Bay in KwaZulu Natal in the Greater St. Lucia Wetland Park. Satellite tagging has revealed that individuals may travel distances of tens of 1 000s of kms. On the West Coast their summer and winter distributions are centred around the Orange River mouth and between Cape Columbine and Cape Point. The likelihood of an encounter in the offshore waters of the Survey area is relatively low.

8.4.2.4 TURTLES

Three species of turtle occur along the West Coast, namely the Leatherback (*Dermochelys coriacea*) (**Figure 27**, left), and occasionally the Loggerhead (*Caretta caretta*) (**Figure 27**, right) and the Green (*Chelonia mydas*) turtle. Loggerhead and Green turtles are expected to occur only as occasional visitors along the West Coast. The most recent conservation status, which assessed the species on a sub-regional scale, is provided in **Table 10**.

Figure 27: Leatherback (left) and loggerhead turtles (right) occur along the West Coast of Southern Africa.

The Leatherback is the only turtle likely to be encountered in the offshore waters of west South Africa. The Benguela ecosystem, especially the northern Benguela where jelly fish numbers are high, is increasingly being recognized as a potentially important feeding area for leatherback turtles from several globally significant nesting populations in the south Atlantic (Gabon, Brazil) and south east Indian Ocean (South Africa). Leatherback turtles from the east South Africa population have been satellite tracked swimming around the west coast of South Africa and remaining in the warmer waters west of the Benguela ecosystem (**Figure 28** below).

Table 10: Global and Regional Conservation Status of the turtles occurring off the South Coast showing variation depending on the listing used.

Listing	Leatherback	Loggerhead	Green
IUCN Red List:			
Species (date)	V (2013)	V (2017)	E (2004)
Population (RMU)	CR (2013)	NT (2017)	*
Sub-Regional/National			
NEMBA TOPS (2017)	CR	E	E
Sink & Lawrence (2008)	CR	E	E
Hughes & Nel (2014)	E	V	NT
NT – Near Threatened V – Vulnerable E – Endangered CR – Critically Endangered DD – Data Deficient UR – Under Review * - not yet assessed			

Leatherback turtles inhabit deeper waters and are considered a pelagic species, travelling the ocean currents in search of their prey (primarily jellyfish). While hunting they may dive to over 600 m and remain submerged for up to 54 minutes. Their abundance in the study area is unknown but expected to be low. Leatherbacks feed on jellyfish and are known to have mistaken plastic marine debris for their natural food. Ingesting this can obstruct the gut, lead to absorption of toxins and reduce the absorption of nutrients from their real food. Leatherback Turtles are listed as 'Critically endangered' worldwide by the IUCN and are in the highest categories in terms of need for conservation in CITES (Convention on International Trade in Endangered Species), and CMS (Convention on Migratory Species). The 2017 South African list of Threatened and Endangered Species (TOPS) similarly lists the species as 'Critically endangered', whereas on the National Assessment leatherbacks were listed as

‘Endangered’, whereas Loggerhead and green turtles are listed globally as ‘Vulnerable’ and ‘Endangered’, respectively, whereas on TOPS both species are listed as ‘Endangered’. As a signatory of CMS, South Africa has endorsed and signed a CMS International Memorandum of Understanding specific to the conservation of marine turtles. South Africa is thus committed to conserve these species at an international level.

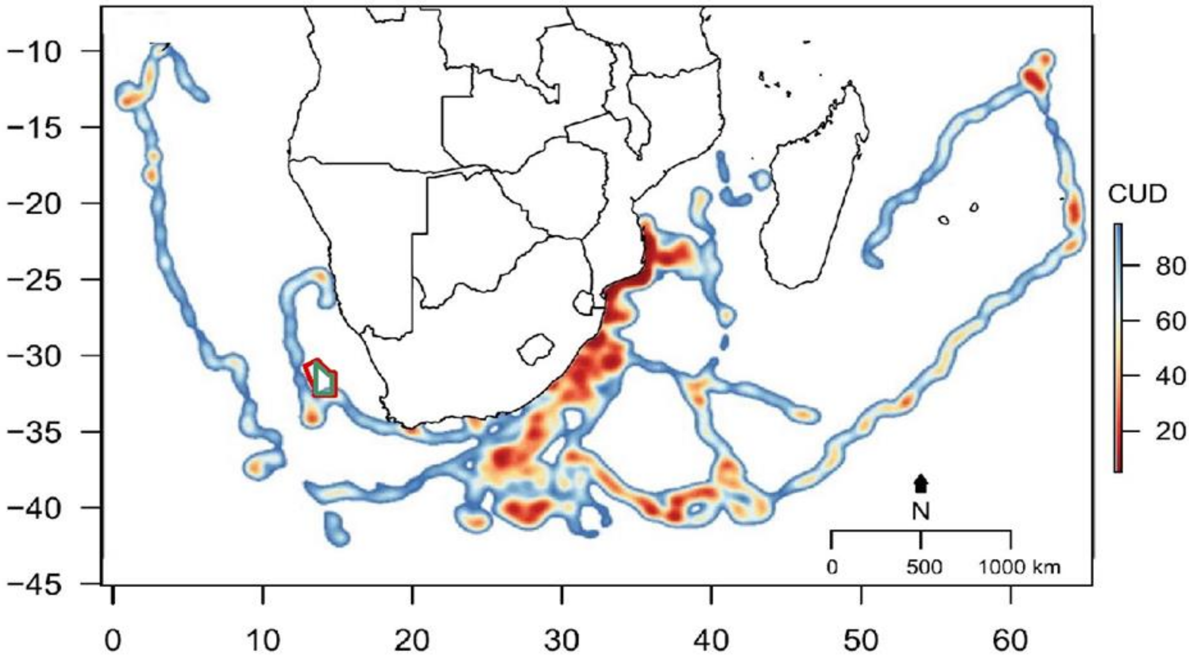


Figure 28: Survey area in relation to the migration corridors of leatherback turtles in the south-western Indian Ocean. Relative use of corridors is shown through intensity of shading: light, low use; dark, high use.

8.4.2.5 SEABIRDS

Large numbers of pelagic seabirds exploit the pelagic fish stocks of the Benguela system. Of the 49 species of seabirds that occur in the Benguela region, 14 are defined as resident, 10 are visitors from the northern hemisphere and 25 are migrants from the Southern Ocean. The species classified as being common in the southern Benguela are listed in **Table 11** below. The area between Cape Point and the Orange River supports 38% and 33% of the overall population of pelagic seabirds in winter and summer, respectively. Most of the species in the region reach highest densities offshore of the shelf break (200 – 500 m depth), well inshore of the proposed area of interest, with highest population levels during their non-breeding season (winter). Pintado petrels and Prion spp. Show the most marked variation here.

Fifteen species of seabirds breed in southern Africa; Cape Gannet (**Figure 29** left) and African Penguin (**Figure 29** right), four species of Cormorant, White Pelican, three Gull and four Tern species (**Table 11** and **Table 12**). The breeding areas are distributed around the coast with islands being especially important. The closest breeding islands to the Survey area are Bird Island in Lambert’s Bay, the Saldanha Bay Islands and Dassen Island, which lie approximately 300 km, 285 km and 310 km to the east and south east of the eastern and southern boundary of the proposed 3D survey area, respectively. The number of successfully breeding birds at the particular breeding sites varies with food abundance. Most of the breeding seabird species forage at sea with most birds being found relatively close inshore (10 30 km). Cape Gannets, which breed at only three locations in South Africa (Bird Island Lamberts Bay, Malgas Island and Bird Island Algoa Bay) are known to forage within 200 km offshore, and African Penguins have also been recorded as far as 60 km offshore. The proposed 3D survey area lies well offshore of the aggregate core home ranges of Cape Gannet and African Penguin (**Figure 30**). Aggregate core home ranges and foraging areas for Cape Cormorant and Bank Cormorant similarly lie well inshore of the Survey area. There is, however, overlap of the foraging areas of Wandering Albatross and Atlantic Yellow-nosed Albatross with the Survey area (**Figure 30**).

Figure 29: Cape Gannets *Morus capensis* (left) and African Penguins *Spheniscus demersus* (right) breed primarily on the offshore Islands (Pisces, 2021).

Table 11: Pelagic seabirds common in the southern Benguela region. IUCN Red List and Regional Assessment status are provided (Pisces, 2021).

Common Name	Species name	Global IUCN	Regional Assessment
Shy Albatross	*Thalassarche cauta*	Near Threatened	Near Threatened
Black-browed Albatross	*Thalassarche melanophrys*	Least concern	Endangered
Atlantic Yellow-nosed	*Thalassarche chlororhynchos*	Endangered	Endangered
Indian Yellow-nosed	*Thalassarche carteri*	Endangered	Endangered
Wandering Albatross	*Diomedea exulans*	Vulnerable	Vulnerable
Southern Royal Albatross	*Diomedea epomophora*	Vulnerable	Vulnerable
Northern Royal Albatross	*Diomedea sanfordi*	Endangered	Endangered
Sooty Albatross	*Phoebetria fusca*	Endangered	Endangered
Light-mantled Albatross	*Phoebetria 74uture74t7474*	Near Threatened	Near Threatened
Tristan Albatross	*Diomedea dabbenena*	Critically Endangered	Critically Endangered
Grey-headed Albatross	*Thalassarche chrysostoma*	Endangered	Endangered
Giant Petrel sp.	*Macronectes halli/giganteus*	Least concern	Near Threatened
Southern Fulmar	*Fulmarus glacialoides*	Least concern	Least concern
Pintado Petrel	*Daption capense*	Least concern	Least concern
Blue Petrel	*Halobaena caerulea*	Least concern	Near Threatened
Salvin's Prion	*Pachyptila salvini*	Least concern	Near Threatened
Arctic Prion	*Pachyptila desolata*	Least concern	Least concern
Slender-billed Prion	*Pachyptila belcheri*	Least concern	Least concern
Broad-billed Prion	*Pachyptila vittata*	Least concern	Least concern
Kerguelen Petrel	*Aphrodroma brevirostris*	Least concern	Near Threatened
Greatwinged Petrel	*Pterodroma macroptera*	Least concern	Near Threatened
Soft-plumaged Petrel	*Pterodroma mollis*	Least concern	Near Threatened
White-chinned Petrel	*Procellaria aequinoctialis*	Vulnerable	Vulnerable
Spectacled Petrel	*Procellaria conspicillata*	Vulnerable	Vulnerable
Cory's Shearwater	*Calonectris diomedea*	Least concern	Least concern
Sooty Shearwater	*Puffinus griseus*	Near Threatened	Near Threatened
Flesh-footed Shearwater	*Ardenna carneipes*	Near Threatened	Least concern
Great Shearwater	*Puffinus gravis*	Least concern	Least concern
Manx Shearwater	*Puffinus puffinus*	Least concern	Least concern
Little Shearwater	*Puffinus assimilis*	Least concern	Least concern
European Storm Petrel	*Hydrobates pelagicus*	Least concern	Least concern
Leach's Storm Petrel	*Oceanodroma leucorhoa*	Vulnerable	Critically Endangered
Wilson's Storm Petrel	*Oceanites oceanicus*	Least concern	Least concern
Black-bellied Storm Petrel	*Fregetta tropica*	Least concern	Near Threatened
White-bellied Storm Petrel	*Fregetta grallaria*	Least concern	Least concern
Pomarine Jaeger	*Stercorarius pomarinus*	Least concern	Least concern
Subantarctic Skua	*Catharacta antarctica*	Least concern	Endangered

Common Name	Species name	Global IUCN	Regional Assessment
Parasitic Jaeger	*Stercorarius parasiticus*	Least concern	Least concern
Long-tailed Jaeger	*Stercorarius longicaudus*	Least concern	Least concern
Sabine's Gull	*Larus sabini*	Least concern	Least concern
Lesser Crested Tern	*Thalasseus bengalensis*	Least concern	Least concern
Sandwich Tern	*Thalasseus sandvicensis*	Least concern	Least concern
Little Tern	*Sternula albifrons*	Least concern	Least concern
Common Tern	*Sterna hirundo*	Least concern	Least concern
Arctic Tern	*Sterna paradisaea*	Least concern	Least concern
Antarctic Tern	*Sterna 75uture75*	Least concern	Endangered

Table 12: Breeding resident seabirds present along the South Coast. IUCN Red List and National Assessment status are provided.

Common Name	Species Name	National Assessment	Global Assessment
African Penguin	*Spheniscus demersus*	Endangered	Endangered
African Black Oystercatcher	*Haematopus moquini*	Least Concern	Near Threatened
White-breasted Cormorant	*Phalacrocorax carbo*	Least Concern	Least Concern
Cape Cormorant	*Phalacrocorax capensis*	Endangered	Endangered
Bank Cormorant	*Phalacrocorax neglectus*	Endangered	Endangered
Crowned Cormorant	*Phalacrocorax coronatus*	Near Threatened	Near Threatened
White Pelican	*Pelecanus onocrotalus*	Vulnerable	Least Concern
Cape Gannet	*Morus capensis*	Endangered	Endangered
Kelp Gull	*Larus dominicanus*	Least Concern	Least Concern
Greyheaded Gull	*Larus cirrocephalus*	Least Concern	Least Concern
Hartlaub's Gull	*Larus hartlaubii*	Least Concern	Least Concern
Caspian Tern	*Hydroprogne caspia*	Vulnerable	Least Concern
Swift Tern	*Sterna bergii*	Least Concern	Least Concern
Roseate Tern	*Sterna dougallii*	Endangered	Least Concern
Damara Tern	*Sterna balaenarum*	Vulnerable	Vulnerable

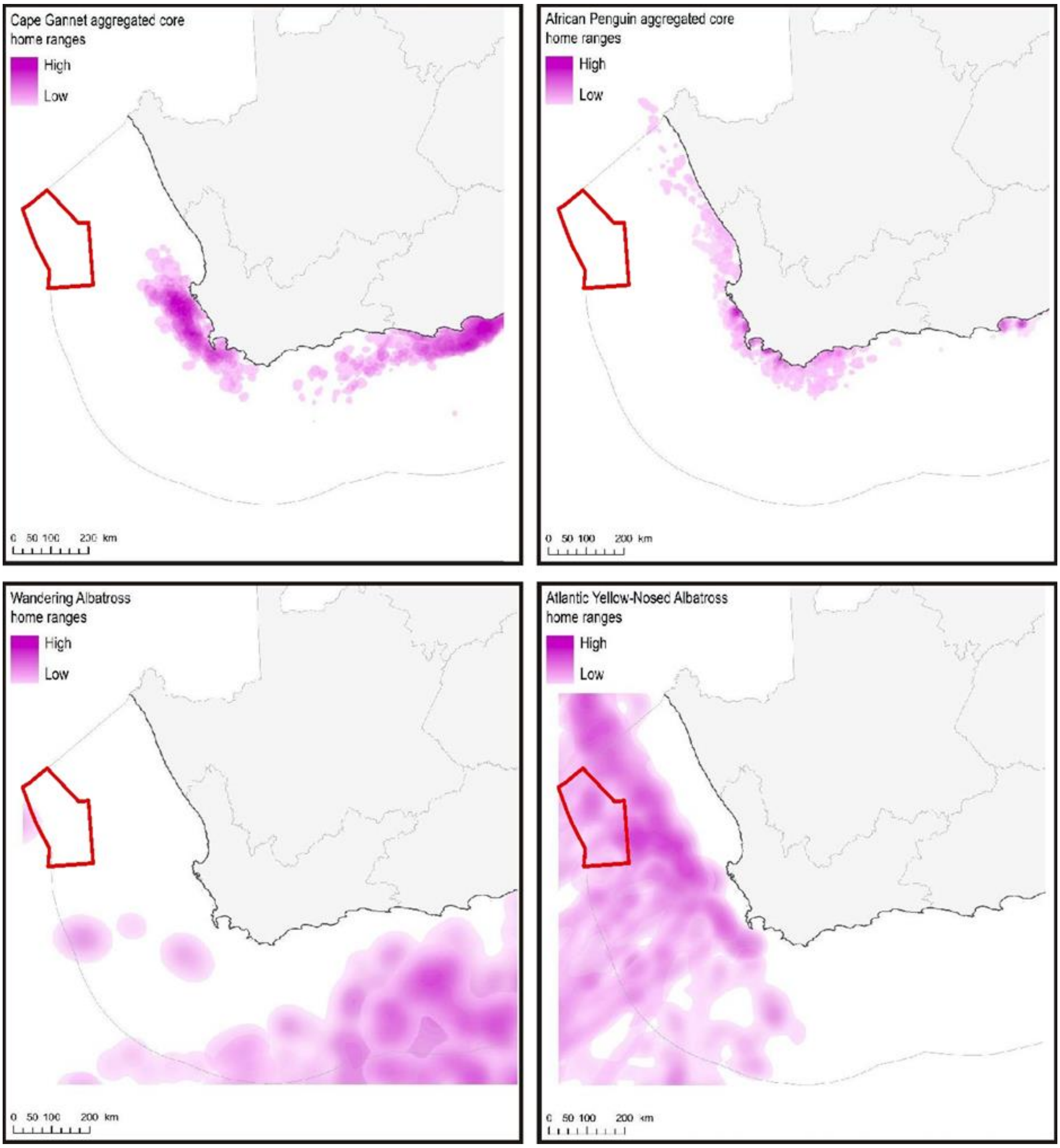


Figure 30: The proposed 3D survey area in relation to aggregate core home ranges of Cape Gannet (top left), African Penguin (top right) for different colonies and life-history stages, and foraging areas of Wandering Albatross (bottom left) and Atlantic Yellow-nosed Albatross (bottom right). For foraging areas, darker shades are areas of higher use and where foraging areas from different colonies overlap.

Interactions with commercial fishing operations, either through incidental bycatch or competition for food resources, are the greatest threat to southern African seabirds, impacting 56% of seabirds of special concern. Crawford et al., (2014), reported that four of the seabirds assessed as ‘Endangered’ compete with South Africa’s fisheries for food: African Penguins, Cape Gannets and Cape Cormorants for sardines and anchovies, and Bank Cormorants for rock lobsters. Populations of seabirds off the West Coast have recently shown significant decreases, with the population numbers of African Penguins currently only 2.5% of what the population was 80 years ago; declining from 1 million breeding pairs in the 1920s, 25 000 pairs in 2009 and 15 000 in 2018. For Cape Gannets, the global population decreased from about 250 000 pairs in the 1950s and 1960s to approximately 130 000 in 2018, primarily as a result of a >90% decrease in Namibia’s population in response to the collapse of Namibia’s sardine resource. In South Africa, numbers of Cape Gannets have increased since 1956 and South Africa now holds >90% of the global population. However, numbers have recently decreased in the Western Cape but increased in Algoa Bay mirroring the southward and eastward shift sardine and anchovy. Algoa Bay currently holds approximately 75% of the South African Gannet population.

Cape cormorants and Bank cormorants showed a substantial decline from the late 1970s/early 1980s to the late 2000s/early 2010s, with numbers of Cape cormorants dropping from 106 500 to 65 800 breeding pairs, and Bank cormorants from 1 500 to only 800 breeding pairs over that period.

Demersal and pelagic longlining are key contributors to the mortality of albatrosses (Browed albatross 7%, Indian and Atlantic Yellow-Nosed Albatross 3%), petrels (white-chinned petrel 66%), shearwaters and Cape Gannets (2%) through accidental capture (bycatch and/or entanglement in fishing gear), with an estimated annual mortality of 450 individuals of 14 species for the period 2006 to 2013. Other threats include predation by mice on petrel and albatross chicks on sub-Antarctic islands, predation of chicks of Cape, Crowned and Bank Cormorants by Great White Pelicans, and predation of eggs and chicks of African Penguins, Bank, Cape and Crowned Cormorants by Kelp gulls. Disease (avian flu), climate change (heat stress and environmental variability) and oil spills are also considered major contributors to seabird declines.

8.4.2.6 MARINE MAMMALS

The marine mammal fauna occurring off the southern African coast includes several species of whales and dolphins and one resident seal species. Thirty-three species of whales and dolphins are known (based on historic sightings or strandings records) or likely (based on habitat projections of known species parameters) to occur in these waters (Table 13). Of the species listed, the blue whale is considered ‘Critically Endangered’, fin and sei whales are ‘Endangered’ and one is considered vulnerable (IUCN Red Data list Categories). Altogether 17 species are listed as ‘data deficient’ underlining how little is known about cetaceans, their distributions and population trends. The offshore areas have been particularly poorly studied with most available information from deeper waters (>200 m) arising from historic whaling records prior to 1970. In the past ten years, passive acoustic monitoring and satellite telemetry have begun to shed light on current patterns of seasonality and movement for some large whale species but information on smaller cetaceans in deeper waters remains poor. Records from marine mammal observers on seismic survey vessels have provided valuable data into cetacean presence although these are predominantly during summer months. Information on general distribution and seasonality is improving but data population sizes and trends for most cetacean species occurring on the west coast of southern Africa is lacking.

The survey area extends from the Namibian border to 32°27’ offshore of St Helena Bay from roughly the 2 000 m isobath to 3 600 m water depth. Oceanographically this area lies largely outside the cool waters of the Benguela Ecosystem and receives some input from the warm Agulhas Current as well as the warm waters of the South Atlantic. In terms of cetacean distribution patterns, the area thus covers a broad range of habitats and species associated with each of those water masses may occur within the target area. Records from stranded specimens show that the area between St Helena Bay and Cape Agulhas is an area of transition between Atlantic and Indian Ocean species and includes records from Benguela associated species such as dusky dolphins, Heaviside’s dolphins and long finned pilot whales, and those of the warmer east coast such as striped and Risso’s dolphins. Species such as rough toothed dolphins, Pan-tropical spotted dolphins and short finned pilot whales are known from the southern Atlantic. Owing to the uncertainty of species occurrence offshore, species that may occur there have been included here for the sake of completeness.

The distribution of cetaceans can largely be split into those associated with the continental shelf and those that occur in deep, oceanic water. Importantly, species from both environments may be found on the continental slope (200 – 2 000 m) making this the most species rich area for cetaceans and also high in density. Cetacean density on the continental shelf is usually higher than in pelagic waters as species associated with the pelagic environment tend to be wide ranging across 1 000s of km. The most common species within the project area (in terms of likely encounter rate not total population sizes) are likely to be the long-finned pilot whale, Risso’s dolphin, common dolphin, sperm whale (winter distribution) and humpback whale (**Figure 31**).

Cetaceans are comprised of two taxonomic groups, the mysticetes (filter feeders with baleen) and the odontocetes (predatory whales and dolphins with teeth). The term ‘whale’ is used to describe species in both groups and is taxonomically meaningless (e.g. the killer whale and pilot whale are members of the Odontoceti, family Delphinidae and are thus dolphins). Due to differences in sociality, communication abilities, ranging behaviour and acoustic behaviour, these two groups are considered separately.

Table 13 lists the cetaceans likely to be found within the project area. The majority of data available on the seasonality and distribution of large whales in the project area is the result of commercial whaling activities mostly dating from the 1960s. Changes in the timing and distribution of migration may have occurred since these data were collected due to extirpation of populations or behaviours (e.g. migration routes may be learnt behaviours). The large whale species for which there are current data available are the humpback and southern right whale, although almost all data is limited to that collected on the continental shelf close to shore.

A review of the distribution and seasonality of the key cetacean species likely to be found within the project area is provided below.

8.4.2.6.1 MYSTICETE (BALEEN) WHALES

The majority of mysticetes whales fall into the family Balaenopeteridae. Those occurring in the area include the blue, fin, sei, Antarctic minke, dwarf minke, humpback and Bryde's whales. The southern right whale (Family Balaenidae) and pygmy right whale (Family Neobalaenidae) are from taxonomically separate groups. The majority of mysticete species occur in pelagic waters with only occasional visits to shelf waters. All of these species show some degree of migration either to or through the latitudes encompassed by the broader project area when *en route* between higher latitude (Antarctic or Subantarctic) feeding grounds and lower latitude breeding grounds. Depending on the ultimate location of these feeding and breeding grounds, seasonality may be either unimodal, usually in winter months, or bimodal (e.g., May to July and October to November), reflecting a northward and southward migration through the area. Northward and southward migrations may take place at different distances from the coast due to whales following geographic or oceanographic features, thereby influencing the seasonality of occurrence at different locations. Because of the complexities of the migration patterns, each species is discussed separately below.

Table 13: Cetaceans occurrence off the South Coast of South Africa, their seasonality, likely encounter frequency with proposed reconnaissance activities and South African and Global IUCN Red List conservation status.

Common Name	Species	Hearing Frequency	Shelf (<200 m)	Offshore (>200 m)	Seasonality	RSA Regional Assessment	IUCN Global Assessment
Delphinids							
Dusky dolphin	*Lagenorhynchus obscurus*	HF	Yes (0- 800 m)	No	Year round	Least Concern	Data Deficient
Heaviside's dolphin	*Cephalorhynchus heavisidii*	VHF	Yes (0-200 m)	No	Year round	Least Concern	Near Threatened
Common bottlenose dolphin	*Tursiops truncatus*	HF	Yes	Yes	Year round	Least Concern	Least Concern
Common dolphin	*Delphinus delphis*	HF	Yes	Yes	Year round	Least Concern	Least Concern
Southern right whale dolphin	*Lissodelphis peronii*	HF	Yes	Yes	Year round	Least Concern	Least Concern
Striped dolphin	*Stenella coeruleoalba*	HF	No	Unknown	Unknown	Least Concern	Least Concern
Pantropical spotted dolphin	*Stenella attenuata*	HF	Edge	Yes	Year round	Least Concern	Least Concern
Long-finned pilot whale	*Globicephala melas*	HF	Edge	Yes	Year round	Least Concern	Least Concern
Short-finned pilot whale	*Globicephala macrorhynchus*	HF	Unknown	Unknown	Unknown	Least Concern	Least Concern
Rough-toothed dolphin	*Steno bredanensis*	HF	Unknown	Unknown	Unknown		Least Concern
Killer whale	*Orcinus orca*	HF	Occasional	Yes	Year round	Least Concern	Data deficient
False killer whale	*Pseudorca crassidens*	HF	Occasional	Yes	Year round	Least Concern	Near Threatened
Pygmy killer whale	*Feresa attenuata*	HF	Unknown	Yes	Unknown	Least Concern	Least Concern
Risso's dolphin	*Grampus griseus*	HF	Yes (edge)	Yes	Unknown	Data Deficient	Least Concern
Sperm whales							

Common Name	Species	Hearing Frequency	Shelf (<200 m)	Offshore (>200 m)	Seasonality	RSA Regional Assessment	IUCN Global Assessment
Pygmy sperm whale	*Kogia breviceps*	VHF	Edge	Yes	Year round	Data Deficient	Data Deficient
Dwarf sperm whale	*Kogia sima*	VHF	Edge	Unknown	Unknown	Data Deficient	Data Deficient
Sperm whale	*Physeter macrocephalus*	HF	Edge	Yes	Year round	Vulnerable	Vulnerable
Beaked whales							
Cuvier's	*Ziphius cavirostris*	HF		Yes	Year round	Data Deficient	Least Concern
Arnoux's	*Beradius arnouxii*	HF		Yes	Year round	Data Deficient	Data Deficient
Southern bottlenose	*Hyperoodon planifrons*	HF		Yes	Year round	Least Concern	Least Concern
Layard's	*Mesoplodon layardii*	HF		Yes	Year round	Data Deficient	Data Deficient
True's	*Mesoplodon mirus*	HF		Yes	Year round	Data Deficient	Data Deficient
Gray's	*Mesoplodon grayi*	HF		Yes	Year round	Data Deficient	Data Deficient
Blainville's	*Mesoplodon densirostris*	HF		Yes	Year round	Data Deficient	Data Deficient
Baleen whales							
Antarctic Minke	*Balaenoptera bonaerensis*	LF	Yes	Yes	>Winter	Least Concern	Near Threatened
Dwarf minke	*B. acutorostrata*	LF	Yes	Yes	Year round	Least Concern	Least Concern
Fin whale	*B. physalus*	LF	Yes	Yes	MJJ & ON	Endangered	Vulnerable
Blue whale (Antarctic)	*B. musculus intermedia*	LF	No	Yes	Winter peak	Critically Endangered	Critically Endangered
Sei whale	*B. borealis*		Yes	Yes	MJ & ASO	Endangered	Endangered
Bryde's (inshore)	*B brydei (subspp)*	LF	Yes	Yes	Year round	Vulnerable	Least Concern

Common Name	Species	Hearing Frequency	Shelf (<200 m)	Offshore (>200 m)	Seasonality	RSA Regional Assessment	IUCN Global Assessment
Bryde's (offshore)	*B. brydei*	LF	Yes	Yes	Summer (JF)	Data Deficient	Least Concern
Pygmy right	*Caperea marginata*	LF	Yes	Unknown	Year round	Least Concern	Least Concern
Humpback sp.	*Megaptera novaeangliae*	LF	Yes	Yes	Year round, SONDJF	Least Concern	Least Concern
Humpback B2 population	*Megaptera novaeangliae*	LF	Yes	Yes	Spring Summer peak ONDJF	Vulnerable	Not Assessed
Southern Right	*Eubalaena australis*	LF	Yes	No	Year round, SONDJF	Least Concern	Least Concern
Marine animals do not hear equally well at all frequencies within their functional hearing range. Based on the hearing range and sensitivities, Southall et al. (2019) have categorised noise sensitive marine mammal species into six underwater hearing groups: low-frequency (LF), high-frequency (HF) and very high-frequency (VHF) cetaceans, Sirenians (SI), Phocid carnivores in water (PCW) and other marine carnivores in water (OCW).							

Table 14: Seasonality of baleen whales in the broader project area based on data from multiple sources, predominantly commercial catches and data from stranding events. Values of high (H), Medium (M) and Low (L) are relative within each row (species) and not comparable between species.

Whale Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bryde's Inshore	L	L	L	L	L	L	L	L	L	L	L	L
Sei	L	L	L	L	H	H	L	H	H	H	L	L
Fin	M	M	M	H	H	H	M	H	H	H	M	M
Blue	L	L	L	L	L	H	H	H	L	M	L	L
Minke	M	M	M	H	H	H	M	H	H	H	M	M

Whale Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Humpback	M	M	L	L	L	H	H	M	M	L	M	H
Southern Right	H	M	L	L	L	H	H	H	M	M	H	H

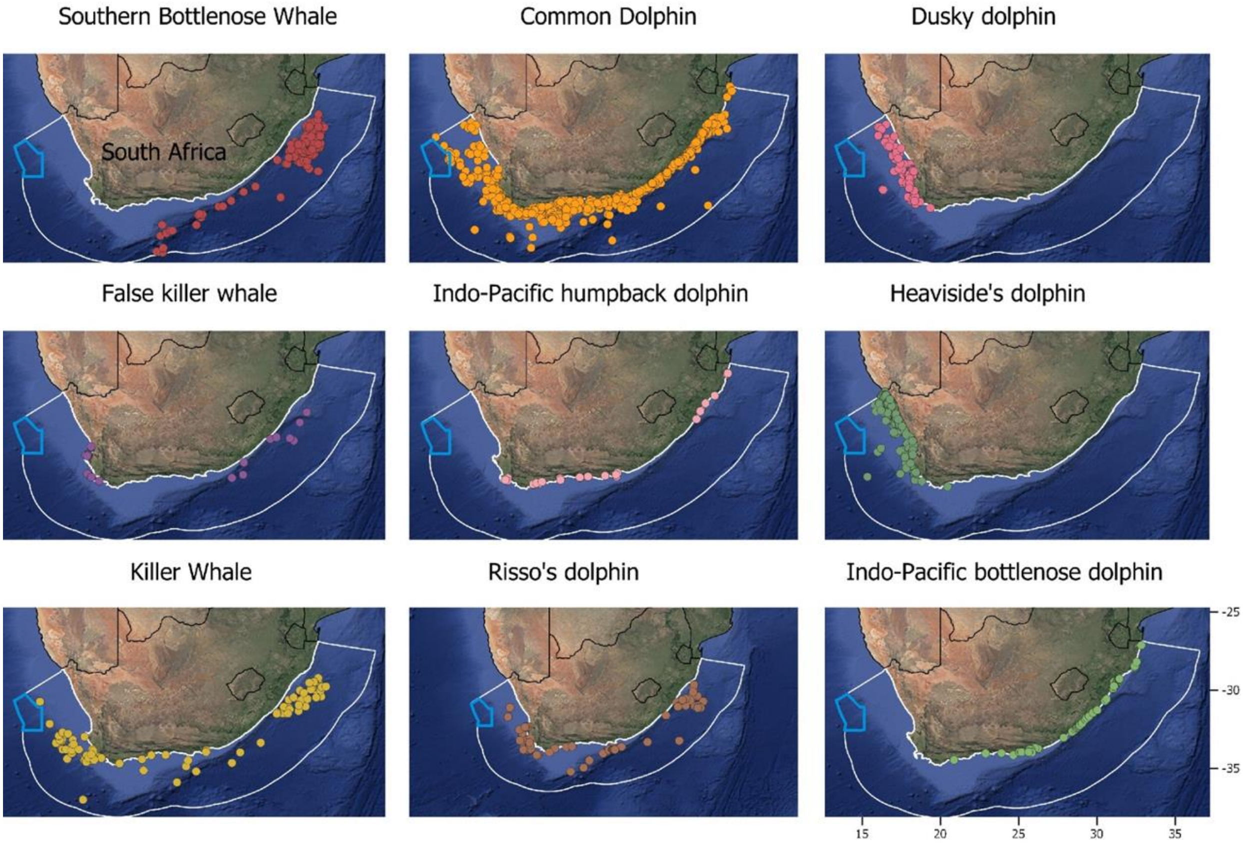


Figure 31: The 3D survey area (yellow polygop) in relation to projections of predicted distributions for nine odontocete species off the West Coast of South Africa.

Bryde's whales: Two genetically and morphologically distinct populations of Bryde's whales (**Figure 32** below, left) live off the coast of southern Africa. The "offshore population" lives beyond the shelf (>200 m depth) off west Africa and migrates between wintering grounds off equatorial west Africa (Gabon) and summering grounds off western South Africa. Its seasonality on the West Coast is thus opposite to the majority of the balaenopterids with abundance likely to be highest in the broader project area in January – March. Several strandings of adult offshore Bryde's whales in central Namibia confirm that the species passes through the project area. The "inshore population" of Bryde's, which lives on the continental shelf and Agulhas Bank, is unique amongst baleen whales in the region by being non-migratory. The published range of the population is the continental shelf and Agulhas Bank of South Africa ranging from Durban in the east to at least St Helena Bay off the west coast with possible movements further north up the West Coast and into Namibia during the winter months.

Sei whales: Sei whales spend time at high altitudes (40-50˚S) during summer months and migrate north through South African waters (where they were historically hunted in relatively high numbers) to unknown breeding grounds further north. Their migration pattern thus shows a bimodal peak with numbers west of Cape Columbine highest in May and June, and again in August, September and October. All whales were caught in waters deeper than 200 m with most deeper than 1 000 m. Almost all information is based on whaling records 1958-1963 and there is no current information on abundance or distribution patterns in the region.

Fin whales: Fin whales were historically caught off the West Coast of South Africa, with a bimodal peak in the catch data suggesting animals were migrating further north during May-June to breed, before returning during August-October *en route* to Antarctic feeding grounds. However, the location of the breeding ground (if any) and how far north it is remains a mystery. Some juvenile animals may feed year-round in deeper waters off the shelf. There are no recent data on abundance or distribution of fin whales off western South Africa.

Figure 32: The Bryde's whale *Balaenoptera brydei* (left) and the Minke whale *Balaenoptera bonaerensis* (right).

Blue whales: Although Antarctic blue whales were historically caught in high numbers off the South African West Coast, with a single peak in catch rates during July in Namibia and Angola suggesting that these latitudes are close to the northern migration limit for the species in the eastern South Atlantic. Although there had been only two confirmed sightings of the species in the area since 1973, evidence of blue whale presence off Namibia is increasing. Recent acoustic detections of blue whales in the Antarctic peak between December and January and in northern Namibia between May and July supporting observed timing from whaling records. Several recent (2014-2015) sightings of blue whales during seismic surveys off the southern part of Namibia in water >1 000 m deep confirm their existence in the area and occurrence in Autumn months. The chance of encountering the species in the proposed survey area is considered low.

Minke whales: Two forms of minke whale (**Figure 32** above, right) occur in the southern Hemisphere, the Antarctic minke whale (*Balaenoptera bonaerensis*) and the dwarf minke whale (*B. acutorostrata subsp*.); both species occur in the Benguela . Antarctic minke whales range from the pack ice of Antarctica to tropical waters and are usually seen more than ~50 km offshore. Although adults migrate from the Southern Ocean (summer) to tropical/temperate waters (winter) to breed, some animals, especially juveniles, are known to stay in tropical/temperate waters year-round. Recent data available from passive acoustic monitoring over a two-year period off the Walvis Ridge shows acoustic presence in June – August and November – December, supporting a bimodal distribution in the area. The dwarf minke whale has a more temperate distribution than the Antarctic minke and they do not range further south than 60-65°S. Dwarf minkes have a similar migration pattern to Antarctic minkes with at least some animals migrating to the Southern Ocean during summer. Dwarf minke whales occur closer to shore than Antarctic minkes and have been seen <2 km from shore on several occasions around South Africa. Both species are generally solitary, and densities are likely to be low in the project area.

Pygmy right whale: The pygmy right whale is the smallest of the baleen whales reaching only 6 m total length as an adult. The species is typically associated with cool temperate waters between 30°S and 55°S with records from southern and central Namibia being the northern most for the species.

The most abundant baleen whales in the Benguela are southern right whales and humpback whales (**Figure 33** below). In the last decade, both species have been increasingly observed to remain on the west coast of South Africa well after the 'traditional' South African whale season (June – November) into spring and early summer (October – February) where they have been observed feeding in upwelling zones, especially off Saldanha and St Helena Bay. Increasing numbers of summer records of both species, from the southern half of Namibia suggest that animals may also be feeding in the Lüderitz upwelling cell and will therefore occur in or pass through the project area.

Figure 33: The Humpback whale Megaptera novaeangliae (left) and the Southern Right whale *Eubalaena australis* (right) are the most abundant large cetaceans occurring along the southern African West Coast.

Humpback whales: The majority of humpback whales passing through the Benguela are migrating to breeding grounds off tropical west Africa, between Angola and the Gulf of Guinea. In coastal waters, the northward migration stream is larger than the southward peak, suggesting that animals migrating north strike the coast at varying places north of St Helena Bay, resulting in increasing whale density on shelf waters and into deeper pelagic waters as one moves northwards, but no clear migration ‘corridor. On the southward migration, many humpbacks follow the Walvis Ridge offshore then head directly to high latitude feeding grounds, while others follow a more coastal route (including the majority of mother-calf pairs) possibly lingering in the feeding grounds off west South Africa in summer. Although migrating through the Benguela, there is no existing evidence of a clear ‘corridor’ and humpback whales appear to be spread out widely across the shelf and into deeper pelagic waters, especially during the southward migration. Recent abundance estimates put the number of animals in the west African breeding population to be in excess of 9 000 individuals in 2005 and it is likely to have increased since this time at about 5% per annum. Humpback whales are thus likely to be the most frequently encountered baleen whale in the project area, ranging from the coast out beyond the shelf, with year-round presence but numbers peaking in July – February and a smaller peak with the southern breeding migration around September – October but with regular encounters until February associated with subsequent feeding in the Benguela ecosystem.

Southern right whales: The southern African population of southern right whales historically extended from southern Mozambique (Maputo Bay) to southern Angola (Baie dos Tigres) and is considered to be a single population within this range (Roux et al. 2011). The most recent abundance estimate for this population is available for 2017 which estimated the population at ~6 100 individuals including all age and sex classes, and still growing at ~6.5% per annum (Brandaõ et al. 2017). When the population numbers crashed in 1920, the range contracted down to just the south coast of South Africa, but as the population recovers, it is repopulating its historic grounds including Namibia (Roux et al. 2001, 2015; de Rock et al. 2019) and Mozambique (Banks et al., 2011).

Some southern right whales move from the South Coast breeding ground directly to the West Coast feeding ground (Mate et al., 2011). When departing from feeding ground all satellite tagged animals in that study took a direct south-westward track. Mark-recapture data from 2003-2007 estimated roughly one third of the South African right whale population at that time were using St Helena Bay for feeding (Peters et al., 2005). While annual surveys have revealed a steady population increase since the protection of the species from commercial whaling, the South African right whale population has undergone substantial changes in breeding cycles and feeding areas (Van Den Berg et al., 2020), and numbers of animal using our coast since those studies were done – notably a significant decrease in the numbers of cow-calf-pairs following the all-time record in 2018, a marked decline of unaccompanied adults since 2010 and variable presence of mother-calf pairs since 2015 (Roux et al. 2015; Vermeulen et al. 2020). The change in demographics are indications of a population undergoing nutritional stress and has been attributed to likely spatial and/or temporal displacement of prey due to climate variability (Vermeulen et al. 2020; see also Derville et al. 2019, 2020; Kershaw et al., 2021; van Weelden et al., 2021). Recent sightings (2018-2021) confirm that there is still a clear peak in numbers on the West Coast (Table Bay to St Helena Bay) between February and April. Given this high proportion of the population known to feed in the southern Benguela, and current numbers reported, it is highly likely that several hundreds of right whales can be expected to pass through the southern portion of the Reconnaissance Permit Area when migrating southwards from the feeding areas between April and June (**Figure 34**).

Figure 34: The Reconnaissance Permit Area (red polygon) in relation to 'blue corridors' or 'whale superhighways' showing tracks of Humpback whales (orange) and Southern Right whales (green) between southern Africa and the Southern Ocean feeding grounds (adapted from Johnson et al., 2022).

8.4.2.6.2 ODONTOCETES (TOOTHED) WHALES

The Odontoceti are a varied group of animals including the dolphins, porpoises, beaked whales and sperm whales. Species occurring within the broader project area display a diversity of features, for example their ranging patterns vary from extremely coastal and highly site specific to oceanic and wide ranging. Those in the region can range in size from 1.6-m long (Heaviside's dolphin) to 17 m (bull sperm whale).

Sperm whales: All information about sperm whales in the southern African sub-region results from data collected during commercial whaling activities prior to 1985. Sperm whales are the largest of the toothed whales and have a complex, structured social system with adult males behaving differently to younger males and female groups. They live in deep ocean waters, usually greater than 1 000 m depth, although they occasionally come onto the shelf in water 500 – 200 m deep (Figure 35, left). They are considered to be relatively abundant globally, although no estimates are available for South African waters. Seasonality of catches suggests that medium and large sized males are more abundant in winter months while female groups are more abundant in autumn (March – April), although animals occur year round. Sperm whales are thus likely to be encountered in relatively high numbers in deeper waters (>500 m), predominantly in the winter months (April – October). Sperm whales feed at great depths during dives in excess of 30 minutes making them difficult to detect visually, however the regular echolocation clicks made by the species when diving make them relatively easy to detect acoustically using Passive Acoustic Monitoring (PAM).


Figure 35: Sperm whales *Physeter macrocephalus* (left) and killer whales *Orcinus orca* (right) are toothed whales likely to be encountered in offshore waters.

Pygmy and Dwarf Sperm Whales: The genus Kogia currently contains two recognised species, the pygmy (*K. breviceps*) and dwarf (*K. sima*) sperm whales, both of which most frequently occur in pelagic and shelf edge waters, although their seasonality is unknown. Due to their small body size, cryptic behaviour, low densities and small school sizes, these whales are difficult to observe at sea, and morphological similarities make field identification to species level problematic. The majority of what is known about Kogiid whales in the southern African subregion results from studies of stranded specimens. Kogia species are most frequently occur in pelagic and shelf edge waters, are thus likely to occur in the survey area at low levels; seasonality is unknown. Dwarf sperm whales are associated with warmer tropical and warm-temperate waters, being recorded from both the Benguela and Agulhas ecosystem in waters deeper than ~1 000 m. During 2020 the incidence of kogiid strandings between Strandfontein on the West Coast and Groot Brak River on the South Coast (n=17), was considerably higher than the annual average during the previous 10 years (n=7). The dwarf sperm whale accounted for 60% of these strandings, of which most were recorded during autumn and winter. These seasonal stranding patterns are consistent with previously published accounts for the South African coast. In 2020, 40% of the total strandings were recorded in winter and 15% during summer. The occurrence of strandings throughout the year may, however, indicate the presence of a resident population with a seasonal distribution off the South Coast in autumn and winter. The cause of the strandings is unknown.

Killer whales: whales (**Figure 35**, right) in South African waters were referred to a single morphotype, Type A, although recently a second 'flat-toothed' morphotype that seems to specialise in an elasmobranch diet has been identified but only 5 records are known all from strandings. Killer whales (**Figure 34)** have a circum-global distribution being found in all oceans from the equator to the ice edge. Killer whales occur year-round in low densities off South Africa, Namibia and in the Eastern Tropical Atlantic. Historically sightings were correlated with that of baleen whales, especially sei whales on their southward migration. In more recent years – their presence in coastal waters (e.g. False Bay) has been strongly linked to the presence and hunting of common dolphins. Further from shore, there have been regular reports of killer whales associated with long-line fishing vessels on the southern and eastern Agulhas Bank, and the Cape Canyon to the south-west of Cape Point. Killer whales are found in all depths from the coast to deep open ocean environments and may thus be encountered in the project area at low levels.

False killer whale: Although the false killer whale is globally recognized as one species, clear differences in morphological and genetic characteristics between different study sites show that there is substantial difference between populations and a revision of the species taxonomy may be needed. False killer whales are more likely to be confused with the smaller melon-headed or pygmy killer whales with which they share all-black colouring and a similar head-shape, than with killer whales. The species has a tropical to temperate distribution and most sightings off southern Africa have occurred in water deeper than 1 000 m, but with a few recorded close to shore. They usually occur in groups ranging in size from 1 – 100 animals. The strong bonds and matrilineal social structure of this species makes it vulnerable to mass stranding (8 instances of 4 or more animals stranding together have occurred in the Western Cape, all between St Helena Bay and Cape Agulhas). There is no information on population numbers or conservation status and no evidence of seasonality in the region.

Pilot Whales: Long finned pilot whales display a preference for temperate waters and are usually associated with the continental shelf or deep water adjacent to it but moving inshore to follow prey (primarily squid). They are regularly seen associated with the shelf edge by Marine Mammal Observers (MMOs), fisheries observers and researchers. The distinction between long-finned and short finned pilot whales is difficult to make at sea. As the latter are regarded as more tropical species confined to the southwest Indian Ocean, it is likely that the majority of pilot whales encountered in the project area will be long-finned. There are many confirmed sighting of pilot whales along the shelf edge of South Africa and Namibia including within the survey area since 2010. Observed group sizes range from 8-100 individuals. Pilot whales are commonly sighting by MMOs and detected by PAM during a seismic surveys. A recent tagging study showed long-finned pilot whale movements within latitudes of 33-36°S, along the shelf-edge from offshore of Cape Columbine to the Agulhas Bank, with concentrations in canyon areas, especially around the Cape Point Valley, and to a lesser degree around the Cape Canyon. It is postulated that the pilot whales target prey species in these productive areas.

Common dolphin: Two forms of common dolphins occur around southern Africa, a long-beaked and short-beaked form, although they are currently considered part of a single global species. The long-beaked common dolphin lives on the continental shelf of south Africa rarely being observed north of St Helena Bay on the west coast or in waters more 500 m deep, although more recent sightings, including those from MMOs, suggest sightings regularly out to 1 000 m or more (SLR data, Sea Search data). Group sizes of common dolphins can be large, averaging 267 (± SD 287) for the South Africa region. Far less is known about the short-beaked form, which is challenging to differentiate at sea from the long-beaked form. Group sizes are also typically large. It is likely that common dolphins encountered in the Northern Cape or deeper than 2 000 m are of the short-beaked form.

Dusky dolphin: In water <500 m deep, dusky dolphins (Figure 36, left) are likely to be the most frequently encountered small cetacean as they are very "boat friendly" and often approach vessels to bowride. The species is resident year-round throughout the Benguela ecosystem in waters from the coast to at least 500 m deep. Although no information is available on the size of the population, they are regularly encountered in near shore waters between Cape Town and Lamberts Bay with group sizes of up to 800 having been reported. A hiatus in sightings (or low-density area) is reported between ~27°S and 30°S, associated with the Lüderitz upwelling cell. Dusky dolphins are resident year-round in the Benguela.

Heaviside's dolphins: Heaviside's dolphins (**Figure 36**, right) are relatively abundant in the Benguela ecosystem region with 10 000 animals estimated to live in the 400 km of coast between Cape Town and Lamberts Bay. This species occupies waters from the coast to at least 200 m depth, and may show a diurnal onshore-offshore movement pattern, but this varies throughout the species range. Heaviside's dolphins are resident year-round but will only occur well inshore of the Survey area.

Figure 36: The dusky dolphin Lagenorhynchus obscurus (left) and endemic Heaviside's Dolphin Cephalorhynchus heavisidii (right).

Bottlenose dolphin: Two species of bottlenose dolphins occur around southern Africa. The smaller Indo-Pacific bottlenose dolphin (aduncus form) occurs exclusively to the east of Cape Point in water usually less than 50 m deep and generally within 1 km of the shore. The larger common bottlenose dolphin (*truncatus* form) is widely distributed in tropical and temperate waters throughout the world, but frequently occur in small (10s to low 100s) isolated coastal populations. An offshore 'form' of common bottlenose dolphins occurs around the coast of southern Africa including Namibia and Angola with sightings restricted to the continental shelf edge and deeper. Offshore bottlenose dolphins frequently form mixed species groups, often with pilot whales or Risso's dolphins. Encounters in the offshore waters of Survey area are likely to be low.

Risso's Dolphin: A medium sized dolphin with a distinctively high level of scarring and a proportionally large dorsal fin and blunt head. Risso's dolphins are distributed worldwide in tropical and temperate seas and show a general preference for shelf edge waters <1 500 m deep. Many sightings in southern Africa have occurred around the Cape Peninsula and along the shelf edge of the Agulhas Bank. Presence within the inshore portions of the Survey area is possible.

Other Delphinids: Several other species of dolphins that might occur in deeper waters at low levels include the pygmy killer whale, southern right whale dolphin, rough toothed dolphin, pantropical spotted dolphin and striped dolphin. Nothing is known about the population size or density of these species in the project area but encounters are likely to be rare.

Beaked whales: These whales were never targeted commercially and their pelagic distribution makes them the most poorly studied group of cetaceans. They are all considered to be true deep-water species usually being seen in waters in excess of 1 000 – 2 000 m deep. With recorded dives of well over an hour and in excess of 2 km deep, beaked whales are amongst the most extreme divers of any air breathing animals. All the beaked whales that may be encountered in the project area are pelagic species that tend to occur in small groups usually less than five, although larger aggregations of some species are known. The long, deep dives of beaked whales make them difficult to detect visually, but PAM will increase the probability of detection as animals are frequently echo-locating when on foraging dives. Beaked whales seem to be particularly susceptible to man-made sounds and several strandings and deaths at sea, often *en masse*, have been recorded in association with mid-frequency naval sonar and a seismic survey for hydrocarbons also running a multi-beam echo-sounder and sub bottom profiler. Although the exact reason that beaked whales seem particularly vulnerable to man-made noise is not yet fully understood, existing evidence suggests that animals change their dive behaviour in response to acoustic disturbance, showing a fear-response and surfacing too quickly with insufficient time to release nitrogen resulting in a form on decompression sickness. Necropsy of stranded animals has revealed gas embolisms and haemorrhage in the brain, ears and acoustic fat – injuries consistent with decompression sickness (acoustically mediated bubble formation). Beyond decompression sickness, the fear/flee response may be the first stage in a multi-stage process ultimately resulting in stranding. Thus, although hard to detect and avoid – beaked whales are amongst the most sensitive marine mammals to noise exposure and all cautions must be taken to reduce impact. Presence in the project area may fluctuate seasonally, but insufficient data exist to define this clearly. Sightings of beaked whales in the project area are expected to be very low.

All whales and dolphins are given protection under the South African Law. The Marine Living Resources Act, 1998 (No. 18 of 1998) states that no whales or dolphins may be harassed, killed or fished. In terms of this Act no vessel or aircraft may, without a permit or exemption, approach closer than 300 m to any whale and a vessel should move to a minimum distance of 300 m from any whales if a whale surfaces closer than 300 m from a vessel or aircraft.

8.4.2.6.3 SEALS

The Cape fur seal (*Arctocephalus pusillus pusillus*) (**Figure 37**) is the only species of seal resident along the west coast of Africa, occurring at numerous breeding and non-breeding sites on the mainland and on nearshore islands and reefs. Vagrant records from four other species of seal more usually associated with the subantarctic environment have also been recorded: southern elephant seal (*Mirounga leoninas*), subantarctic fur seal (Arctocephalus tropicalis), crabeater (*Lobodon carcinophagus*) and leopard seals (*Hydrurga leptonyx*).

Figure 37: Colony of Cape fur seals *Arctocephalus pusillus pusillus*.

There are a number of Cape fur seal colonies within the broader study area: at Bucchu Twins near Alexander Bay, at Cliff Point (~17 km north of Port Nolloth), at Kleinzee (incorporating Robeiland), Strandfontein Point (south of Hondeklipbaai), Paternoster Rocks and Jacobs Reef at Cape Columbine, Vondeling Island, Robbesteen near Koeberg, Seal Island in False Bay and Geyser Rock at Dyer Island, Quoin Point and Seal Island in Mossel Bay. The colony at Kleinzee has the highest seal population and produces the highest seal pup numbers on the South African Coast. The colony at Buchu Twins and Cliff Point, formerly non-breeding colonies, have also attained breeding status. Non-breeding colonies and haul-out sites occur at Doringbaai south of Cliff Point, Rooiklippies, Swartduin and Noup between Kleinzee and Hondeklipbaai, at Spoeg River and Langklip south of Hondeklip Bay, on Bird Island at Lambert's Bay, at Paternoster Point at Cape Columbine and Duikerklip in Hout Bay. These colonies all fall well inshore and to the east of the Survey area.

Seals are highly mobile animals with a general foraging area covering the continental shelf up to 120 nautical miles offshore, with bulls ranging further out to sea than females. Their diet varies with season and availability and includes pelagic species such as horse mackerel, pilchard, and hake, as well as squid and cuttlefish.

Historically the Cape fur seal was heavily exploited for its luxurious pelt. Sealing restrictions were first introduced to southern Africa in 1893, and harvesting was controlled until 1990 when it was finally prohibited. The protection of the species has resulted in the recovery of the populations, and numbers continue to increase. Consequently, their conservation status is not regarded as threatened. The Cape Fur Seal population in South Africa is regularly monitored by the DFFE. The overall population is considered healthy and stable in size, although there has been a westward and northward shift in the distribution of the breeding population.

8.5 FISHERIES

This section provides a description of the fisheries activities of the application area. The information has been sourced from the Fisheries Impact Assessment undertaken by CapMarine included in **Appendix C**.

8.5.1 OVERVIEW OF FISHERIES SECTORS

South Africa has a coastline that spans two ecosystems over a distance of 3 623 km, extending from the Orange River in the west on the border with Namibia, to Ponta do Ouro in the east on the Mozambique border. The western coastal shelf has highly productive commercial fisheries similar to other upwelling ecosystems around the world, while the East Coast is considerably less productive but has high species diversity, including both endemic and Indo-Pacific species. South Africa's fisheries are regulated and monitored by the DFFE. All fisheries in South Africa, as well as the processing, sale in and trade of almost all marine resources, are regulated under the Marine Living resources Act (Act No. 18 of 1998 – MLRA).

Approximately 14 different commercial fisheries sectors currently operate within South African waters. **Table 15** below lists these along with ports and regions of operation, catch landings and the number of active vessels and rights holders (2017). The proportional volume of catch and economic value of each of these sectors for 2017 is indicated in **Figure 38** below. The primary fisheries in terms of economic value and overall tonnage of landings are the demersal (bottom) trawl and long-line fisheries targeting the Cape hakes (Merluccius paradoxus and M. capensis) and the pelagic-directed purse-seine fishery targeting pilchard (Sardinops sagax), anchovy (Engraulis encrasicolus) and red-eye round herring (*Etrumeus whitheadii*). Highly migratory tuna and tuna-like species are caught on the high seas and seasonally within the South African waters by the pelagic long-line and pole fisheries. Targeted species include albacore (*Thunnus alalunga*), bigeye tuna (*T. obesus*), yellowfin tuna (*T. albacares*) and swordfish (*Xiphias gladius*). The traditional line fishery targets a large assemblage of species close to shore including snoek (*Thyrsites atun*), Cape bream (*Pachymetopon blochii)*, geelbek (*Atractoscion aequidens)*, kob (*Argyrosomus japonicus)*, yellowtail (*Seriola lalandi)* and other reef fish. Crustacean fisheries comprise a trap and hoop net fishery targeting West Coast rock lobster (*Jasus lalandii*), a line trap fishery targeting the South Coast rock lobster (*Palinurus gilchristi*) and a trawl fishery based solely on the East Coast targeting penaeid prawns, langoustines (*Metanephrops andamanicus* and *Nephropsis 91uture91t91*), deep-water rock lobster (*Palinurus delagoae*) and red crab (*Chaceon macphersoni*). Other fisheries include a mid-water trawl fishery targeting horse mackerel (*Trachurus trachurus capensis*) predominantly on the Agulhas Bank (South Coast) and a hand-jig fishery targeting chokka squid (*Loligo vulgaris reynaudii*) exclusively on the South Coast. In addition to commercial sectors, recreational fishing occurs along the coastline comprising shore angling and small, open boats generally less than 10 m in length. The commercial and recreational fisheries are reported to catch over 250 marine species, although fewer than 5% of these are actively targeted by commercial fisheries, which comprise 90% of the landed catch.

Most commercial fish landings must take place at designated fishing harbours. For the larger industrial vessels targeting hake, only the major ports of Saldanha Bay, Cape Town, Mossel Bay and Port Elizabeth are used. On the West Coast, St. Helena Bay and Saldanha Bay are the main landing sites for the small pelagic fleets. These ports also have significant infrastructure for the processing of anchovy into fishmeal as well as the canning of sardine. Smaller fishing harbours on the West / South-West Coast include Port Nolloth, Hondeklip, Laaiplek, Hout Bay and Gansbaai harbours. On the East Coast, Durban and Richards Bay are deployment ports for the crustacean trawl and large pelagic longline sectors. There are more than 230 small-scale fishing communities on the South african coastline. Small-scale fisheries commonly use boats but occur mainly close to the shore. Recreational fisheries comprise shore-based, estuarine and boat-based line fisheries as well as spearfishing and net fisheries, including cast, drag and hoop net techniques.

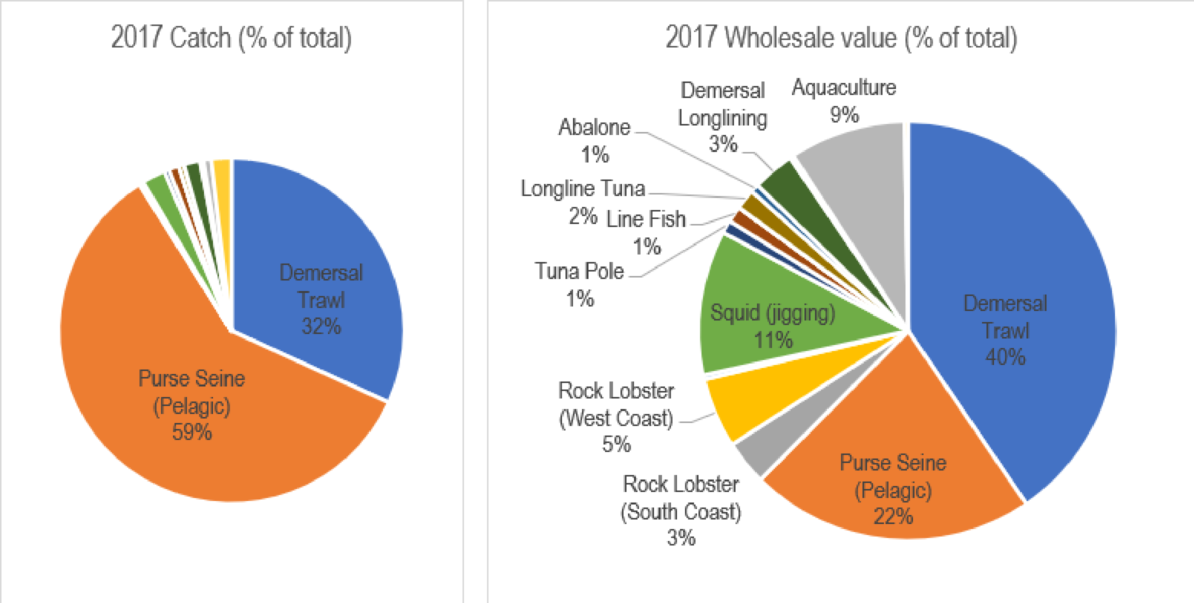


Figure 38: Pie chart showing percentage of landings by weight (left) and wholesale value (right) of each commercial fishery sector as a contribution to the total landings and value for all commercial fisheries sectors combined (2017).

Table 15: South African offshore commercial fishing sectors: wholesale value of production in 2017 ((adapted from DEFF, 2019)

Sector	No. of Rights Holders (Vessels)	Catch (tons)	Landed Catch /sales (tons)	Wholesale Value of Production in 2017 (R'000)	% of Total Value
Small pelagic purse-seine	111 (101)	313476	313476	2164224	22.0
Demersal trawl (offshore)	50 (45)	163743	98200	3891978	39.5
Demersal trawl (inshore)	18 (31)	4452	2736	90104	0.9
Mid-water trawl	34 (6)				
Demersal long-line	146 (64)	8113	8113	319228	3.2
Large pelagic long-line	30 (31)	2541	2541	154199	1.6
Tuna pole	170 (128)	2399	2399	97583	1.0
Line fish	422 (450)	4931	4931	122096	1.2
Longline shark demersal		72	72	1566	0.0
South coast rock lobster	13 (12)	699	451	*337912*	3.4
West coast rock lobster	240 (105)	1238	1238	*531659*	5.4
Crustacean trawl	6 (5)	310	310	32012	0.3
Squid jig	92 (138)	11578	11578	1099910	11.2
Miscellaneous nets	190 (N/a)	1502	1502	25589	0.3
Oysters	146 pickers	42	42	3300	0.0

Sector	No. of Rights Holders (Vessels)	Catch (tons)	Landed Catch /sales (tons)	Wholesale Value of Production in 2017 (R'000)	% of Total Value
Seaweeds	14 (N/a)	9877	6874	27095	0.3
Abalone	N/a (N/a)	86	86	*61920*	0.6
Aquaculture		3907	3907	881042	9.0
Total		**528966**	**458456**	**9841417**	**100**

Table 16: South African offshore commercial fishing sectors, landings, number of rights holders, wholesale catch value and target species.

Sector	Areas of Operation	Main Ports in Priority	Target Species
Small pelagic purse-seine	West, South Coast	St Helena Bay, Saldanha, Hout Bay, Gansbaai, Mossel Bay	Anchovy (*Engraulis encrasicolus*), sardine (*Sardinops sagax*), Redeye round herring (*Etrumeus whiteheadi*)
Demersal trawl (offshore)	West, South Coast	Cape Town, Saldanha, Mossel Bay, Port Elizabeth	Deepwater hake (*Merluccius paradoxus*), shallow-water hake (*Merluccius capensis*)
Demersal trawl (inshore)	South Coast	Cape Town, Saldanha, Mossel Bay	East coast sole (*Austroglossus pectoralis*), shallow-water hake (*Merluccius capensis*), juvenile horse mackerel (*Trachurus capensis*)
Mid-water trawl	West, South Coast	Cape Town, Port Elizabeth	Adult horse mackerel (*Trachurus capensis*)
Demersal long-line	West, South Coast	Cape Town, Saldanha, Mossel Bay, Port Elizabeth, Gansbaai	Shallow-water hake (*Merluccius capensis*)
Large pelagic long-line	West, South, East Coast	Cape Town, Durban, Richards Bay, Port Elizabeth	Yellowfin tuna (*T. albacares*), big eye tuna (*T. obesus*), Swordfish (*Xiphius gladius),* southern bluefin tuna (*T. maccoyii*)
Tuna pole	West, South Coast	Cape Town, Saldanha	Albacore tuna (*T. alalunga*)
Line fish	West, South, East Coast	All ports, harbours and beaches around the coast	Snoek (*Thyrsites atun*), Cape bream (*Pachymetopon blochii)*, geelbek (*Atractoscion aequidens)*, kob (*Argyrosomus japonicus)*, yellowtail (*Seriola lalandi),* Sparidae, Serranidae, Carangidae, Scombridae, Sciaenidae
South coast rock lobster	South Coast	Cape Town, Port Elizabeth	*Palinurus gilchristi*
West coast rock lobster	West Coast	Hout Bay, Kalk Bay, St Helena	*Jasus lalandii*
Crustacean trawl	East Coast	Durban, Richards Bay	Tiger prawn (*Panaeus monodon*), white prawn (*Fenneropenaeus indicus*), brown prawn (*Metapenaeus monoceros*), pink prawn (*Haliporoides triarthrus*)
Squid jig	South Coast	Port Elizabeth, Port St Francis	Squid/chokka (*Loligo vulgaris reynaudii)*

Sector	Areas of Operation	Main Ports in Priority	Target Species
Gillnet	West Coast	False Bay to Port Nolloth	Mullet / harders (*Liza richardsonii*)
Beach seine	West, South, East Coast	Coastal	Mullet / harders (*Liza richardsonii*)
Oysters	South, East Coast	Coastal	Cape rock oyster (*Striostrea margaritaceae*)
Seaweeds	West, South, East	Coastal	Beach-cast seaweeds (kelp, *Gelidium* spp. And *Gracilaria* spp.
Abalone	West Coast	Coastal	*Haliotis midae*

8.5.2 SPAWNING AND RECRUITMENT OF FISH STOCKS

The South African coastline is dominated by seasonally variable and sometimes strong currents, and most species have evolved highly selective reproductive patterns to ensure that eggs and larvae can enter suitable nursery grounds situated along the coastline. Three nursery grounds can be identified in South African waters, viz the Natal Bight; the Agulhas Bank and the inshore Western Cape coasts. Each is linked to a spawning area, a transport and/or recirculation mechanism, a potential for deleterious offshore or alongshore transport and an enriched productive area of coastal or shelf-edge upwelling.

Hake, sardines, anchovy and horse mackerel are broadcast spawners, producing large numbers of eggs that are widely dispersed in ocean currents. The principal commercial fish species undergo a critical migration pattern in the Agulhas and Benguela ecosystems. Adults spawn on the Agulhas Bank in spring (September to November) between the shelf-edge upwelling and the cold-water ridge, where copepod availability is highest. The spawn moves southwards with the Agulhas current before drifting northwards in the Benguela current across the shelf. As the eggs drift, hatching takes place followed by larval development. Settlement of larvae occurs in the inshore areas, in particular the bays that are used as nurseries – this takes place from October through to March. Juveniles shoal and then begin a southward migration – it is at this stage that anchovy and sardine are targeted by the small pelagic purse seine fishery. Demersal species such as hake migrate offshore into deeper water where they are targeted by commercial fisheries. Spawning of key species are presented below:

- Hake, snoek and round herring move to the western Agulhas Bank and southern west coast to spawn during key periods (late winter to early spring), when losses due to offshore drift are at a minimum and eggs and larvae drift northwards and inshore to the west coast nursery grounds.
- Hake are serial spawners and are reported to spawn throughout the year with peaks in October/November and March/April. During these periods there is a greater concentration of drifting eggs and larvae compared to other months. Spawning of the shallow-water hake occurs primarily over the shelf (<200 m) whereas that by the deep-water hake occurs off the shelf.
- Horse mackerel spawn over the east/central Agulhas Bank during winter months but are also concentrated on the eastern part of the bank most months in feeding aggregations. Juveniles occur close inshore off the southern Cape coastline and west coast nursery habitats.
- Anchovies are only known to spawn on the western and central Agulhas Bank, with spawning peaking during mid-summer (November–December) and some shifts to the west coast in years when Agulhas Bank water intrudes strongly north of Cape Point.
- Sardines spawn mainly on the central Agulhas Bank, although spawning may occur across the whole of the Bank. Spawning occurs during spring in early spring and autumn, on either side of the peak anchovy spawning period. Spawning also occurs on the west coast during November between latitudes 31S and 35S. There is also some evidence of spawning off the east coast, Kwa-Zulu Natal during July–November. There is an intense seasonal migration of sardine eastwards that occurs in mid-winter and which is associated with westerly frontal systems driving fish inshore in counter currents.

- Squid (Loligo spp.) spawn in the nearshore zone on the eastern Agulhas Bank, principally in shallow waters (<50 m) between Knysna and Gqeberha. Their distribution and abundance are erratic and linked to temperature, turbidity, and currents. This niche area on the eastern Agulhas Bank optimises their spawning and early life stage as nowhere else on the shelf are both bottom temperature and bottom dissolved oxygen simultaneously at optimal levels for egg development. The greatest concentration of their food (copepods) tends to be found further west in the cold-water ridge on the central Agulhas Bank. Squid are not broadcast spawners but instead they lay benthic egg sacs. The paralarvae that hatch from the sacs are distributed close inshore and juveniles are dispersed over the entire shelf region of the Agulhas Bank. Larvae and juveniles are carried offshore and westwards (via the Benguela jet) to feed and mature, before returning to the spawning grounds to complete their lifecycle.
- The inshore area of the Agulhas Bank, especially between the cool water ridge and the shore, serves as an important nursery area for numerous line fish. A significant proportion of these eggs and larvae originate from spawning grounds along the east coast, as adults undertake spawning migrations along the South Coast into KwaZulu-Natal waters. The eggs and larvae are subsequently dispersed southwards by the Agulhas Current, with juveniles occurring on the inshore Agulhas Bank, using the area between the cold-water ridge and the shore as nursery grounds. In the case of the carpenter, a high proportion of the reproductive output comes from the central Agulhas Bank and the Tsitsikamma MPA, and two separate nursery grounds appear to exist, one near Gqeberha and a second off the deep reefs off Cape Agulhas, with older fish spreading eastwards and westwards.

Refer to **Figure 39** for an overview of the main fish spawning grounds and nursery areas off the West and South Coasts of South Africa. **Figure 40** shows spawning grounds and nursery areas of snoek.

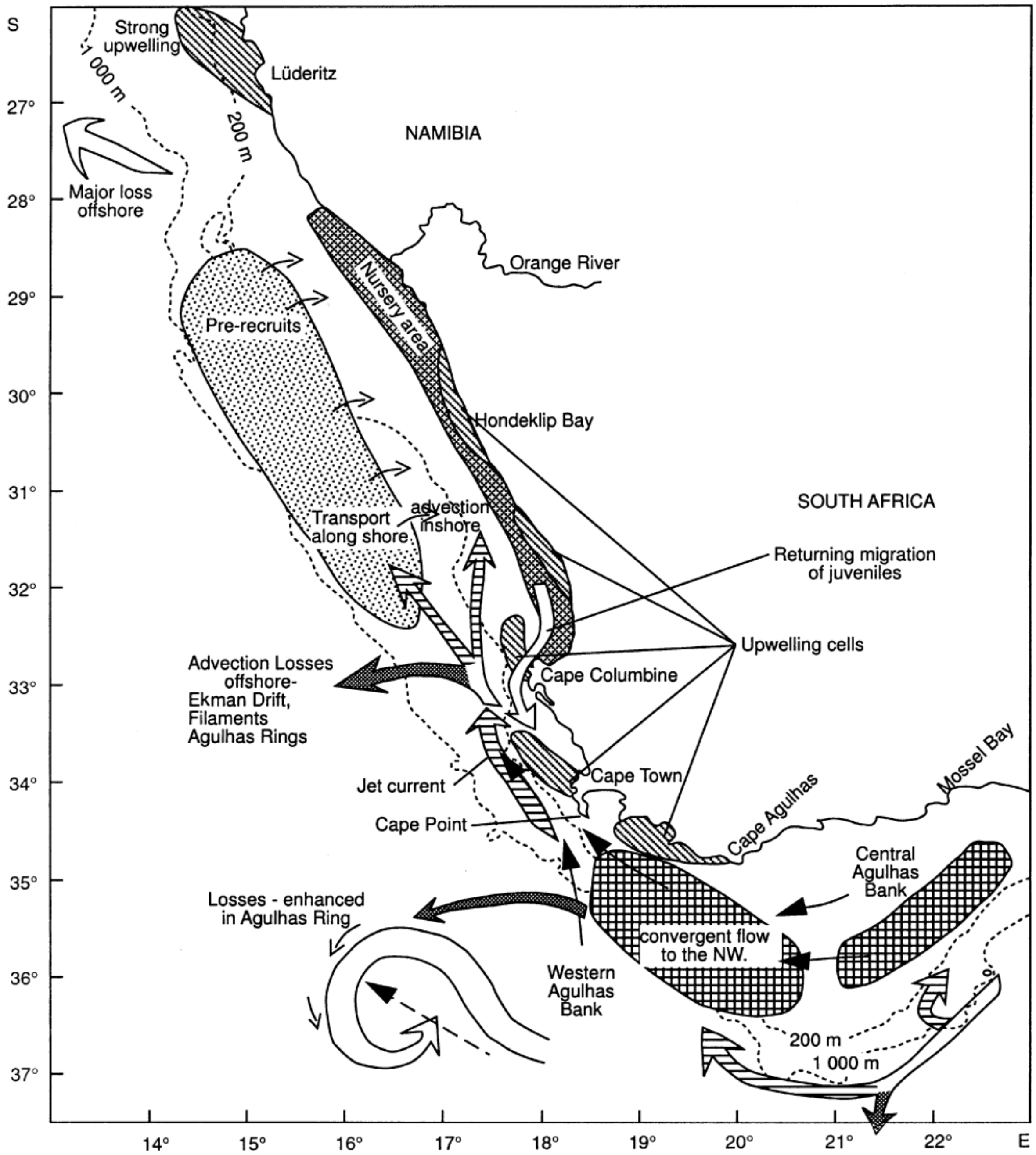


Figure 39: Generalised figure of the main fish recruiting process for species caught on the West Coast of South Africa.

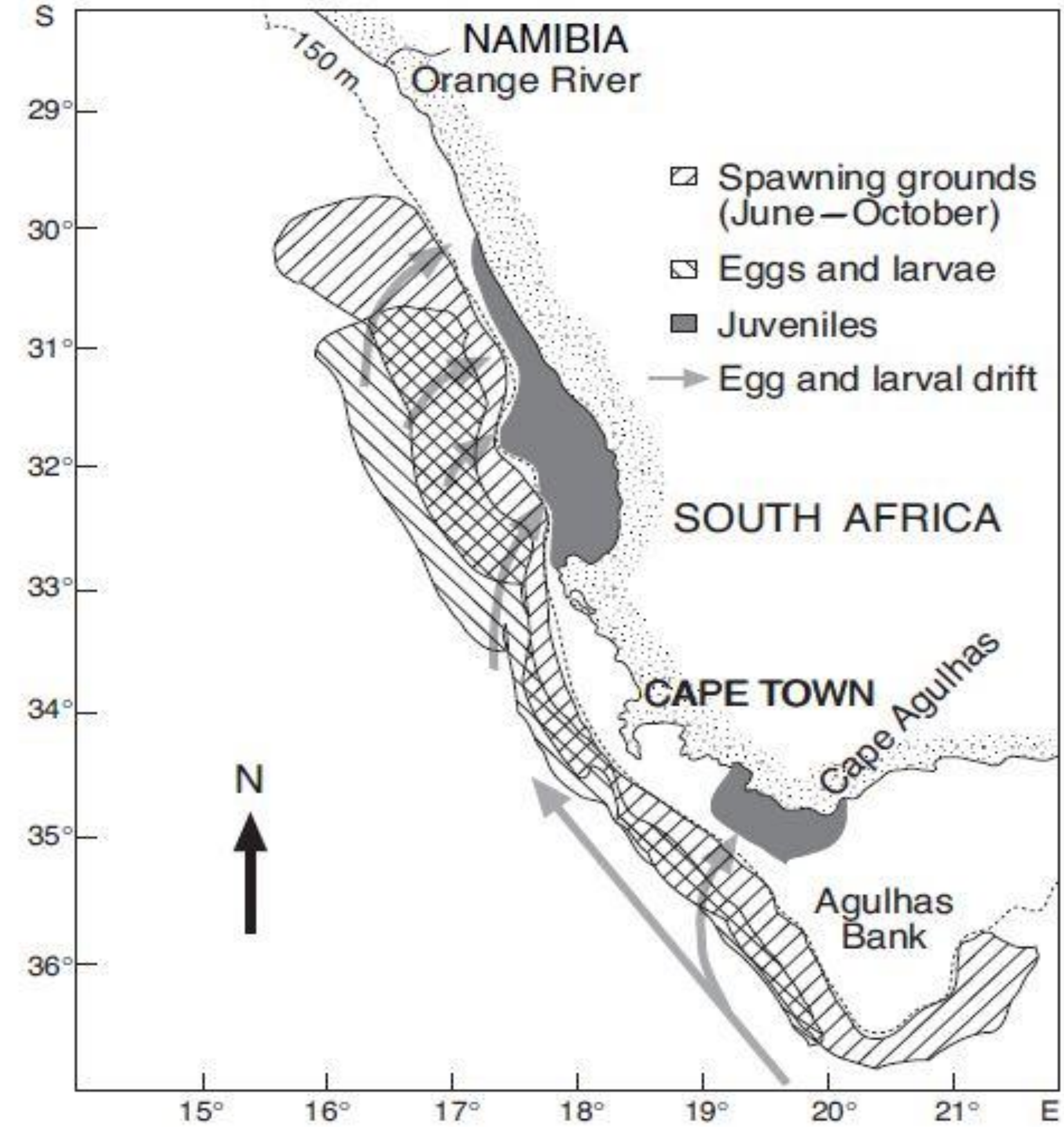


Figure 40: Conceptual model depicting the life history of snoek in the southern Benguela ecosystem, including spawning grounds, distribution and transport of eggs and larvae, and the nursery areas.

8.5.3 COMMERCIAL FISHING SECTORS

8.5.3.1 DEMERSAL TRAWL

The primary fisheries in terms of highest economic value are the demersal (bottom) trawl and long-line fisheries targeting the Cape hakes (*Merluccius paradoxus* and *M. capensis*). Secondary species include a large assemblage of demersal fish of which monkfish (*Lophius vomerinus*), kingklip (*Genypterus capensis*) and snoek (*Thyrsites atun*) are the most commercially important. The demersal trawl fishery comprises an offshore and inshore fleet, which differ primarily in terms of vessel capacity and the areas in which they operate. The wholesale value of catch landed by the inshore and offshore demersal trawl sectors, combined, during 2017 was R3.982 Billion, or 40.5% of the total value of all fisheries combined. The 2021 TAC for hake is set at 139 109 tons, of which 84% and 6% is allocated to the offshore and inshore trawl sectors, respectively.

The offshore fishery is comprised of 45 vessels operating from most major harbours on both the West and South Coasts. On the West and South-West Coasts, these grounds extend in a continuous band along the shelf edge between the 200 m and 1 000 m bathymetric contours although most effort is in the >300 m to 600 m depth range. Monkfish-directed trawlers tend to fish shallower waters than hake-directed vessels on mostly muddy substrates. Trawl nets are generally towed parallel to the depth contours (thereby maintaining a relatively constant depth) in a north-westerly or south-easterly direction. Trawlers also target fish aggregations around bathymetric features, in particular seamounts and canyons, where there is an increase in seafloor slope and in these cases the direction of trawls follow the depth contours. The deep-sea sector is prohibited from operating in waters shallower than 110 m or within five nautical miles of the coastline.

The inshore fishery consists of 31 vessels, which operate on the South Coast mainly from the harbours of Mossel Bay and Port Elizabeth. Inshore grounds are located on the Agulhas Bank and extend towards the Great Kei River in the east. Vessels also target sole close inshore between Struisbaai and Mossel Bay, between the 50 m and 80 m isobaths. Hake is targeted further offshore in traditional grounds between 100 m and 200 m depth in fishing grounds known as *the Blues* located on the Agulhas Bank.

Otter trawling is the main trawling method used in the South African hake fishery. This method of trawling makes use of trawl doors (also known as otter boards) that are dragged along the seafloor ahead of the net, maintaining the horizontal net opening. Bottom contact is made by the footrope and by long cables and bridles between the doors and the footrope. Behind the trawl doors are bridles connecting the doors to the wings of the net (to the ends of the footrope and headrope). A headline, bearing floats and the weighted footrope (that may include rope, steel wire, chains, rubber discs, spacers, bobbins or weights) maintain the vertical net opening. The “belly”, “wings” and the “cod-end” (the part of the net that retains the catch) may contact the seabed. The configuration of trawling gear is similar for both offshore and inshore vessels however inshore vessels are smaller and less powerful than those operating within the offshore sector. The offshore fleet is segregated into wetfish and freezer vessels which differ in terms of the capacity for the processing of fish at sea and in terms of vessel size and capacity. While freezer vessels may work in an area for up to a month at a time, wetfish vessels may only remain in an area for about a week before returning to port. Wetfish vessels range between 24 m and 56 m in length while freezer vessels are usually larger, ranging up to 90 m in length. Inshore vessels range in length from 15 m to 40 m. Trips average three to five days in length and all catch is stored on ice.

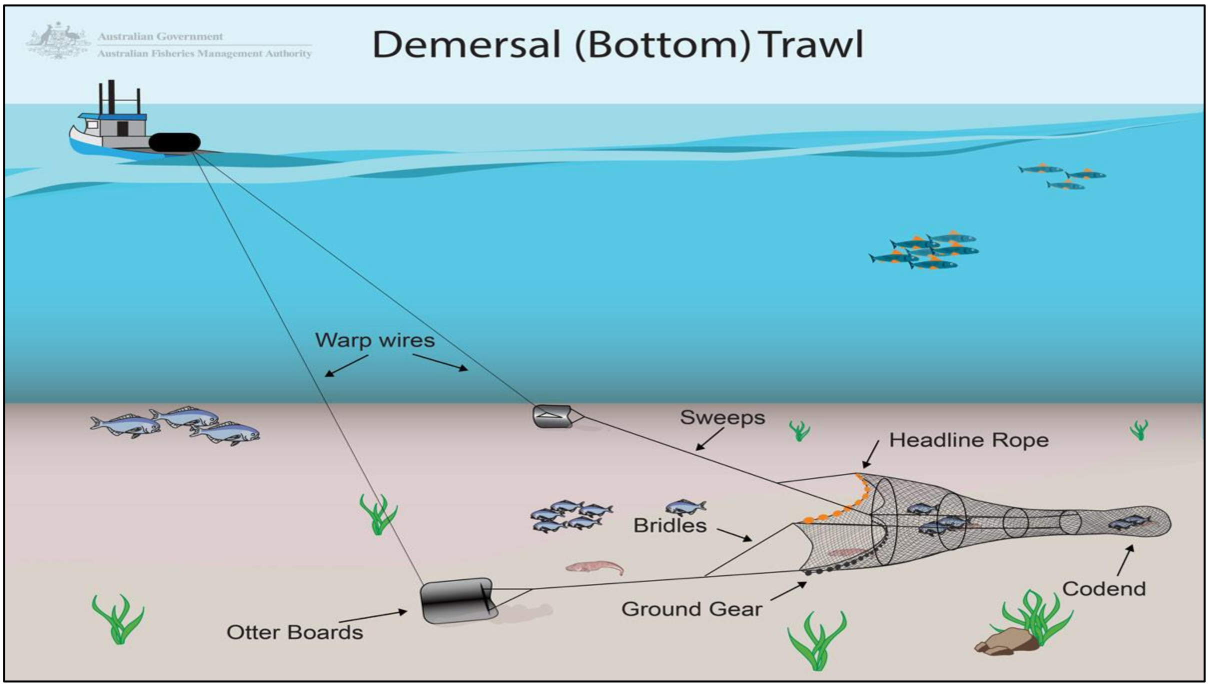


Figure 41: Typical gear configuration used by offshore demersal trawlers targeting hake.

The activity of the fishery is restricted by permit condition to operating within the confines of a historical “footprint” – an area of approximately 57 300 km^2 and 17 000 km^2 for the offshore and inshore fleets, respectively. **Figure 42** below shows an overview of the spatial distribution of fishing activity within the EEZ and in relation to the proposed survey area.

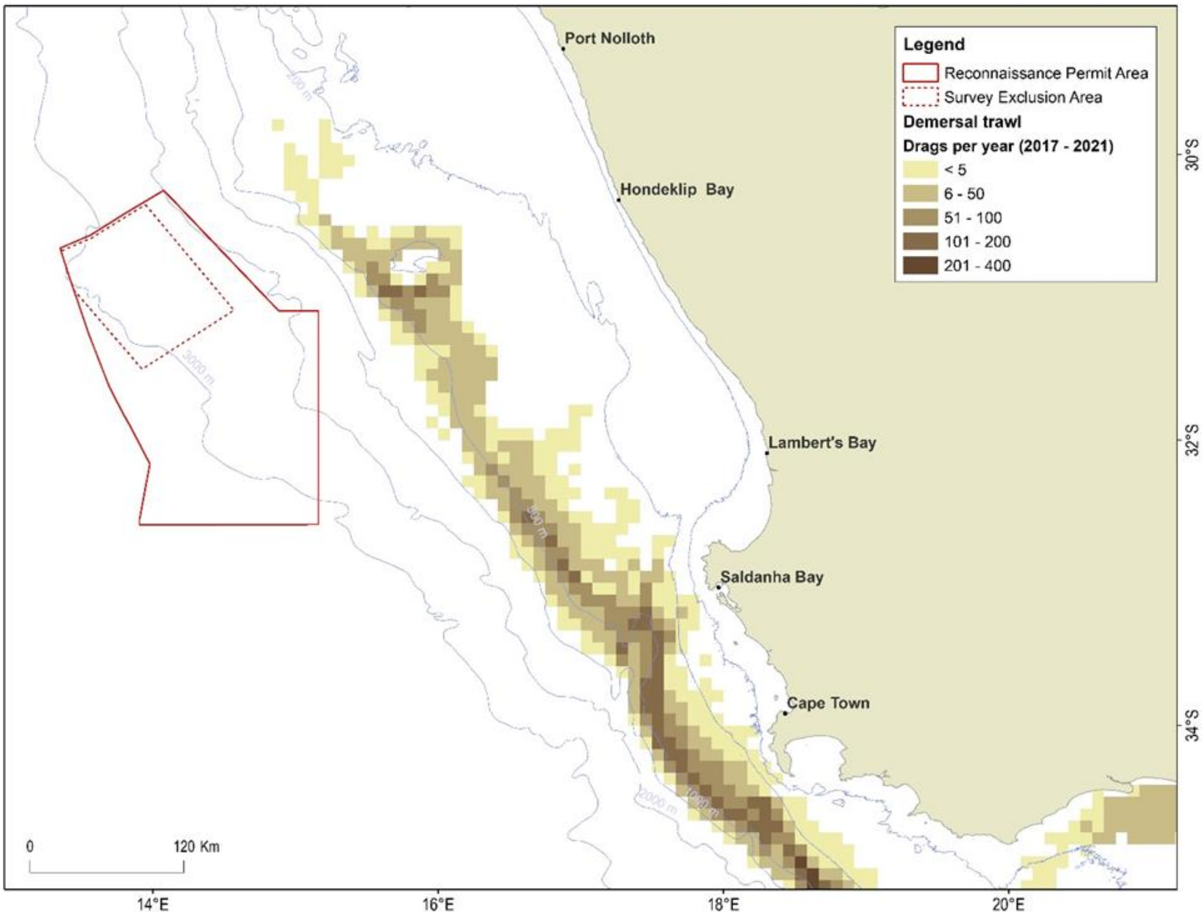


Figure 42: Overview of the spatial distribution of fishing effort expended by the demersal trawl sector and the demersal catch reporting grid system in relation in relation to the proposed 3D seismic survey area.

8.5.3.2 MID-WATER TRAWL

The midwater trawl fishery targets adult Cape horse mackerel (*Trachurus capensis*), which aggregate in highest concentration on the Agulhas Bank. Cape horse mackerel are semi-pelagic shoaling fish that occur on the continental shelf off southern Africa from southern Angola to the Wild Coast. Off South Africa, adult horse mackerel are currently more abundant off the South Coast than the West Coast. Horse mackerel yield a low-value product and are a source of cheap protein. This sector included six vessels and 34 rights holders which target adult horse mackerel of which a total catch of 19 555 tons were landed in 2019. Mid-water trawl is defined in the MLRA as any net which can be dragged by a fishing vessel along any depth between the sea bed and the surface of the sea without continuously touching the bottom. In practice, mid-water trawl gear does occasionally come into contact with the seafloor. Mid-water trawling gear configuration is similar to that of demersal trawlers, except that the net is manoeuvred vertically through the water column (refer to **Figure 43** for a schematic diagram of gear configuration). Several demersal trawlers are able to undertake mid-water trawling by switching gear and operating under dual rights, but currently the FMV Desert Diamond is the only dedicated mid-water trawler and is the largest registered South African commercial fishing vessel. The *Desert Diamond* is 120 m in length and has a Gross Registered Tonnage (GRT) of 8 000 t. The towed gear may extend up to 1 km astern of the vessel and comprises trawl warps, net and cod end. Trawl warps are between 32 mm and 38 mm in diameter. The trawl doors (3.5 t each) maintain the net opening which ranges from 120 to 130 m in width and from 40 m to 80 m in height. Weights in front of, and along the ground-rope provide for vertical opening of the trawl. The cable transmitting acoustic signal from the net sounder might also provide a lifting force that maximizes the vertical trawl opening. To reduce the resistance of the gear and achieve a large opening, the front part of the trawls are usually made from very large rhombic or hexagonal meshes. The use of nearly parallel ropes instead of meshes in the front part is also a common design. Once the gear is deployed, the net is towed for several hours at a speed of 4.8 to 6.8 knots predominantly parallel with the shelf break.

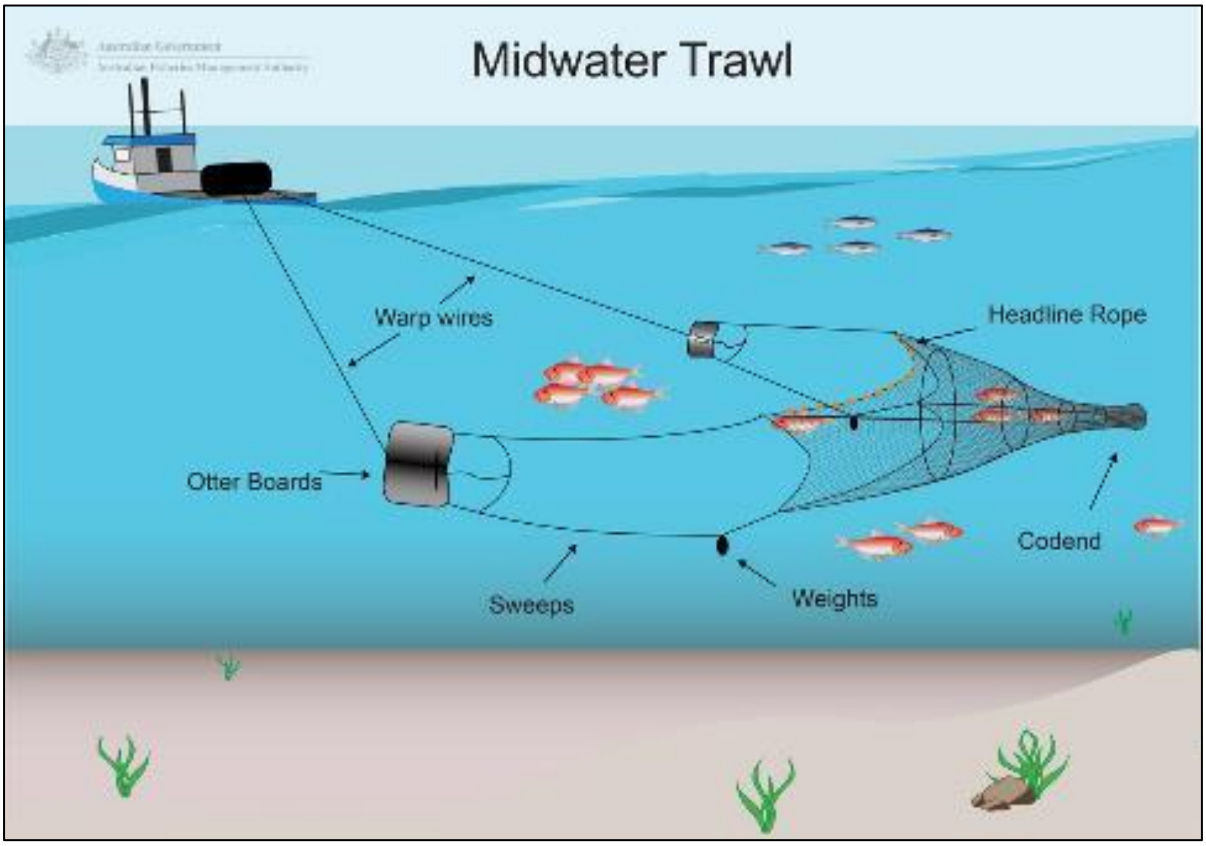


Figure 43: Schematic diagram showing the typical gear configuration of a mid-water trawler.

The fishery operates predominantly on the edge of the Agulhas Bank, where shoals are found in commercial abundance. Fishing grounds off the South Coast are situated along the shelf break and three dominant areas can be defined. The first lies between 22 E and 23°E at a distance of approximately 70 nm offshore from Mossel Bay and the second extends from 24°E to 27°E at a distance of approximately 30 nm offshore. The third area lies to the south of the Agulhas Bank 21 °E and 22 °E. These grounds range in depth from 100 m to 400 m and isolated trawls are occasionally recorded up to 650 m. From 2017, DFFE has permitted experimental fishing to take place westward of 20°E. Figure 44 below shows the spatial extent of grounds fished by mid-water trawlers within the EEZ and in relation to the proposed 3D seismic survey area. Sector activity off the West Coast takes place predominantly south of Cape Town at a depth range of between 120 m and 580 m. There is no overlap between midwater trawl grounds and the Reconnaissance Permit application area which is situated at least 50 km from the closest fishing location and 300 km from the main fishing areas.

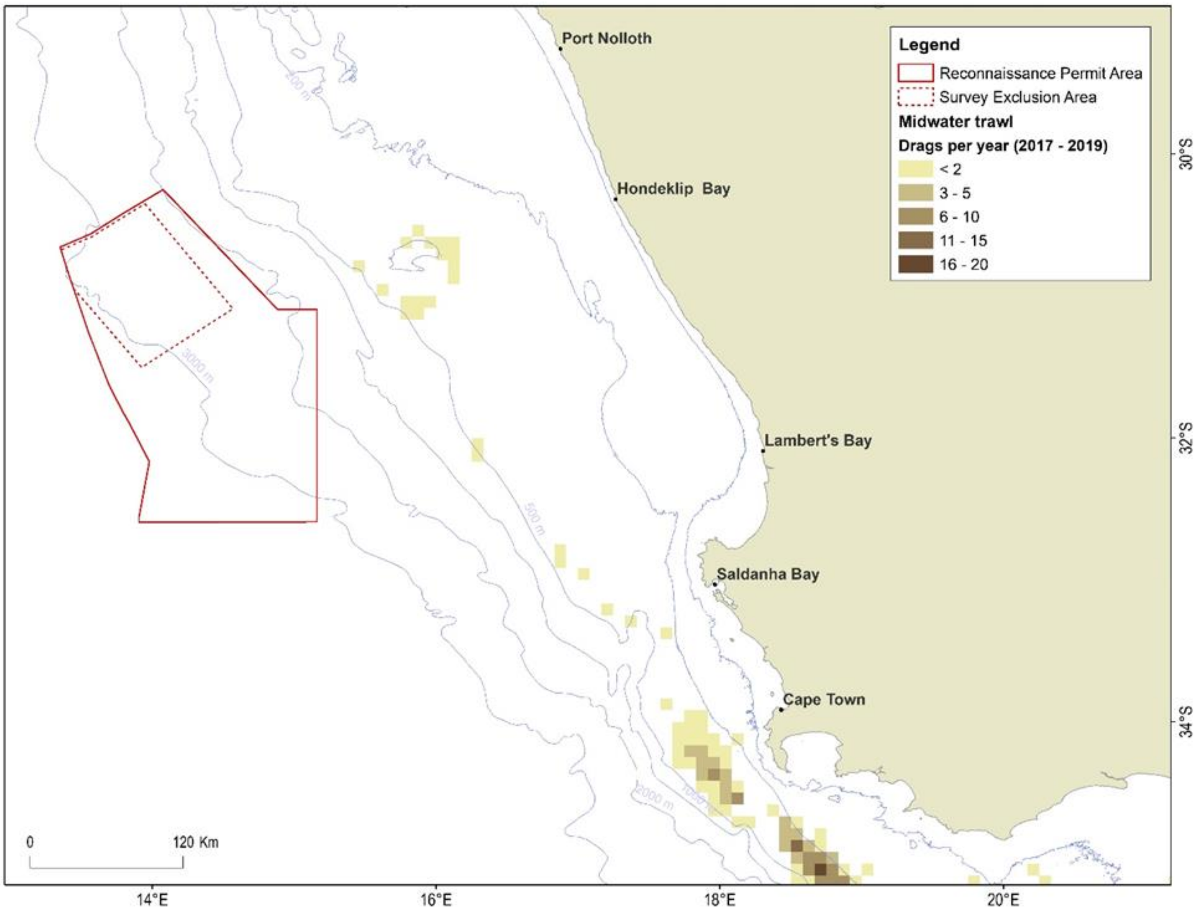


Figure 44: DFFE's catch reporting grid system and the spatial distribution of fishing effort expended by the midwater trawl sector in relation to the Reconnaissance Permit application area.

8.5.3.3 DEMERSAL HAKE LONGLINE

Like the demersal trawl fishery, the target species of the longline fishery is the Cape hakes, with a small non-targeted commercial by-catch that includes kingklip. In 2017, 8 113 tons of catch was landed with a wholesale value of R319.2 Million, or 3.2% of the total value of all fisheries combined. Landings of 8 230 tons were reported in 2018.

A demersal longline vessel may deploy either a double or single line which is weighted along its length to keep it close to the seafloor. Steel anchors, of 40 kg to 60 kg, are placed at the ends of each line to anchor it and are marked with an array of floats. If a double line system is used, top and bottom lines are connected by means of dropper lines. Since the top-line (polyethylene, 10 – 16 mm diameter) is more buoyant than the bottom line, it is raised off the seafloor and minimizes the risk of snagging or fouling. The purpose of the top-line is to aid in gear retrieval if the bottom-line breaks at any point along the length of the line. Lines are typically between 10 km and 20 km in length, carrying between 6 900 and 15 600 hooks each. Baited hooks are attached to the bottom line at regular intervals (1 to 1.5 m) by means of a snood. Gear is usually set at night at a speed of between five and nine knots. Once deployed the line is left to soak for up to eight hours before it is retrieved. A line hauler is used to retrieve gear (at a speed of approximately one knot) and can take six to ten hours to complete. A schematic representation of the gear configuration used by the demersal longline fleet is shown in **Figure 45** below.

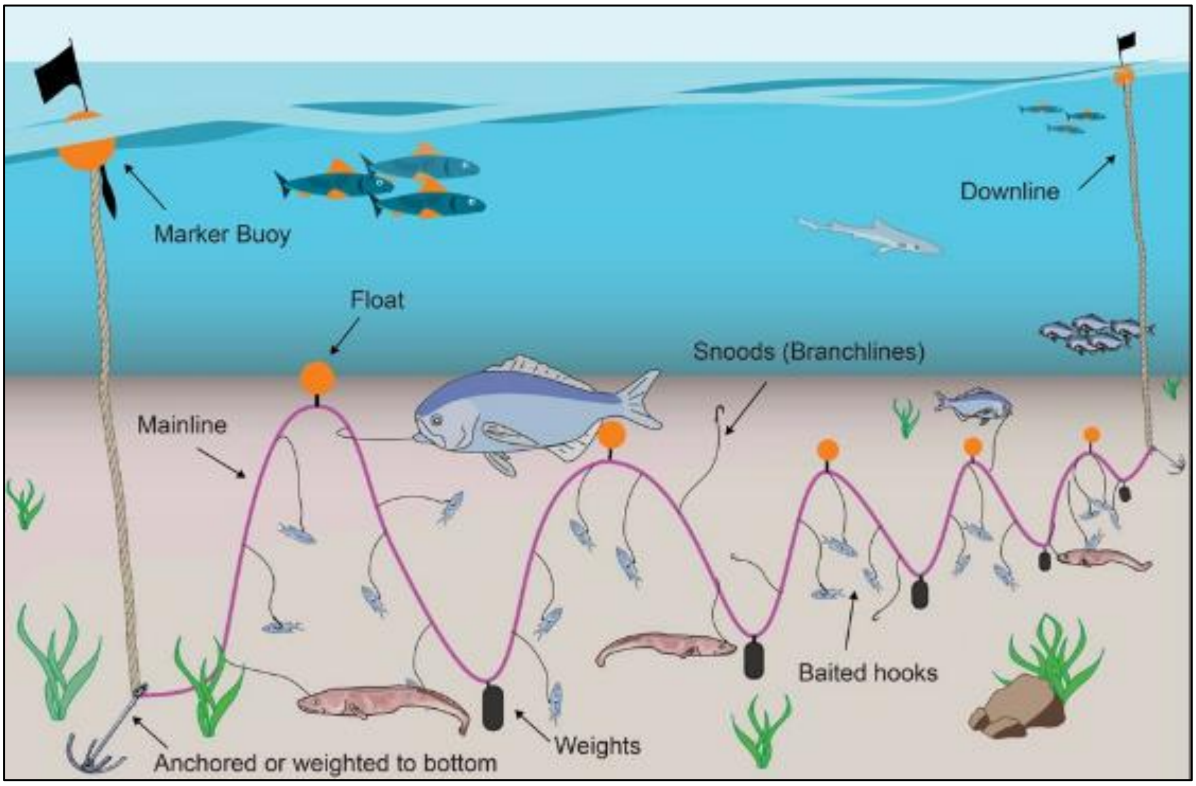


Figure 45: Typical configuration of demersal longline gear used in the South African hake-directed fishery.

Currently 64 hake-directed vessels are active within the fishery, most of which operate from the harbours of Cape Town and Hout Bay. Fishing grounds are similar to those targeted by the hake-directed trawl fleet. The hake longline footprint extends down the west coast from approximately 150 km offshore of Port Nolloth (15°E, 29°S). It lies inshore to the south of St Helena Bay moving offshore once again as it skirts the Agulhas Bank to the south of the country (21°E, 37°S). Along the South Coast the footprint moves inshore again towards Mossel Bay. The eastern extent of the footprint lies at approximately (26°E, 34.5°S). Lines are set parallel to bathymetric contours, along the shelf edge up to the 1 000 m depth contour in places. The patchy nature of effort in the north western extents of the footprint and the eastern edge of the Agulhas Bank may be attributed to proximity to fishing harbours. **Figure 46** below shows the spatial extent of demersal longline grounds in relation to the proposed 3D seismic survey area.

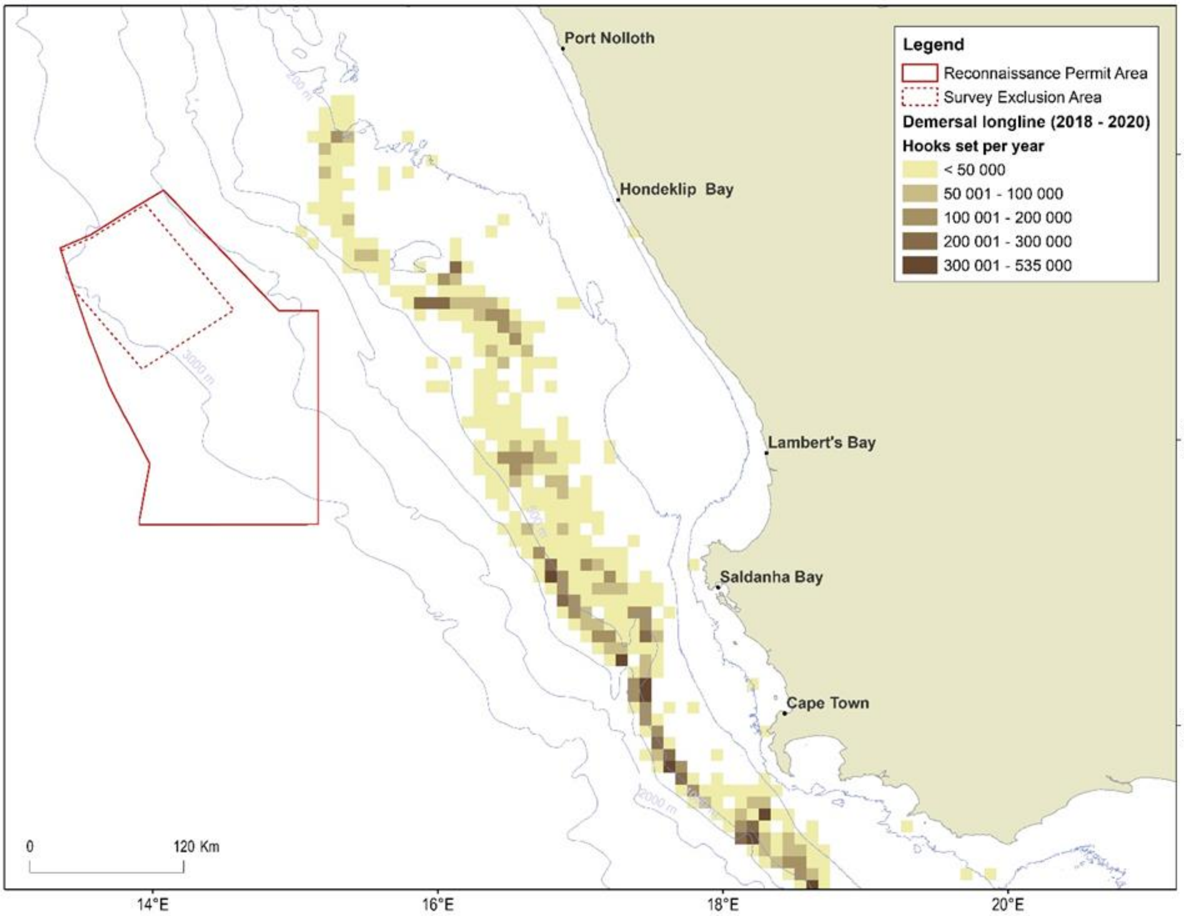


Figure 46: An overview of the spatial distribution of fishing effort expended by the hake demersal longline sector and in relation to the proposed 3D seismic survey area.

8.5.3.4 DEMERSAL SHARK LONGLINE

The shark longline sector formally commenced in 1991 when 30 permits were issued initially to target both demersal and pelagic sharks (pelagic sharks are those living in the water column, often occurring further offshore). In 2005 the dual targeting of demersal and pelagic sharks under the same permit was discontinued and the sector became an exclusive demersal shark longline fishery reduced to eleven Right Holders in 2004 and just six in 2006. The demersal shark longline fishery is permitted to operate in coastal waters from the Orange River on the West Coast to the Kei River on the East Coast but fishing rarely takes place north of Table Bay. Vessels are typically <30 m in length and use nylon monofilament Lindgren Pitman spool systems to set weighted longlines baited with up to 2 000 hooks (average = 917 hooks). The fishery operates in waters generally shallower than 100 m and uses bottom-set gear to target predominantly soupfin sharks and smoothhound sharks. Following an initial period of adjustment to catching and marketing demersal sharks, catches of soupfin and smoothhound sharks started increasing in 2006, and reporting became more reliable. As the majority of Right Holders own additional Rights in other fisheries, the number of active vessels fluctuates over the year but rarely exceeds four vessels operating at the same time. Annual landings have fluctuated widely due to variation in demand and price. Rights are due to be re-allocated during the fishing Rights allocation process in 2021/2022.

The commercial-scale exploitation of sharks began in the 1930s around traditional fishing villages in the Western Cape. This fishery used handlines and targeted inshore demersal sharks for their livers to be used in the production of Vitamin A oil. By the 1940s, catches of soupfin sharks had declined (Davies, 1964) as targeting shifted. To date, this Western Cape soupfin fishery has not recovered to historical catch levels. To compensate for declining catch rates of high-value line fish species, a rapid increase was seen in shark catches between 1990 and 1993. After 2000, species-specific reporting came into effect and sharks continued to constitute a large proportion of the livelihood of these fishers around South Africa, with the establishment of a number of dedicated shark processing facilities.

Shark catches by the line fishery since the 1990s have typically fluctuated in response to the availability of higher priced line fish species and market influences. Species targeted include soupfin sharks, smoothhound sharks, dusky sharks *Carcharhinus obscurus*, bronze whaler sharks *C. brachyurus*, and various skate species.

Figure 47 shows the spatial distribution of shark-directed demersal longline catch between 2017 and 2019 in relation to the Reconnaissance Permit application area and proposed 3D seismic survey area. Recent fishing activity shows effort occurs East of Cape Point, inshore of the 100 m depth contour and thus inshore of the Reconnaissance Permit application area. The closest fishing activity is situated 360 km from the Reconnaissance Permit area at closest point. There is no overlap of the demersal longline sector with the Reconnaissance Permit area.

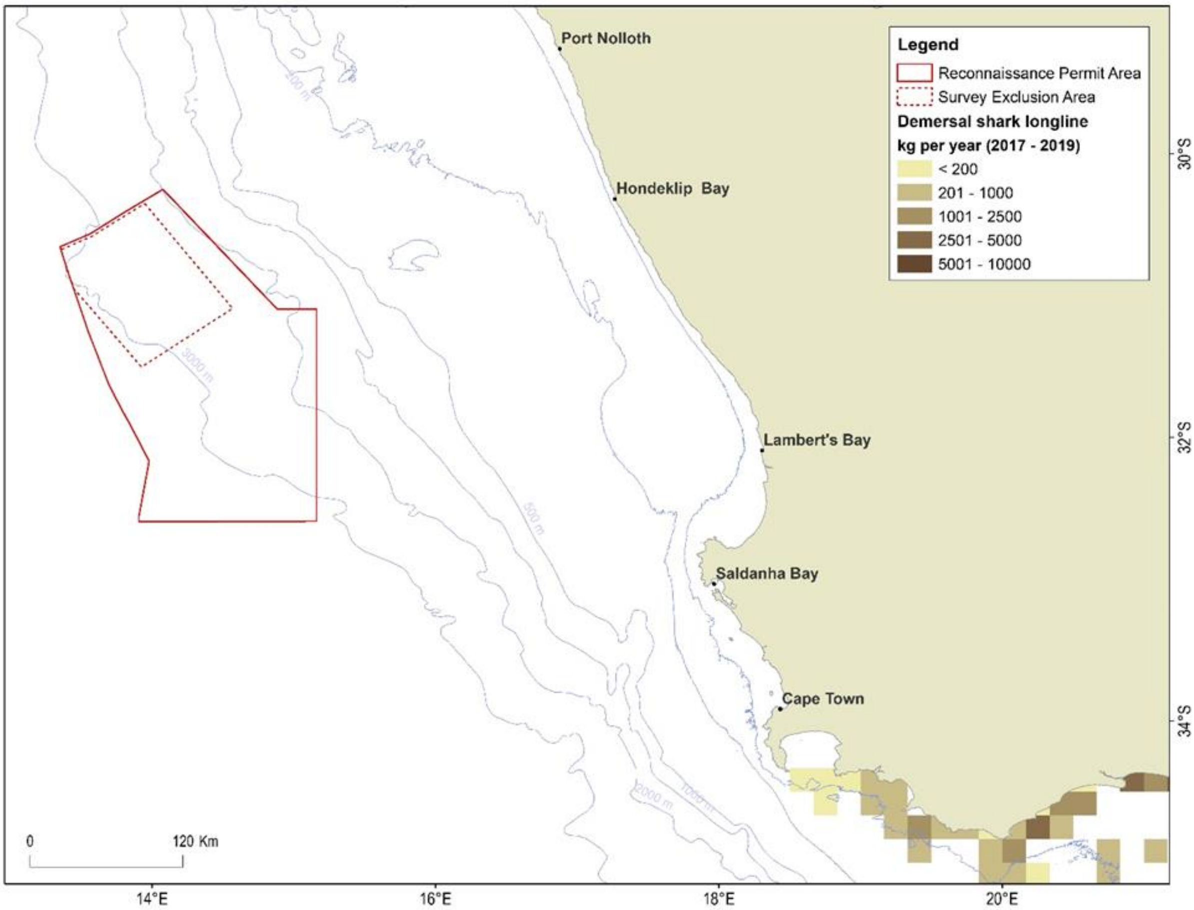


Figure 47: An overview of the spatial distribution of fishing effort expended by the shark-directed demersal longline sector in relation to the Reconnaissance Permit application area.

8.5.3.5 SMALL PELAGIC PURSE-SEINE

The pelagic-directed purse-seine fishery targeting pilchard (*Sardinops sagax)*, anchovy (*Engraulis encrasicolus*) and red-eye round herring (*Etrumeus whitheadi*) is the largest South African fishery by volume (tons landed) and the second most important in terms of economic value. The wholesale value of catch landed by the sector during 2017 was R2.164 Billion or 22% of the total value of all fisheries combined. Landings during 2019 amounted to 226 872 tons.

The abundance and distribution of small pelagic species fluctuates considerably in accordance with the upwelling ecosystem in which they exist. Fish are targeted in inshore waters, primarily along the West and South Coasts of the Western Cape and the Eastern Cape coast, up to a maximum offshore distance of about 100 km.

The fleet consists of approximately 100 wooden, glass-reinforced plastic and steel-hulled vessels ranging in length from 11 m to 48 m. The targeted species are surface-shoaling and once a shoal has been located the vessel will steam around it and encircle it with a large net, extending to a depth of 60 m to 90 m (**Figure 48** below). Netting walls surround aggregated fish, preventing them from diving downwards. These are surface nets framed by lines: a float line on top and lead line at the bottom. Once the shoal has been encircled the net is pursed, hauled in and the fish pumped on board into the hold of the vessel. It is important to note that after the net is deployed, the vessel has no ability to manoeuvre until the net has been fully recovered on board and this may take up to 1.5 hours. Vessels usually operate overnight and return to offload their catch the following day.

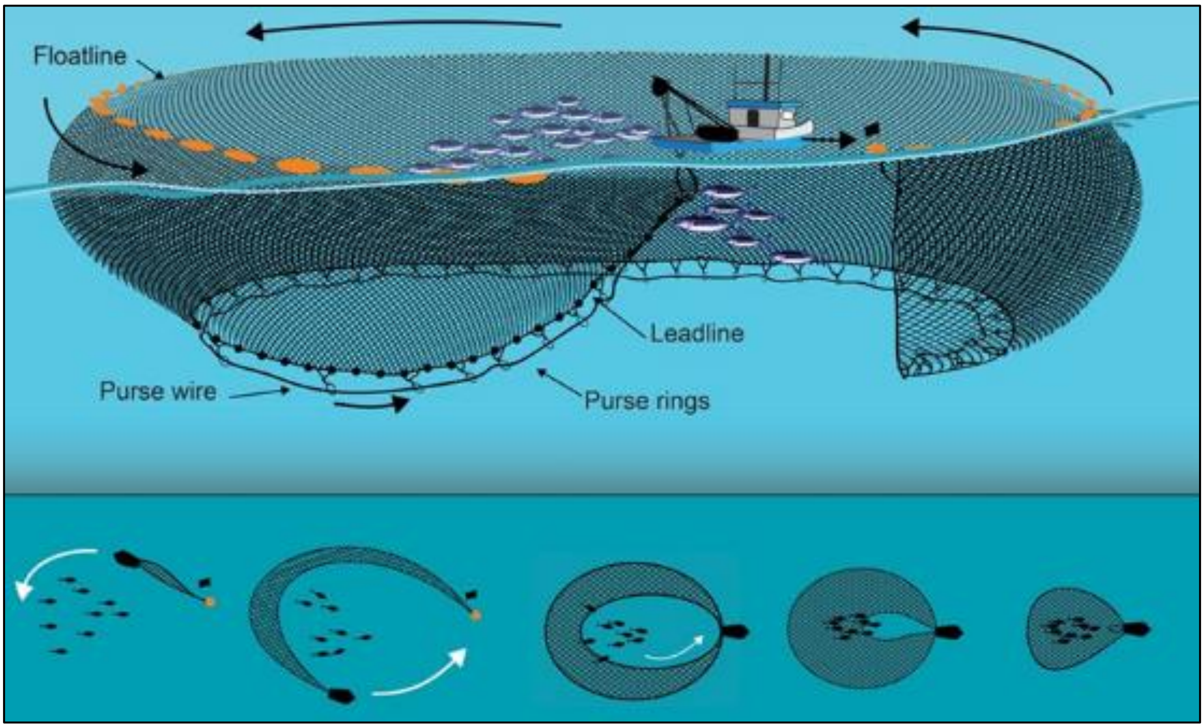


Figure 48: Schematic diagram showing typical configuration and deployment of a small pelagic purse-seine for targeting anchovy and sardine as used in South African waters.

The majority of the fleet operate from St Helena Bay, Laaiplek, Saldanha Bay and Hout Bay with fewer vessels operating on the South Coast from the harbours of Gansbaai, Mossel Bay and Port Elizabeth. Ports of deployment correspond to the location of canning factories and fish reduction plants along the coast. The geographical distribution and intensity of the fishery is largely dependent on the seasonal fluctuation and distribution of the targeted species. The sardine-directed fleet concentrates effort in a broad area extending from Lambert's Bay, southwards past Saldanha and Cape Town towards Cape Point and then eastwards along the coast to Mossel Bay and Port Elizabeth. The anchovy-directed fishery takes place predominantly on the South-West Coast from Lambert's Bay to Kleinbaai (19.5°E) and similarly the intensity of this fishery is dependent on fish availability and is most active in the period from March to September. Round herring (non-quota species) is targeted when available and specifically in the early part of the year (January to March) and is distributed from Lambert's Bay to south of Cape Point. This fishery may extend further offshore than the sardine and anchovy-directed fisheries. The fishery operates throughout the year with a short seasonal break from mid-December to mid-January. Figure 49 below shows the spatial extent of fishing grounds in relation to the proposed 3D survey area.

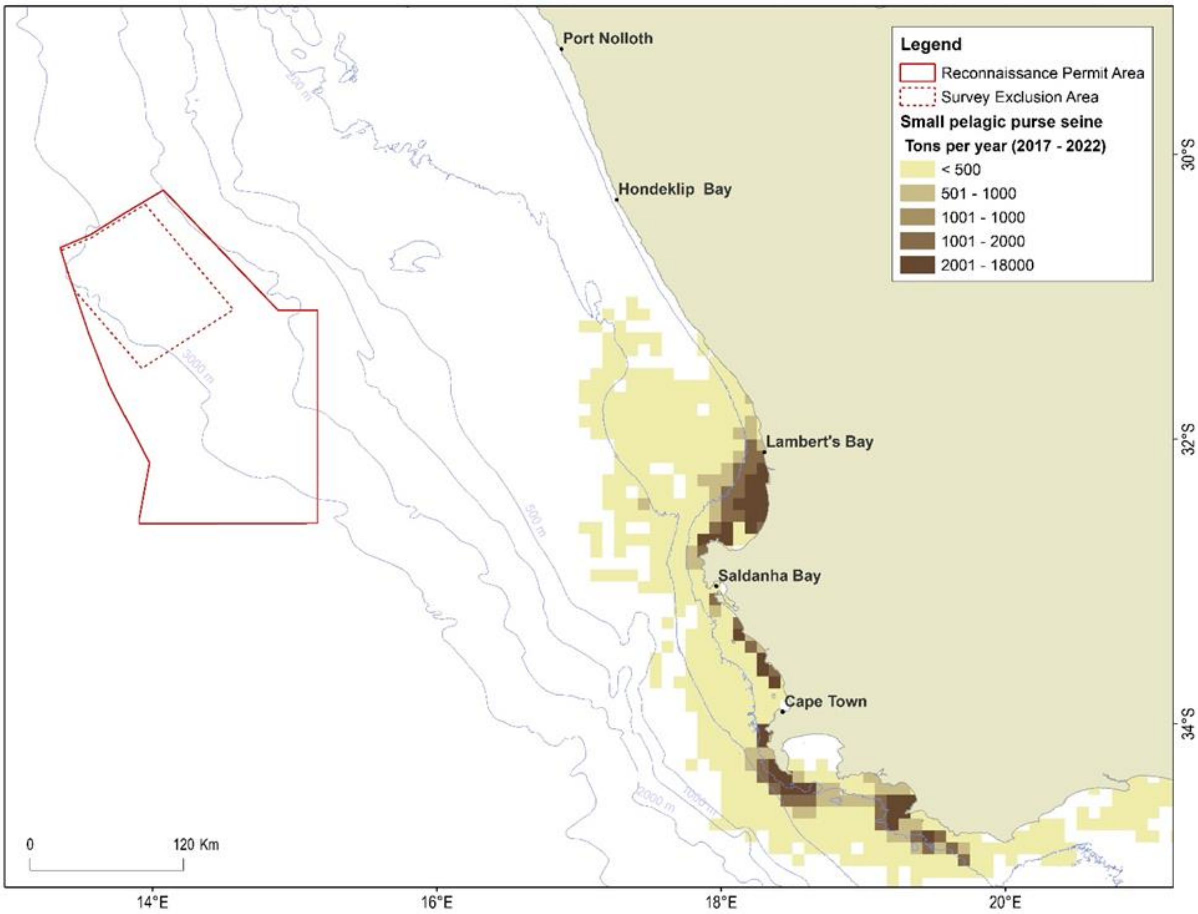


Figure 49: An overview of the spatial distribution of catch reported by the purse-seine sector targeting small pelagic species in relation to the proposed survey application area.

8.5.3.6 LARGE PELAGIC LONGLINE

Highly migratory tuna and tuna-like species are caught on the high seas and seasonally within the South African EEZ by the pelagic longline and pole fisheries. Targeted species include albacore (*Thunnus alalunga*), bigeye tuna (*T. obesus*), yellowfin tuna (*T. albacares*) and swordfish (*Xiphias gladius*). The wholesale value of catch landed by the sector during 2017 was R154.2 Million, or 1.6% of the total value of all fisheries combined, with landings of 2541 tons (2017) and 2815 tons (2018). Tuna, tuna-like species and billfishes are migratory stocks and are therefore managed as a “shared resource” amongst various countries under the jurisdiction of the International Commission for the Conservation of Atlantic Tunas (ICCAT) and the Indian Ocean Tuna Commission (IOTC). In the 1970s to mid-1990s the fishery was exclusively operated by Asian fleets (up to 130 vessels) under bilateral agreements with South Africa. From the early 1990s these vessels were banned from South African waters and South Africa went through a period of low fishing activity as fishing rights issues were resolved. Thereafter a domestic fishery developed and 50 fishing rights were allocated to South Africans only. These rights holders now include a fleet of local long-liners and several Japanese vessels fishing in joint ventures with South African companies. In 2017, 60 fishing rights were allocated for a period of 15 years. The total number of active long-line vessels within South African waters is 22, 18 of which fished in the Atlantic (West of 20°E) during 2017. These were exclusively domestic vessels, with three Japanese vessels fishing exclusively in the Indian Ocean (East of 20°E) during 2017.

Gear consists of monofilament mainlines of between 25 km and 100 km in length which are suspended from surface buoys and marked at each end. As gear floats close to the water surface it would present a potential obstruction to surface navigation as well as a snagging risk to the gear array towed by the seismic survey vessel. The main fishing line is suspended about 20 m below the water surface via dropper lines connecting it to surface buoys at regular intervals. Up to 3 500 baited hooks are attached to the mainline via 20 m long trace lines, targeting fish at a depth of 40 m below the surface. Various types of buoys are used in combinations to keep the mainline near the surface and locate it should the line be cut or break for any reason. Each end of the line is marked by a Dahn Buoy and radar reflector, which marks the line position for later retrieval. Typical configuration of set gear is shown in **Figure 50** below.

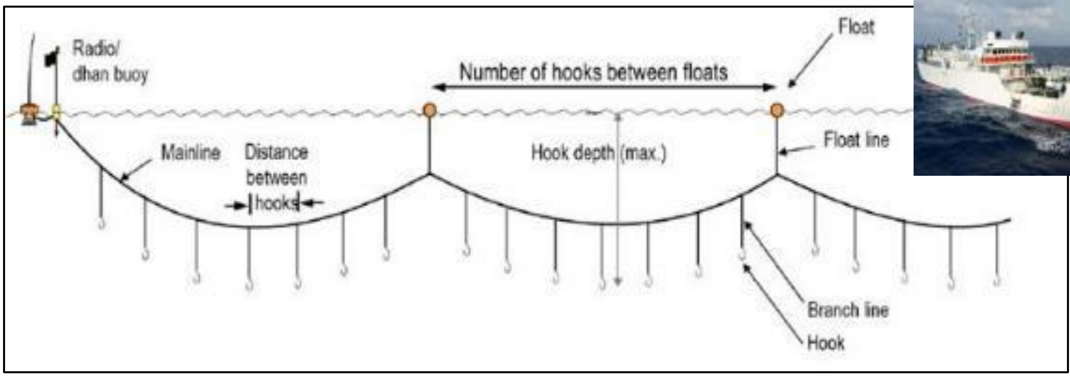


Figure 50: Schematic diagram showing typical configuration of long-line gear targeting pelagic species (left), and photograph of typical high seas long-line vessel (upper right).

Lines are usually set at night and may be left drifting for a considerable length of time before retrieval, which is done by means of a powered hauler at a speed of approximately one knot. During hauling, vessel manoeuvrability is severely restricted. In the event of an emergency, the line may be dropped and hauled in at a later stage.

The fishery operates year-round with a relative increase in effort during winter and spring. Catch per unit effort (CPUE) variations are driven both by the spatial and temporal distribution of the target species and by fishing gear specifications. Variability in environmental factors such as oceanic thermal structure and dissolved oxygen can lead to behavioural changes in the target species, which may in turn influence CPUE. During the period 2000 to 2016, the sector landed an average catch of 4 527 tons and set 3.55 million hooks per year. Total catch and effort figures reported by the fishery for the years 2000 to 2018 are shown in the fisheries report included in **Appendix C**. Eighteen vessels were active in 2018.

Rights Holders in the large pelagic longline fishery are required to complete daily logs of catches, specifying catch locations, number of hooks, time of setting and hauling, bait used, number and estimated weight of retained species, and data on bycatch. The fishery operates extensively within the South African EEZ, primarily along the continental shelf break and into deeper waters. Fishing effort in relation to the Survey area and proposed 3D seismic survey area is shown in **Figure 51**. Over the period 2017 to 2019, an average of 130 lines per year were set within the Reconnaissance Permit application area yielding 155 tons of catch. This is equivalent to 3.2% of the overall effort and 2.2% of the total catch reported by the sector. The Reconnaissance Permit application area is located offshore of the shelf break, and high levels of pelagic longline fishing effort may be expected eastward of the proposed survey area (especially during inshore survey line changes).

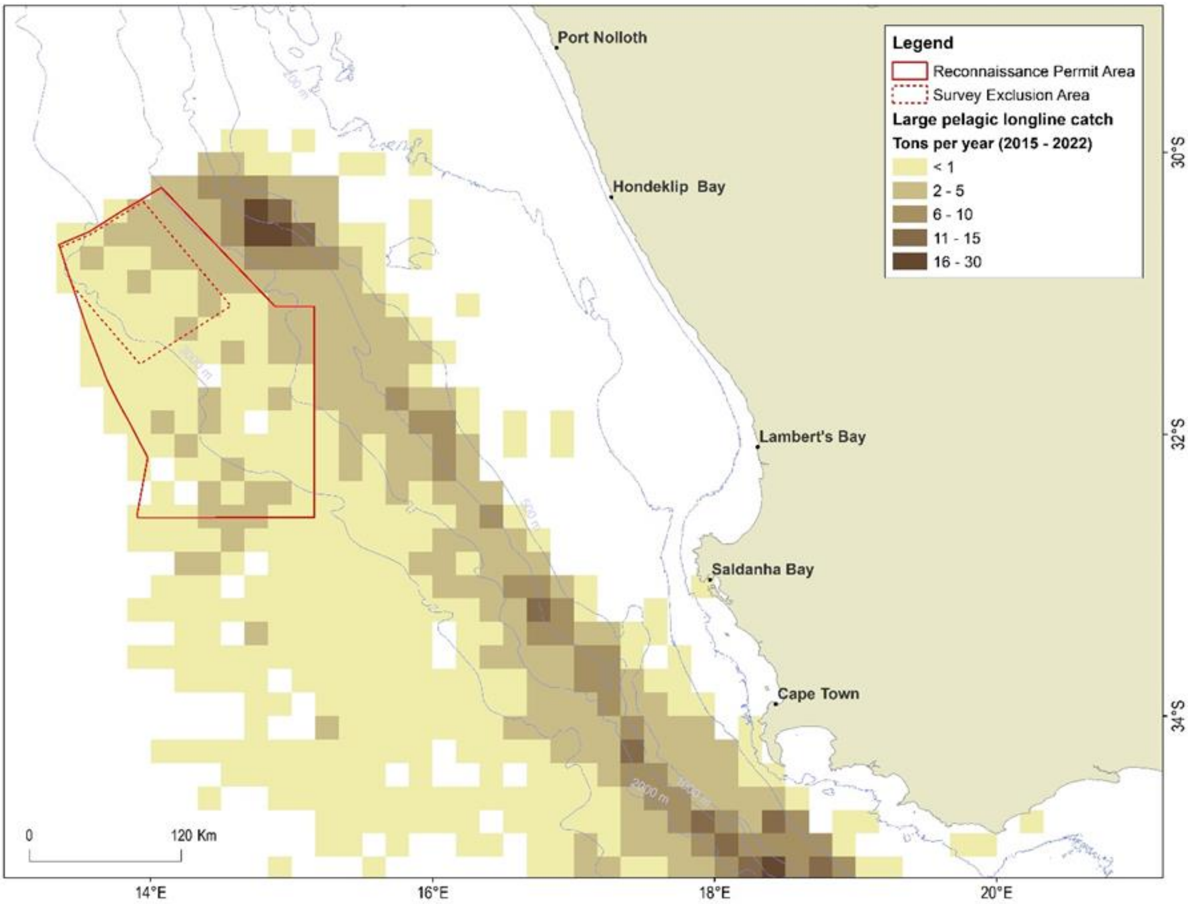


Figure 51: An overview of the spatial distribution of fishing effort expended by the longline sector targeting large pelagic fish species in relation to the proposed survey area.

8.5.3.7 TUNA POLE-LINE

Poling for tuna is predominantly based on the southern Atlantic longfin tuna stock also referred to as albacore (*T. alalunga*). Other catch species include yellowfin tuna, bigeye tuna, skipjack tuna (*Katsuwonus pelamis*), snoek and yellowtail. Landings for 2016 amounted to 2806 tons, with a wholesale value of R124 Million, or 1.2% of the total value of all fisheries combined. A historical time series of catch and effort reported by the South African sector operating within the Atlantic region is shown in **Table 17** below. The reported wholesale value of the fishery in 2018 was R124 Million in 2018, or 1.2% of the total value of all fisheries combined. In 2020, landings of albacore amounted to 3941 tons. A historical time series of catch and effort reported by the South African sector operating within the Atlantic region is shown in Table 3.6. The total effort of 4131 catch days within the ICCAT convention area in 2019 represents an increase in effort of 9% compared to 2018. The total reported annual pole fleet catch of the main target species albacore and yellowfin tuna showed for the first-time relative increases since 2015 and 2014, respectively.

Table 17: Total number of fishing days (effort), active vessels and total catch (t) of the main species caught by tuna pole vessels in the ICCAT region (West of 20E), 2008 – 2018.

	Total Effort		Catch (t)			
Year	Fishing days	Active vessels	Albacore	Yellowfin tuna	Bigeye tuna	Skipjack tuna
2008	3052	115	2083	347	8	4
2009	4431	123	4586	223	17	4
2010	4408	116	4087	177	8	1

Year	Total Effort Fishing days	Active vessels	Catch (t) Albacore	Yellowfin tuna	Bigeye tuna	Skipjack tuna
2011	5001	118	3166	629	15	5
2012	5157	123	3483	162	12	8
2013	4114	107	3492	374	142	3
2014	4416	95	3620	1351	50	5
2015	4738	91	3898	885	57	2
2016	4908	98	2001	599	10	2
2017	3062	92	1640	235	22	7
2018	3751	92	2353	242	14	2
2019	4131	91	2190	378	91	2
2020	3975	97	3941	534	71	1

The active fleet consists of approximately 92 pole-and-line vessels (also referred to as "baitboat"), which are based at the ports of Cape Town, Hout Bay and Saldanha Bay. Vessels normally operate within a 100 nm radius of these locations with effort concentrated in the Cape Canyon area (South-West of Cape Point), and up the West Coast to the Namibian border with South Africa.

Vessels are typically small (an average length of 16 m but ranging up to 25 m). Catch is stored on ice, refrigerated sea water or frozen at sea and the storage method often determines the range of the vessel. Trip durations average between four and five days, depending on catch rates and the distance of the fishing grounds from port. Vessels drift whilst attracting and catching shoals of pelagic tunas. Sonars and echo sounders are used to locate schools of tuna. Once a school is located, water is sprayed outwards from high-pressure nozzles to simulate small baitfish aggregating near the water surface. Live bait is then used to entice the tuna to the surface (chumming). Tuna swimming near the surface are caught with hand-held fishing poles. The ends of the poles are fitted with a short length of fishing line leading to a hook. In order to land heavier fish, lines may be strung from the ends of the poles to overhead blocks to increase lifting power (**Figure 52** below). The nature of the fishery and communication between vessels often results in a large number of vessels operating in close proximity to each other at a time. The vessels fish predominantly during daylight hours and are highly manoeuvrable. However, at night in fair weather conditions the fleet of vessels may drift or deploy drogues to remain within an area and would be less responsive during these periods.

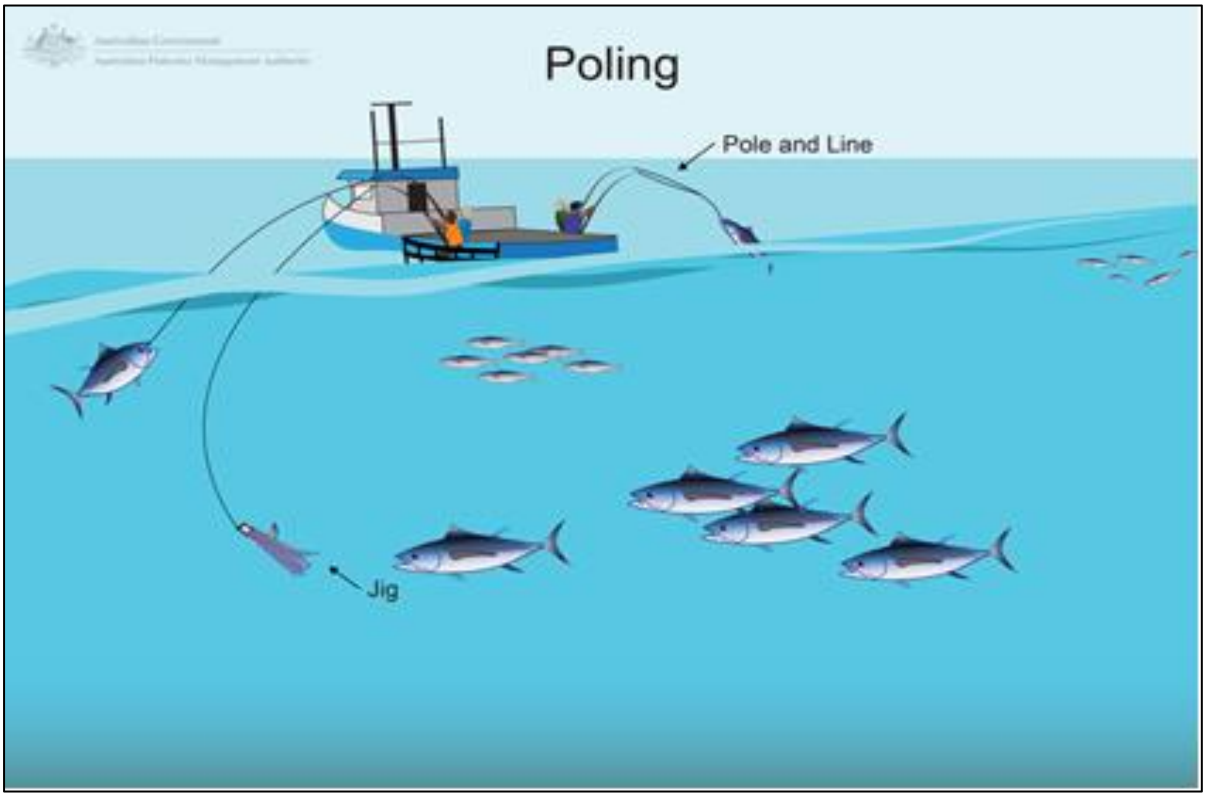


Figure 52: Schematic diagram of pole and line operation.

Fishing activity occurs along the entire West Coast beyond the 200 m bathymetric contour. Activity would be expected to occur along the shelf break with favoured fishing grounds including areas north of Cape Columbine and between 60 km and 120 km offshore from Saldanha Bay. **Figure 53** shows the extent of fishing in relation to the proposed 3D seismic survey area. Fishing records received from DFFE for the reporting period 2007 to 2019 show that tuna-directed fishing does not take place within the Reconnaissance Permit application area, with a distance of 65 km between the inshore extent of the application area and closest fishing grounds.

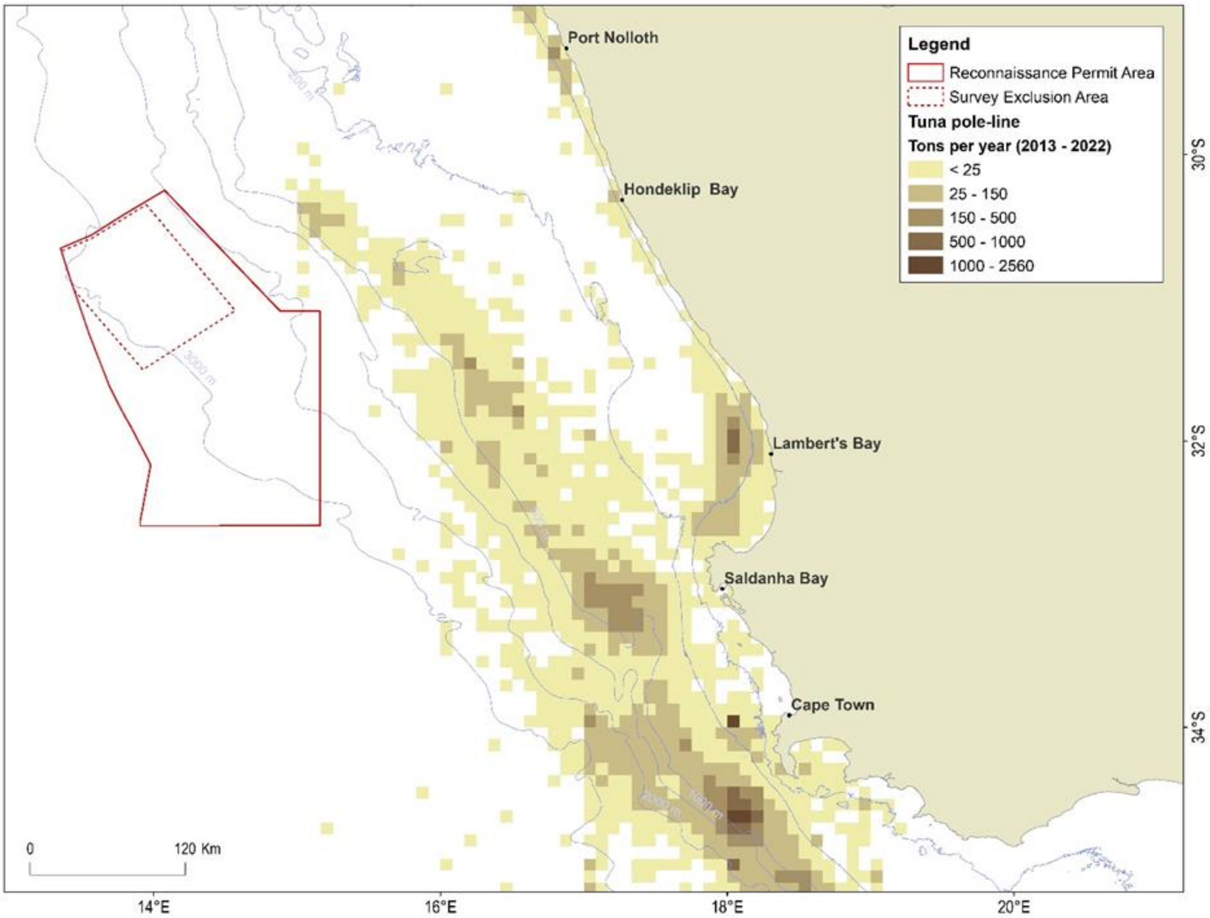


Figure 53: An overview of the spatial distribution of fishing effort expended by the pole-and-line sector targeting pelagic tuna and snoek in relation to the proposed survey area

8.5.3.8 TRADITIONAL LINE FISH

The traditional line fishery is the country's third most important fishery in terms of tonnage landed and economic value. It is a long-standing, nearshore fishery based on a large assemblage of different species using hook and line, but excludes the use of longlines. Within the Western Cape the predominant catch species is snoek (*Thyrsites atun*) while other species such as Cape bream (hottentot) (*Pachymetopon blochii)*, geelbek (*Atractoscion aequidens)*, kob (*Argyrosomus japonicus)* and yellowtail (*Seriola lalandi)* are also important. Towards the East Coast the number of catch species increases and includes resident reef fish (Sparidae and Serranidae), pelagic migrants (Carangidae and Scombridae) and demersal migrants (Sciaenidae and Sparidae). In 2017, the wholesale value of catch was reported as R122.1 million. **Table 18** below lists the catch of important line fish species for the years 2010 to 2018.

Table 18: Annual catch of line fish species (t) from 2010 to 2018.

Year	Snoek	Yellowtail	Kob	Carpenter	slinger	Hottentot Seabream	Geelbek	Santer	Total Catch
2010	6360	171	419	263	180	144	408	69	13688
2011	6205	204	312	363	214	216	286	62	12530
2012	6809	382	221	300	240	160	337	82	11855
2013	6690	712	157	481	200	173	263	84	9142
2014	3863	986	144	522	201	192	212	74	6849

Year	Snoek	Yellowtail	Kob	Carpenter	slinger	Hottentot Seabream	Geelbek	Santer	Total Catch
2015	2045	594	121	519	175	142	238	68	4421
2016	1643	474	133	690	211	209	246	65	4289
2017	2055	377	111	844	218	204	158	74	4391
2018	2089	654	213	723	173	213	214	68	5304

The traditional line fishery is a boat-based activity and has since December 2000 consisted of 3450 crew operating from 455 commercial vessels. The number of rights holders is 425 (valid rights until 31 December 2020). For the 2019/2020 fishing season, 395 vessels and 3007 crew was apportioned to commercial fishing, whilst 60 vessels and 443 crew was apportioned to small-scale fishing. DFFE proposed an increase in the apportionment of Total Allowable Effort (TAE) to small-scale fishing from 13% to 50% commencing in 2021 in order to boost economic possibilities for coastal communities.

Crew use hand line or rod-and-reel to target approximately 200 species of marine fish along the full 3 000 km coastline, of which 50 species may be regarded as economically important. To distinguish between line fishing and long lining, line fishers are restricted to a maximum of 10 hooks per line. Target species include resident reef-fish, coastal migrants and nomadic species. Annual catches prior to the reduction of the commercial effort were estimated at 16 000 tons for the traditional commercial line fishery. Almost all of the traditional line fish catch is consumed locally. The fishery is widespread along the country's shoreline from Port Nolloth on the West Coast to Cape Vidal on the East Coast. Effort is managed geographically with the spatial effort of the fishery divided into three zones. Zone A extends from Port Nolloth to Cape Infanta, Zone B extends from Cape Infanta to Port St Johns and Zone C covers the KwaZulu-Natal region. **Table 19** below lists the annual Total Allowable Effort (TAE) and activated effort per line fish management zone from 2007 to 2019. Most of the catch (up to 95%) is landed by the Cape commercial fishery, which operates on the continental shelf from the Namibian border on the West Coast to the Kei River in the Eastern Cape. Fishing takes place throughout the year but there is some seasonality in catches.

Snoek is an important line fish species as it makes up the largest annual catch in terms of biomass, contributing more than 80% to the total catch west of Cape Infanta. Snoek spawning occurs offshore during winter-spring, along the shelf break (150-400 m) of the western Agulhas Bank and the South African west coast. Prevailing currents transport eggs and larvae to a primary nursery ground north of Cape Columbine and to a secondary nursery area to the east of Danger Point; both shallower than 150 m. Juveniles remain on the nursery grounds until maturity, growing to between 33 and 44 cm in the first year (3.25 cm/month). Onshore-offshore distribution (between 5- and 150-m isobaths) of juveniles is determined largely by prey availability and includes a seasonal inshore migration in autumn in response to clupeoid recruitment. Adults are found throughout the distribution range of the species, and although they move offshore to spawn – there is some southward dispersion as the spawning season progresses – longshore movement is apparently random and without a seasonal basis. Snoek are caught within the inshore zone along most of the South African coastline with the majority of catches being made along the West and South-West Coast of South Africa. Although snoek can be caught year-round, during the snoek seasonal migration (between April and July) when they shoal nearshore, they are caught more frequently using handlines by the line fishery. Snoek are not distributed offshore of the 1000 m depth contour and therefore not targeted or caught by the commercial line fishery in the area of interest.

Vessels range in length between 4.5 m and 11 m and the offshore operational range is restricted by vessel category to 40 nautical miles (75 km). Fishing effort at this outer limit is sporadic. Operating ranges vary greatly but most of the activity is conducted within 15 km of a launch site.

Spatial mapping of effort and catches in the line fishery is less accurate than in other sectors because of the reporting structure implemented by DFFE. Fishing locations are described by skippers in relation to numbered sections along the coast and estimated distance offshore. No bearings are given, and no GPS data are recorded. Furthermore, due to the large number of vessels, associated reporting complexities and also the unwillingness of local fisherman to share fishing locations, inaccuracies in the spatial representation are to be expected. This fishery's operational footprint may at times be limited by operating costs and is sensitive to local reports of fish availability.

Table 19: Annual Total Allowable Effort (TAE) and activated effort per line fish management zone from 2007 to 2012. (The effort levels since 2019 remain largely unchanged)

Total TAE boats (fishers). Upper limit: 455 boats or 3450 crew			**Zone A: Port Nolloth to Cape Infanta**		**Zone B: Cape Infanta to Port St Johns**		**Zone C: KwaZulu-Natal (Sikombe River to Ponto da Ouro)**	
Allocation	455 (3182)		301 (2136)		103 (692)		51 (354)	
Year	Allocated	Activated	Allocated	Activated	Allocated	Activated	Allocated	Activated
2007	455	353	301	231	103	85	51	37
2008	455	372	301	239	103	82	51	51
2009	455	344	300	222	104	78	51	44
2010	455	335	298	210	105	82	51	43
2011	455	328	298	207	105	75	51	46
2012	455	296	298	192	105	62	51	42
2013	455	289	301	189	103	62	51	38
2014**	455	399	340	293	64	58	51	48
2015**	455	356	340	291	64	61	51	45
2016**	455	278	340	274	64	59	51	45
2017**	455	329	340	232	64	60	51	37
2018**	455	324	340	232	64	50	51	42
2019**	455	306	340	218	64	50	51	38
**** In the finalisation of the 2013 commercial Traditional Line fish appeals, the effort apportioned for the small-scale fisheries sector was allocated to the commercial sector. All the small-scale Rights were considered to be activated on allocation**								

Snoek-directed fishing effort is coastal, with vessels operating in waters shallower than 100 m. However, there are records of fishing up to an offshore distance of 55 km off Saldanha Bay where tuna are targeted in the vicinity of Cape Canyon. Note that small-scale fishers are not permitted to target tuna, thus would not be expected to operate at the Cape Canyon. There is no overlap of fishing grounds with the Reconnaissance Permit application area, which is situated at least 200 km from fishing grounds targeted by the line fish sector (**Figure 54**).

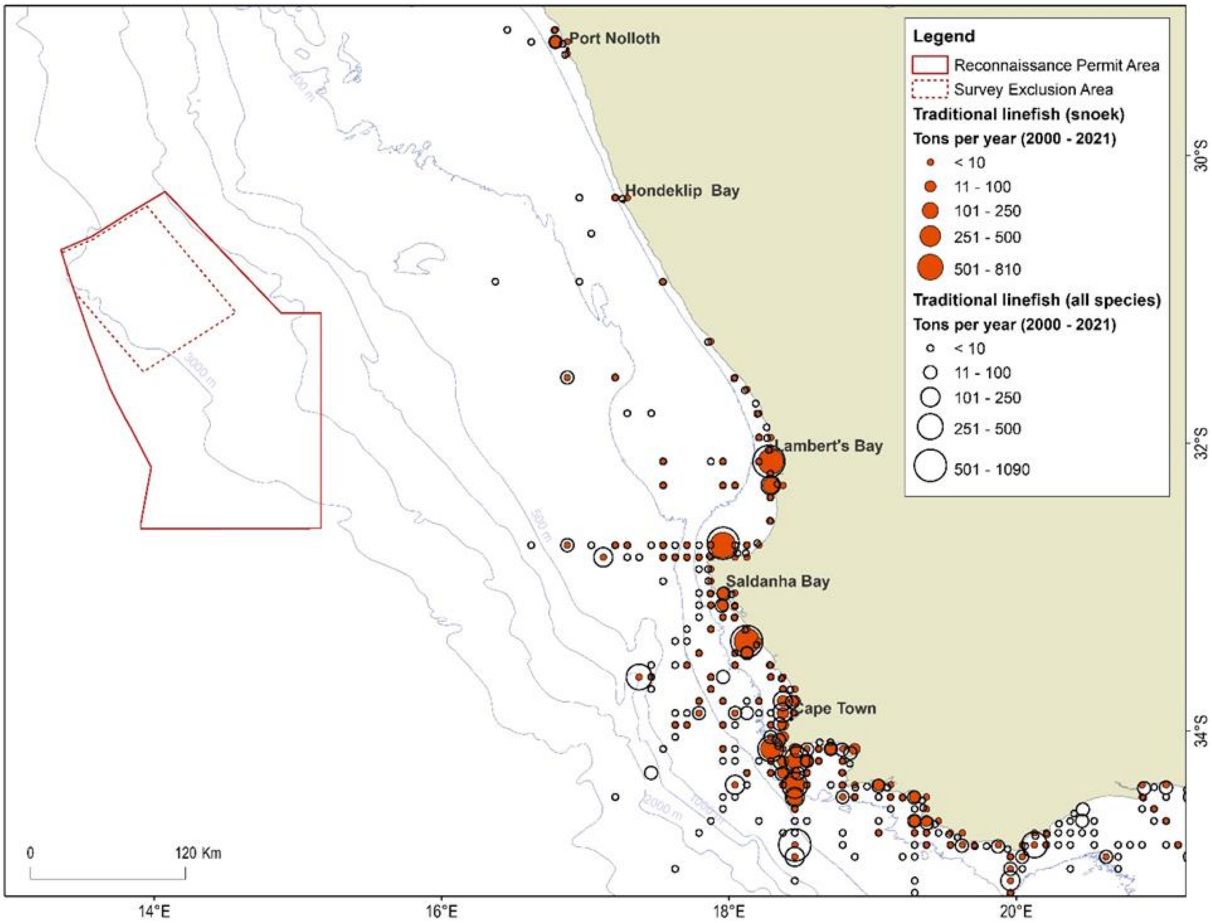


Figure 54: An overview of the spatial distribution of catch taken by the line fish sector in relation to the application area. The snoek component of catch is shown as well as total catch of all species.

8.5.3.9 WEST COAST ROCK LOBSTER

The West Coast rock lobster *Jasus lalandii* is a valuable resource of the South African West Coast and consequently an important income source for West Coast fishermen. The resource occurs inside the 200 m depth contour along the West Coast from Namibia to East London on the East Coast of South Africa. The fishery is composed of four sub-sectors – commercial nearshore, commercial offshore, small-scale and recreational fishing, all of which have to share from the same global Total Allowable Catch (TAC). The 2021 TAC was set at 837 tonnes. Refer to **Table 20** for recent TACs set for rock lobster.

Table 20: Apportionment of TAC of rock lobster by sub-sector (DFFE, 2020).

Description	2019/2020 TAC (t)	2020/2021 TAC (t)
Commercial fishing (offshore)	563.91	435.88
Commercial fishing (nearshore)	170.25	131.03
Recreational fishing	38.76	30.08
Subsistence (interim relief measure) fishing	170.25	131.03
Small-scale fishing sector (nearshore)		
Small-scale fishing sector (offshore)	140.83	108.97
Total	1084	837.0

The resource is managed geographically, with TACs set annually for different management areas. The commercial and small-scale fishing sectors are authorised to undertake fishing for four months in each management zone therefore closed seasons are applicable to different management zones. The start and end dates for the 2020/21 fishing season per sector and zone are shown in **Table 21** below.

Table 21: Start and end dates for the fishing season 2020/21 by management zone (DFFE, 2020).

Area	Catch period	
	Commercial nearshore, interim relief, small-scale: nearshore	**Commercial offshore, small-scale: offshore**
Area 1 + 2	15 Oct, Nov, Dec, Jan, 15 Feb	
Area 3 + 4	15 Nov, Dec, Jan, Feb, 15 Mar	15 Nov, Dec, Jan, Feb, 15 Mar
Area 5 + 6	15 Nov, Dec, Jan, Feb, 15 Mar	
Area 7		Dec, Jan, Feb, Mar
Areas 8 and 11	15 Nov, Dec, Jan, Feb, 15 Mar	Jan, Mar, Apr, May
Area 8 (deep water)		Jun, Jul
Areas 12, 13 and 14	15 Nov, Dec, Jan, Feb, 15 Mar	

The commercial offshore sector operates at a depth range of approximately 30 m to 100 m, making use of traps consisting of rectangular metal frames covered by netting. These traps are set at dusk and retrieved during the early morning. Approximately 138 vessels participate in the offshore sector.

The commercial nearshore sector makes use of hoop nets to target lobster at discrete suitable reef areas along the shore at a water depth of up to 15 – 30 m. These are deployed from a fleet of small dinghies/bakkies which operate from the shore and coastal harbours. Approximately 653 boats participate in the sector.

The delineation of management zones is shown in **Figure 55** below. The five super-areas are: areas 1–2, corresponding to zone A; areas 3–4, to zone B; areas 5–6, to zone C; area 7, being the northernmost area within zone D; and area 8+, comprising area 8 of zone D as well as zones E and F. Refer to Figure 53 for locations of the fishing zones and areas.

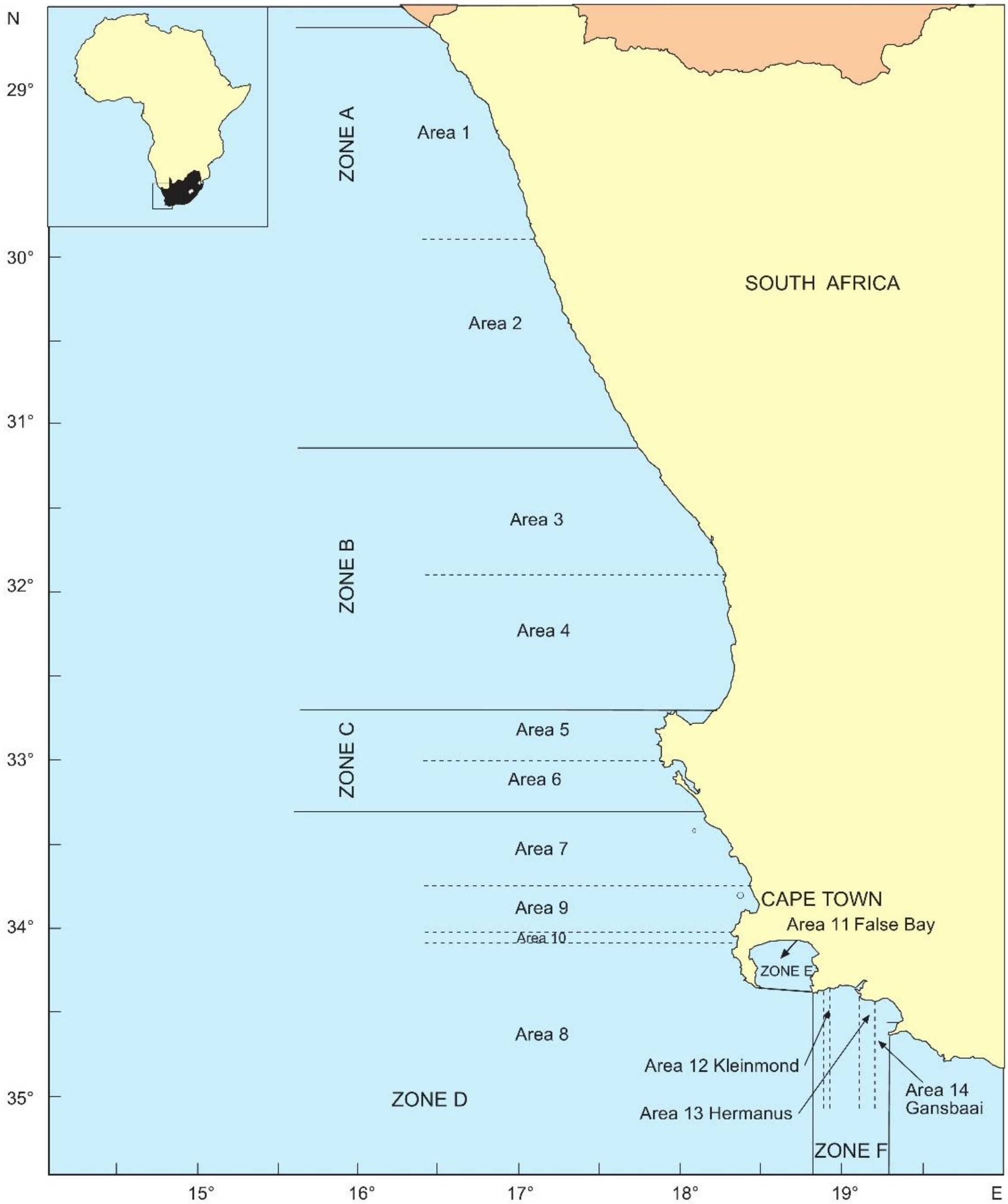


Figure 55: West Coast rock lobster fishing zones and areas. The five super-areas are: areas1–2, corresponding to zone A; areas 3–4, to zone B; areas 5–6, to zone C; area 7, being the northernmost area within zone D; and area 8+, comprising area 8 of zone D as well as zones E and F.

The survey area is situated offshore of the depth range at which rock lobster is targeted. The Reconnaissance Permit application area is situated at least 240 km from the closest rock lobster fishing grounds and there is no spatial overlap (**Figure 56**).

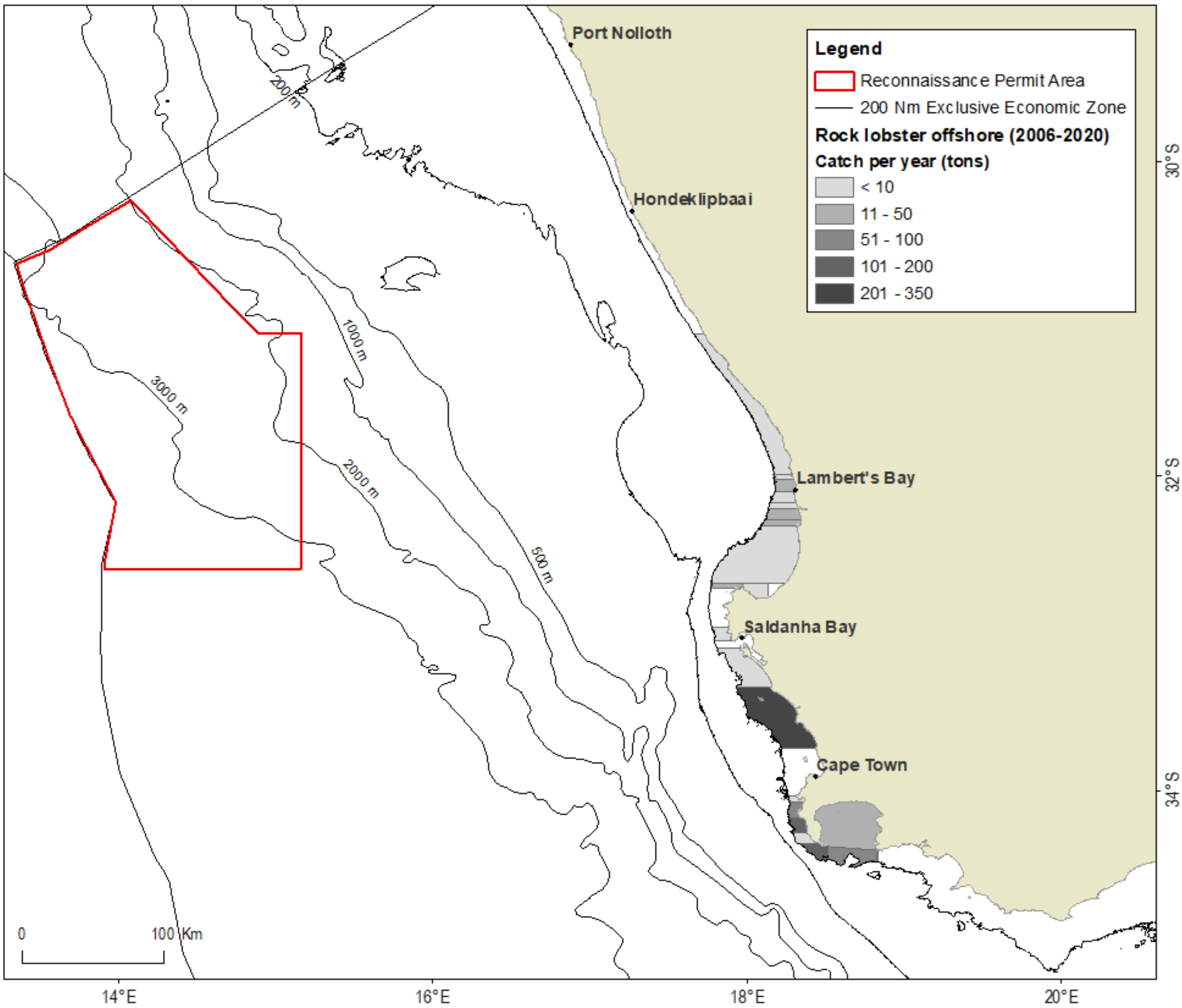


Figure 56: An overview of the spatial distribution of fishing effort expended by the west coast rock lobster offshore (trapboat) sector in relation the proposed seismic survey area.

8.5.3.10 SMALL-SCALE FISHERIES

The concept of Small-Scale Fisheries (SSF) is a relatively new addition to the fisheries complexity in South Africa. The concept has its origin in a global initiative supported by the Food and Agricultural Organisation of the United Nations (FAO). In South Africa, there is a long history of coastal communities utilizing marine resources for various purposes. Many of these communities have been marginalized through apartheid practices and previous fisheries management systems. In 2007 government was compelled through an equality court order to redress the inequalities suffered by these traditional fishers. The development of a SSF sector aims in part to compensate previously disadvantaged fishing communities that have been displaced either politically, economically or by the development of large-scale commercial fisheries. This led to the development of the Small-Scale Fisheries Policy (SSFP), the aim of which is to redress and provide recognition of the rights of small-scale fishers (DAFF, 2015). The SSFP was gazetted in May 2019 under the Marine Living Resources Act, 1998 (Act No. 18 of 1998). It is only now (2021/2022) in an advanced process of implementation. It is a challenging process that has been exacerbated by the conflict and overlap with another fisheries-related process of fishing rights allocations (known as Fishery Rights Allocation Process or "FRAP"). As of February 2022, neither process has been concluded and the issues at stake are highly politicised. The SSF overlaps other historical fisheries in South Africa, leading to legal challenges where the SSF rights allocations are in conflict with other established commercial fishing sectors, most notably the commercial squid fishing sector. SSF is defined as a fishery although specific operations and dynamics are not yet fully defined as they are subject to an ongoing process by DFFE.

Small-scale fishers fish to meet food and basic livelihood needs, but may also directly be involved in fishing for commercial purposes. These fishers traditionally operate on nearshore fishing grounds to harvest marine living resources on a full-time, part-time or seasonal basis. Fishing trips are usually of short-duration and fishing/harvesting techniques are labour intensive .

Small-scale fishers are an integral part of the rural and coastal communities in which they reside and this is reflected in the socio-economic profile of such communities. In the Eastern Cape, KwaZulu-Natal and the Northern Cape, small-scale fishers live predominantly in rural areas while those in the Western Cape live mainly in urban areas.

Many communities living along the coast have, over time, developed local systems of rules to guide their use of coastal lands, forests and waters. These local rules are part of their systems of customary law. Rights to access, use, and own different natural resources arise from local customary systems of law. These systems of law are not written down as in Western law, but are passed down from generation to generation through practice. South Africa's Constitution recognises customary law together with common law and state law. Section 39 (3) makes provision for a community that has a system of customary rights arising from customary law to be recognised as long as these rights comply with the Bill or Rights. In line with this, the SSFP also recognises rights arising in terms of customary law. Customary fishers are normally associated with discrete groups (tribes or communities with unique identities and associations with the sea) who may be defined by traditions and beliefs. These traditions are increasingly being challenged as stocks and marine resources have been depleted. This would include, for example, intertidal harvesting of seaweed, mussels, oysters, cephalopods and virtually any species available to these communities. These fishers are generally localised and do not range far beyond the areas in which they live.

SSF resources are managed in terms of a community-based co-management approach that aims to ensure that harvesting and utilisation of the resource occurs in a sustainable manner in line with the ecosystems approach. The SSF is to be implemented along the coast in series of community co-operatives. Only a co-operative is deemed to be a suitable legal entity for the allocation of small-scale fishing rights. Applicants for small-scale fishing rights must have a historical involvement in traditional fishing operations, including the catching, processing or marketing of fish for a cumulative period of at least 10 years. They also need to show a historical dependence on deriving the major part of their livelihood from traditional fishing operations.

More than 270 communities have registered an Expressions of Interest (EOI) with the Department. DFFE has split SFF by communities into district municipalities and local municipalities. Approximately 10 000 small-scale fishers have been identified around the coast. The survey area is situated offshore of the West Coast, City of Cape Town and Overberg municipal districts. Between Saldanha Bay and Cape Agulhas, 68 communities have been registered for small-scale fishing rights, these co-operatives comprise a total of 2031 fishers. At this point in time, no discreet co-operatives are active, except for on the West Coast in Port Nolloth.

The SSFP requires a multi-species approach to allocating rights, which entails the allocation of rights for a basket of species that may be harvested or caught within particular designated areas. Co-operatives can only request access to species found in their local vicinity. The small-scale fishery rights cover the nearshore area (defined in section 19 of the MLRA as being within close proximity of shoreline). DFFE recommends five basket areas: 1. Basket Area A – The Namibian border to Cape of Good Hope – 57 different resources 2. Basket Area B – Cape of Good Hope to Cape Infanta – 109 different resources 3. Basket Area C – Cape Infanta to Tsitsikamma – 107 different resources 4. Basket Area D – Tsitsikamma to the Pondoland MPA – 138 different resources 5. Basket Area E – Pondoland MPA to the Mozambican border – 127 different resources.

The mix of species to be utilised by small-scale fishers includes species that are exploited by existing commercial sectors viz; traditional line fish, west coast rock lobster, squid, hake handline, abalone, KZN beach seine, netfish (gillnet and beach-seine), seaweed and white mussel. An apportionment of TAE/TACs for these species will be transferred from existing commercial rights to SSF whereas white mussels will become the exclusive domain of SSF. Species nominated for commercial use will be subject to TAE and/or TAC allocation. Species nominated for own use will be available to all members of a particular co-operative, but subject to output controls.

The small-scale fishery rights cover the nearshore area (defined in section 19 of the MLRA as being within close proximity of shoreline). Small-scale fishermen along the Northern Cape and Western Cape coastlines are typically involved in the traditional line, west coast rock lobster and abalone fisheries, whereas communities on the South Coast would be involved in traditional line, squid jig and oyster harvesting. The small-scale communities on the West Coast, with long family histories of subsistence fishing, prioritise the harvest of nearshore resources (using boats) over the intertidal and subtidal resources.

Snoek (*Thyrsites atun*), Cape bream / hottentot (*Pachymetopon blochii*) and yellowtail (*Seriola lalandi*) are important line fish species that are targeted by small-scale fishers operating nearshore along the West and South-West Coast of South Africa. Snoek are targeted by small-scale fishers during the snoek seasonal migration (between April and June), during which time they shoal nearshore and are therefore available by handline. Fishers also target west coast rock lobster (*Jasus lalandii*) using hoopnets set by small "bakkies" on suitable reefs at a water depth of less than 30 m. Fishing activity may range up to 100 m water depth by the larger vessels that participate in the offshore commercial rock lobster trap sector.

Small-scale fishermen along the Northern Cape and Western Cape coastlines are unlikely to range beyond 20 km from the coastline; thus, inshore of the proposed 3D survey area, which is situated 250 km offshore of the coast at its closest point (**Figure 57**). Snoek-directed fishing effort is coastal, with vessels operating in waters shallower than 100 m. However, there are records of fishing up to an offshore distance of 55 km off Saldanha Bay where tuna are targeted in the vicinity of Cape Canyon. Note that small-scale fishers are not permitted to target tuna, thus would not be expected to operate at the Cape Canyon.

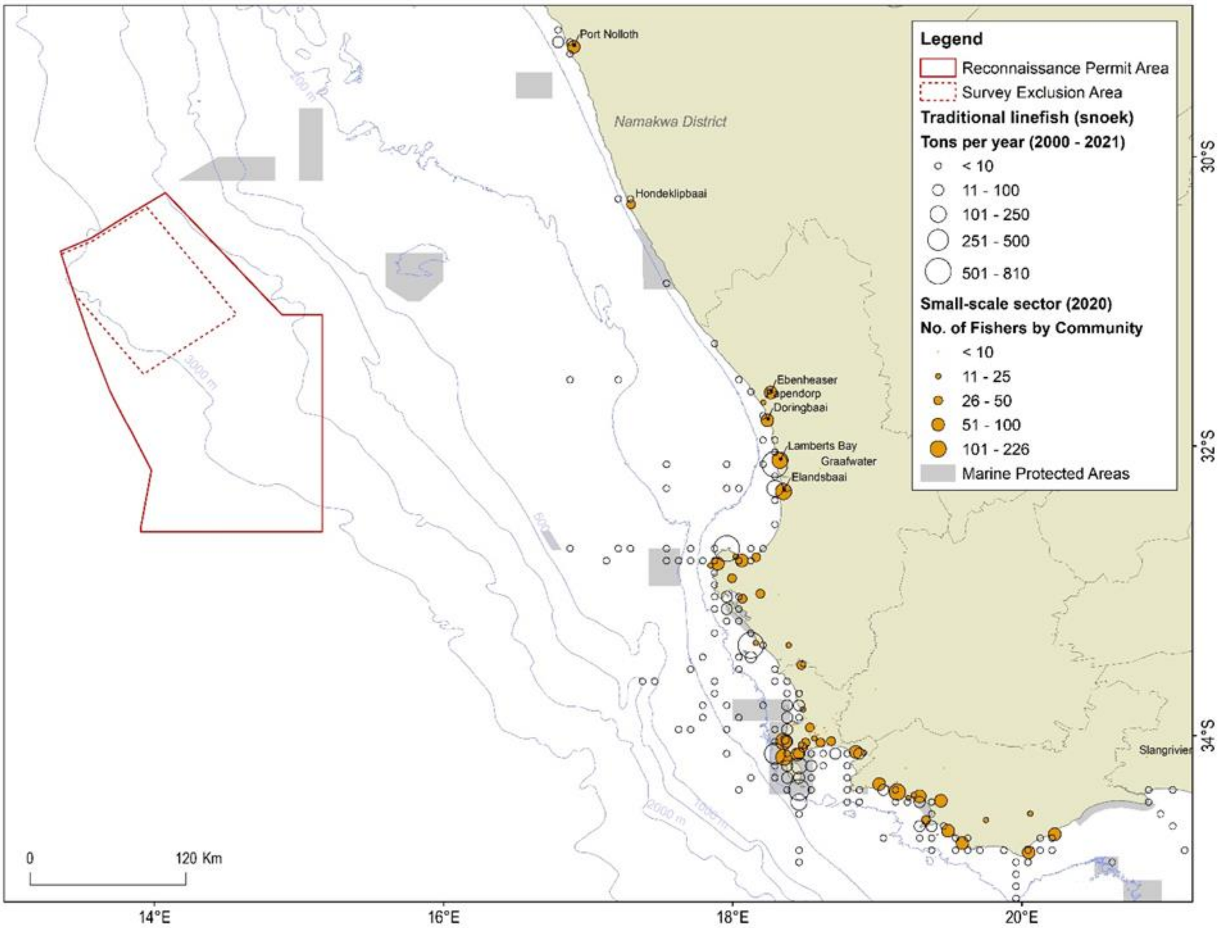


Figure 57: Overview of spatial distribution of small-scale fishing communities and number of participants per community along the South African west coast. The location of snoek catches reported by the line fish sector for the period 2017 to 2019 are shown.

8.5.3.11 BEACH-SEINE AND GILLNET FISHERIES (NETFISH)

There are a number of active beach-seine and gillnet operators throughout South Africa (collectively referred to as the "netfish" sector). Initial estimates indicate that there are at least 7 000 fishermen active in fisheries using beach-seine and gillnets, mostly (86%) along the West and South coasts. These fishermen utilize 1 373 registered and 458 illegal nets and report an average catch of about 1 600 tons annually, constituting 60% harders (also known as mullet, *Liza richardsonii*), 10% St Joseph shark (*Callorhinchus capensis*) and 30% "bycatch" species such as galjoen (*Dichistius capensis*), yellowtail (*Seriola lalandii*) and white steenbras (*Lithognathus lithognathus*). Catch-per-unit-effort declines eastwards from 294 and 115 kg·net-day^{-1} for the beach-seine and gillnet fisheries respectively off the West Coast to 48 and 5 kg·net-day^{-1} off KwaZulu-Natal. Consequently, the fishery changes in nature from a largely commercial venture on the West Coast to an artisanal/subsistence fishery on the East Coast.

The fishery is managed on a Total Allowable Effort (TAE) basis with a fixed number of operators in each of 15 defined areas (see **Table 22** below for the number of rights issued). The number of Rights Holders for 2014 was listed as 28 for beach-seine and 162 for gill-net. Permits are issued solely for the capture of harders, St Joseph and species that appear on the 'bait list'. The exception is False Bay, where Right Holders are allowed to target line fish species that they traditionally exploited.

The beach-seine fishery operates primarily on the West Coast of South Africa between False Bay and Port Nolloth with a few permit holders in KwaZulu-Natal targeting mixed shoaling fish during the annual winter migration of sardine. Beach-seining is an active form of fishing in which woven nylon nets are rowed out into the surf zone to encircle a shoal of fish. They are then hauled shorewards by a crew of 6–30 persons, depending on the size of the net and length of the haul. Nets range in length from 120 m to 275 m. Fishing effort is coastal and net depth may not exceed 10 m (DAFF 2014b). There are currently three rights issued for Area A (Port Nolloth) and no rights issued for Area B (Hondeklipbaai).

The gillnet fishery operates from Yzerfontein to Port Nolloth on the West Coast. Surface-set gillnets (targeting mullet) are restricted in size to 75 m x 5 m and bottom-set gillnets (targeting St Joseph shark) are restricted to 75 m x 2.5 m and are set in waters shallower than 50 m. The spatial distribution of effort is represented as the annual number of nets per kilometre of coastline and ranges up to a maximum of 15 off St Helena Bay. Of a total of 162 right holders, four operate within Area A (Port Nolloth) and two operate within Area B (Hondeklipbaai).

Table 22: Recommended Total Allowable Effort (TAE, number of rights and exemption holders) and rights allocated in 2016-17 for each netfish area. Levels of effort are based on the number of fishers who could maintain a viable income in each area (DAFF 2017).

Area	Locality	Beach-seine	Gill/drift	Total	Rights allocated
A	**Port Nolloth**	**3**	**4**	**7**	**4**
B	**Hondeklipbaai**	**0**	**2**	**2**	**0**
C	Olifantsriviermond-Wadrifsoutpansmond	2	8	10	4
D	Wadrifsoutpansmond-Elandsbaai-Draaihoek	3	6	9	6
E	Draaihoek, (Rochepan)-Cape Columbine, including Paternoster	4	80	84	84
F	Saldhana Bay	1	5	6	5
G	Langebaan Lagoon	0	10	10	10
H	Yzerfontein	2	2	4	1
I	Bokpunt (Melkbos)-Milnerton	3	0	3	1
J	Houtbay beach	2	0	2	0
K	Longbeach-Scarborough	3	0	3	1
L	Smitswinkel Bay, Simonstown, Fishoek	2	0	2	2

Area	Locality	Beach-seine	Gill/drift	Total	Rights allocated
M	Muizenberg-Strandfontein	2	0	2	2
N	Macassar*	0	0	0	(1)
OE	Olifants River Estuary	0	45	45	45

The range of gillnets (50 m) and that of beach-seine activity (20 m) will not overlap with the proposed 3D seismic survey area. The range of gillnet fishing activity off the west coast of South Africa is situated at least 220 km from the Reconnaissance Permit application area (**Figure 58**).

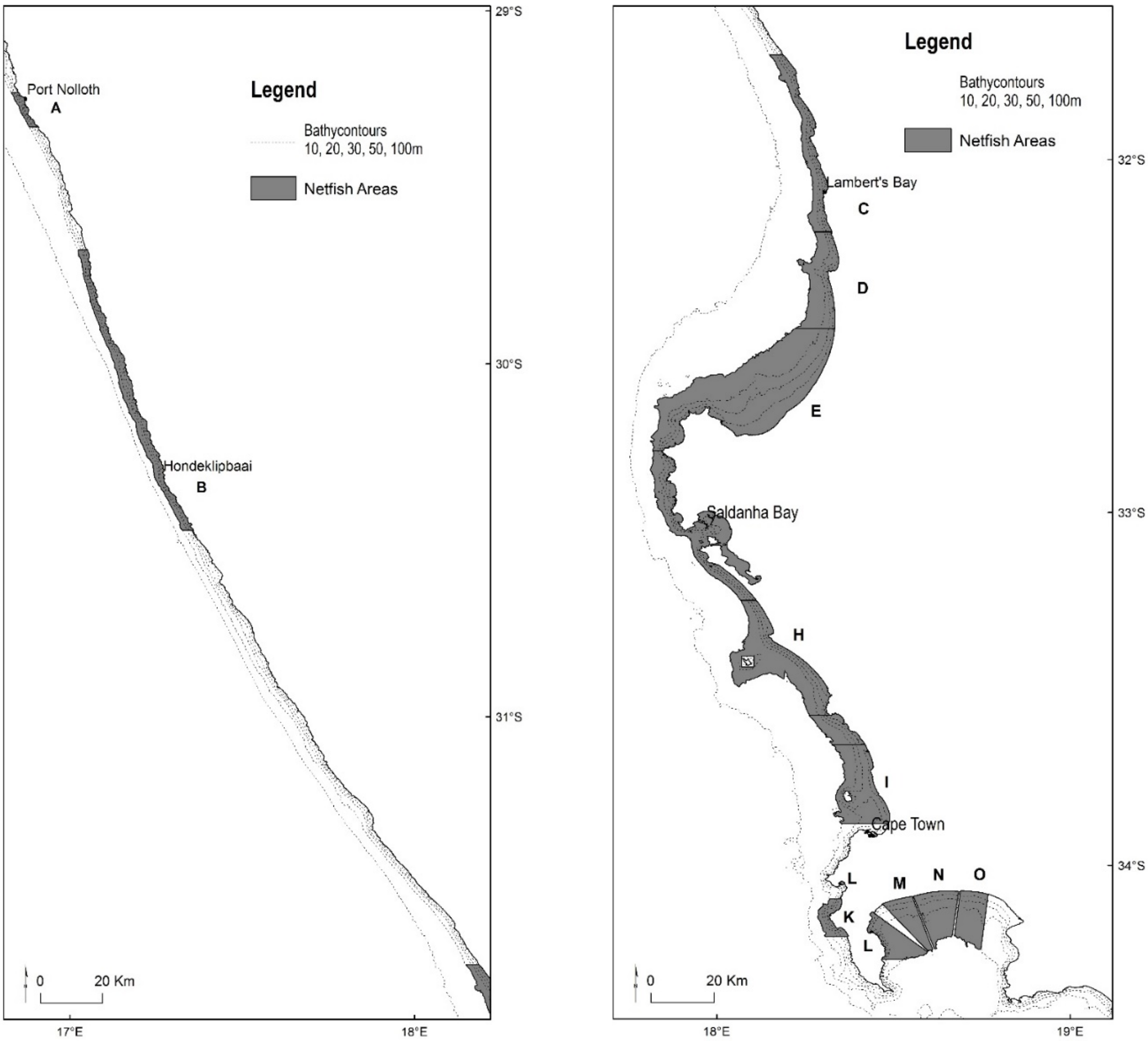


Figure 58: Netfish (gillnet and beach-seine) fishing areas.

8.5.3.12 FISHERIES RESEARCH

Swept-area trawl surveys of demersal fish resources are carried out twice a year by DFFE in order to assess stock abundance. Results from these surveys are used to set the annual TACs for demersal fisheries. First started in 1985, the West Coast survey extends from Cape Agulhas (20°E) to the Namibian maritime boarder and takes place over the duration of approximately one month during January. The survey of the Southeast coast (20°E – 27°E longitude) takes place in April/May. Following a stratified, random design, bottom trawls are conducted to assess the biomass, abundance and distribution of hake, horse mackerel, squid and other demersal trawl species on the shelf and upper slope of the South African coast. Trawl positions are randomly selected to cover specific depth strata that range from the coast to the 1 000 m isobath. On occasion, trawls are targeted in waters deeper than 1 000 m. **Figure 59** below shows the distribution of research trawls undertaken in relation to the proposed 3D seismic survey area.

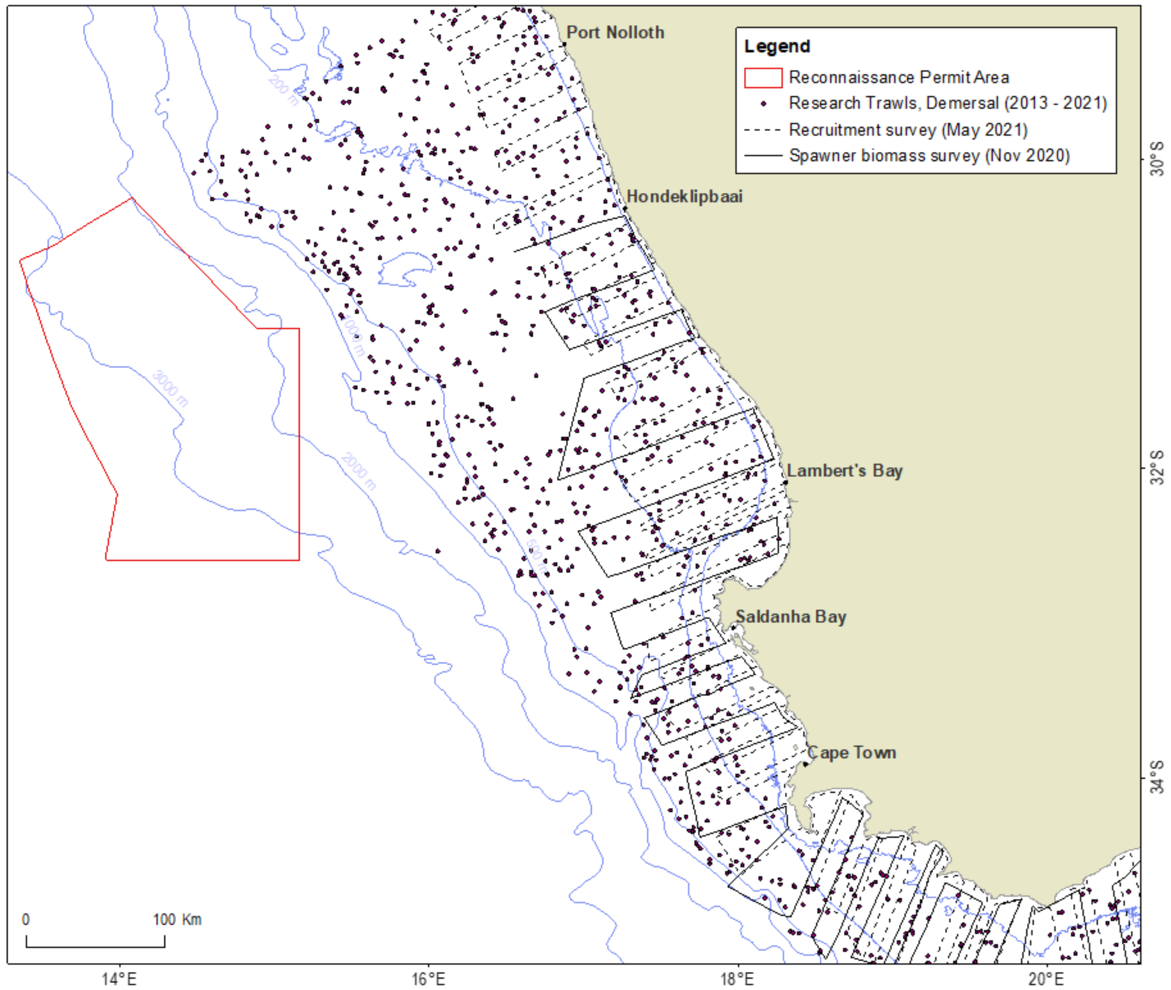


Figure 59: Spatial distribution of trawling effort expended during research surveys undertaken by DFFE to ascertain biomass of demersal fish species. Also shown are the survey transects of recruitment and spawner biomass research surveys undertaken by DFFE in May 2021 and November 2020, respectively, in relation to the 3D seismic survey area.

The biomass of small pelagic species is assessed bi-annually by an acoustic survey. The first of these surveys is timed to commence in mid-May and runs until mid-June while the second starts in mid-October and runs until mid-December. The timing of the demersal and acoustic surveys is not flexible, due to restrictions with availability of the research vessel as well as scientific requirements. During these surveys the survey vessels travel pre-determined transects (perpendicular to bathymetric contours) running offshore from the coastline to approximately the 200 m isobath. The surveys are designed to cover an extensive area from the Orange River on the West Coast to Port Alfred on the East Coast and the DFFE survey vessel progresses systematically from the Northern border Southwards, around Cape Agulhas and on towards the east.

8.5.4 SUMMARY TABLE OF SEASONALITY OF CATCHES FOR COMMERCIAL FISHING SECTORS

The seasonality of each of the main commercial fishing sectors that operate off the west coast of South Africa is indicated in **Table 23** below. Fishing intensity within the Reconnaissance Permit application area is presented for each sector.

Table 23: Summary table showing seasonal variation in fishing effort expended by each of the main commercial fisheries sectors operating in West Coast South African waters.

Sector	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Demersal Trawl	H	H	H	H	H	H	H	H	H	H	H	H
Midwater Trawl	H	H	H	H	H	H	H	H	H	H	H	H
Demersal Longline	M	H	H	H	H	H	H	H	H	H	H	H
Small Pelagic Purse-Seine	M	H	H	H	H	H	H	H	H	H	H	M
Large Pelagic Longline	M	M	M	M	H	H	H	H	H	H	H	M
Tuna Pole-Line	H	H	H	H	H	M	M	M	M	M	H	H
Traditional Line fish	H	M	M	M	M	M	M	M	M	M	M	H
West Coast Rock Lobster	H	H	H	H*	H*	H#	M#	N	N	M	M	H
Small-scale (line fish & rock lobster sectors)	M	M	M	H	H	H	M	M	M	M	M	M
Research survey (trawl)	M	M	M	N	N	N	N	N	N	N	N	N
Research survey (acoustic)	N	N	N	N	M	M	N	N	N	M	M	M
Fishing Intensity by Month (H = high; M = Low to Moderate; N = None)												
***Areas 8 and 11 only; # Area 8 only**												

8.6 CONSERVATION AREAS AND MARINE PROTECTED AREAS

Numerous sanctuaries and Marine Protected Areas (MPA) exist offshore and along the coastline of the Western Cape (**Figure 60**), although none of them overlap with the Survey area. For the sake of completeness, these are described in more detail below.

8.6.1 SANCTUARIES

Sanctuaries are considered a type of management area within South Africa's multi-purpose expanded MPA network in which access and/or resource use is prohibited. Sanctuaries in the vicinity of the project area in which restrictions apply are the McDougall's Bay, Stompneusbaai, Saldanha Bay, Table Bay and Hout Bay rock lobster sanctuaries, which are closed to commercial exploitation of rock lobsters. These sanctuaries were originally proclaimed early in the 20th century under the Sea Fisheries Act of 1988 as a management tool for the protection of the West Coast rock lobster. They lie well inshore or to the south of the Survey area.

8.6.2 MARINE PROTECTED AREAS

'No-take' MPAs offering protection of the Namaqua biozones (sub-photic, deep-photic, shallow-photic, intertidal and supratidal zones) are absent northwards from Cape Columbine. This resulted in substantial portions of the coastal and shelf-edge marine biodiversity in the area being assigned a threat status of 'Critically Endangered', 'Endangered' or 'Vulnerable' in the 2011 National Biodiversity Assessment (NBA) Using biodiversity data mapped for the 2004 and 2011 NBAs a systematic biodiversity plan was developed for the West Coast with the objective of identifying both coastal and offshore priority areas for MPA expansion. Potentially vulnerable marine ecosystems (VMEs) that were explicitly considered during the planning included the shelf break, seamounts, submarine canyons, hard grounds, submarine banks, deep reefs and cold water coral reefs. To this end, nine focus areas were identified for protection on the West Coast between Cape Agulhas and the South African – Namibian border. These focus areas were carried forward during Operation Phakisa, which identified potential offshore MPAs. A network of 20 MPAs was gazetted on 23 May 2019, thereby increasing the ocean protection within the South African Exclusive Economic Zone (EEZ) to 5%. The approved MPAs within the broad project area are shown in **Figure 60**. There are six offshore Marine Protected Areas (MPAs) that fall within the broader project area, namely the Orange Shelf Edge MPA, Child's Bank MPA, Benguela Muds MPA, Cape Canyon MPA, Robben Island MPA and the Southeast Atlantic Seamounts MPA. These are described briefly below.

- The **Orange Shelf Edge MPA** covers depths of between 250 m and 1 500 m and is unique as it has to date never been trawled. Proclaimed in 2019, this MPA provides a glimpse into what a healthy seabed should look like, what animals live there and how the complex relationships between them support important commercial fish species such as hake, thereby contributing fundamentally towards sustainable fisheries development. This MPA also protects the pelagic habitats that are home to predators such as blue sharks, as well as surface waters where thousands of seabirds such as Atlantic yellow-nosed albatrosses feed.
- The 1 335 km^2 **Child's Bank MPA**, located ~48 km inshore of the Survey area, supports seabed habitats inhabited by a diversity of starfish, brittle stars and basket stars, many of which feed in the currents passing the bank's steep walls. Although trawling has damaged coral in the area, some pristine coral gardens remain on the steepest slopes. The Child's Bank area was first proposed for protection in 2004 but was only proclaimed in 2019, after reducing its size to avoid petroleum wellheads and mining areas. The MPA provides critical protection to these deep sea habitats (180 – 450 m) as they allow for the recovery of important nursery areas for young fish.
- The **Benguela Muds MPA** is the smallest of the South African offshore MPAs. At only 72 km^2 the muddy habitats located in this area are created by sediment washed down the Orange River and out to sea. These mud habitats are of limited extent and were considered 'critically endangered' on South Africa's deep continental margin of the west coast. The MPA represents the least trawled stretch of muddy seabed on the west coast.
- The **Cape Canyon** is a deep and dramatic submarine canyon carved into the continental shelf and extending to a maximum depth of 3,600 m. The 580 km2 MPA was proclaimed in 2019 and protects the upper part of the canyon where depths range from 180 to 500 m. Underwater footage has revealed a rich diversity of seafans, hermit crabs and mantis shrimps, with hake, monk and john dory resident on the soft canyon floor. Rocky areas in the west of the canyon support fragile rocky habitat, but the area also includes sandy and muddy habitats, which have been trawled in the past. Interaction of nutrient-rich bottom water with a complex seascape results in upwelling, which in turn provides productive surface waters in which seabirds, humpback whales and Cape fur seals feed.
- The **Namaqua Fossil Forest MPA**, which lies ~210 km inshore of the Survey area, provides evidence of age-old temperate yellowwood forests from a hundred million years ago when the sea-level was more than 200 m below what it is today; trunks of fossilized yellowwood trees covered in delicate corals. These unique features stand out against surrounding mud, silt and gravel habitats. The fossilized trees are not known to be found anywhere else in our oceans and are valuable for research into past climates. In 2014 this area was recognised as globally important and declared as an Ecologically and Biologically Significant Area (EBSA). The 1 200 km^2 MPA protects the unique fossil forests and the surrounding seabed ecosystems and including a new species of sponge previously unknown to science.
- The **Namaqua National Park MPA** provides the first protection to habitats in the Namaqua bioregion, including several 'critically endangered' coastal ecosystem types. The area is a nursery area for Cape

hakes, and the coastal areas support kelp forests and deep mussel beds, I serve as important habitats for the West Coast rock lobster. This 500 km^2 MPA was proclaimed in 2019, both to boost tourism to this remote area and to provide an important baseline from which to understand ecological changes (e.g. introduction of invasive alien marine species, climate change) and human impacts (harvesting, mining) along the West Coast. Protecting this stretch of coastline is part of South Africa's climate adaptation strategy.

- The 612 km^2 **Robben Island MPA** was proclaimed in 2019 to protect the surrounding kelp forests – one of the few areas that still support viable stocks of abalone. The island harbours the 3rd largest penguin colony, with the breeding population peaking in 2004 at 8 524, but declining since. The island also holds the largest numbers of breeding Bank Cormorant in the Western Cape (120 pairs in 2000) and significant populations of Crowned Cormorant, African Black Oystercatcher (35 breeding pairs in 2000), Hartlaub's Gull and Swift Tern.
- The **Rocher Pan MPA**, which stretches 500 m offshore of the high-water mark of the adjacent Rocher Pan Nature Reserve, was declared in 1966. The MPA primarily protects a stretch of beach important as a breeding area to numerous waders.
- The **West Coast National Park**, which was established in 1985 incorporates the Langebaan Lagoon and Sixteen Mile Beach MPAs, as well the islands Schaapen (29 ha), Marcus (17 ha), Malgas (18 ha) and Jutten (43 ha). Langebaan Lagoon was designated as a Ramsar site in April 1988 under the Convention on Wetlands of International Importance especially as Waterfowl Habitat. The lagoon is divided into three different utilization zones namely: wilderness, limited recreational and multi-purpose recreational areas. The wilderness zone has restricted access and includes the southern end of the lagoon and the inshore islands, which are the key refuge sites of the waders and breeding seabird populations respectively. The limited recreation zone includes the middle reaches of the lagoon, where activities such as sailing and canoeing are permitted. The mouth region is a multi-purpose recreation zone for power boats, yachts, water-skiers and fishermen. However, no collecting or removal of abalone and rock lobster is allowed. The length of the combined shorelines of Langebaan Lagoon MPA and Sixteen Mile Beach is 66 km. The uniqueness of Langebaan lies in its being a warm oligotrophic lagoon, along the cold, nutrient-rich and wave exposed West Coast.

8.6.3 SENSITIVE AREAS

Despite the development of the offshore MPA network a number of 'Endangered' and 'Vulnerable' ecosystem types (i.e. Orange Cone Inner Shelf Mud Reef Mosaic, Orange Cone Muddy mid Shelf, Namaqua Muddy Sands, Southern Benguela Outer Shelf Mosaic, Southern Benguela Shelf Edge Mosaic and Southeast Atlantic Lower Slope) are currently 'not well protected' and further effort is needed to improve protection of these threatened ecosystem types. Ideally, all highly threatened ('Critically Endangered' and 'Endangered') ecosystem types should be well protected. Currently, however, most of the Southern Benguela Sandy Shelf Edge and Southeast Atlantic Upper- and Mid-Slope are poorly protected receiving only 0.2-10% protection, whereas the Southeast Atlantic Lower Slope receives no protection at all. Expanding the size of the Orange Shelf Edge MPA to form a single MPA along the South African Border could improve protection of these threatened habitats. Most of the ecosystem types in the proposed 3D survey area are either poorly protected or not protected.

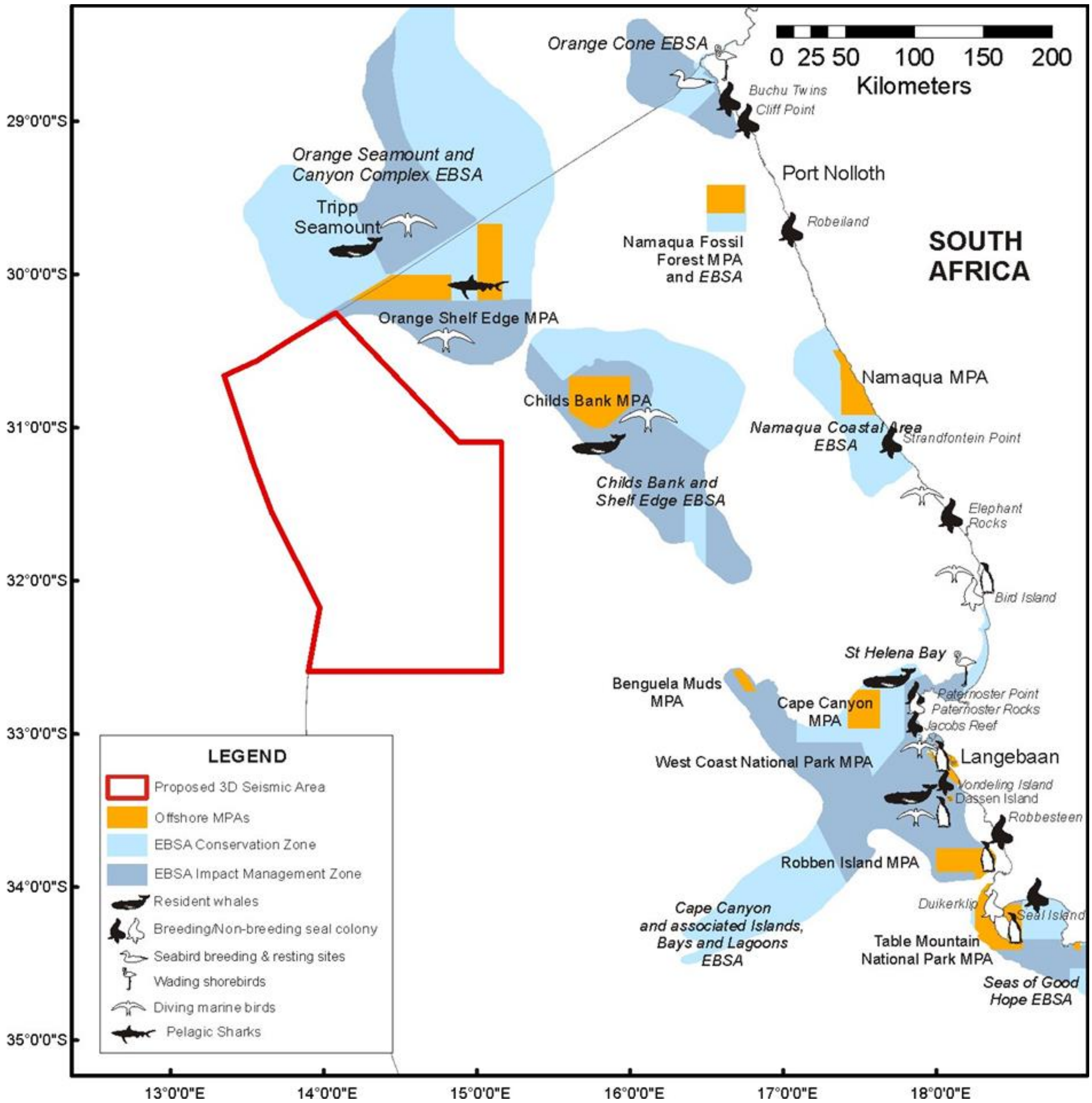


Figure 60: The survey area in relation to project – environment interaction points on the West Coast, illustrating the location of seabird and seal colonies and resident whale populations, Marine Protected Areas (MPAs) and Ecologically and Biologically Significant Areas (EBSAs).

8.6.4 ECOLOGICALLY OR BIOLOGICALLY SIGNIFICANT AREAS

As part of a regional Marine Spatial Management and Governance Programme (MARISMA 2014-2020) the Benguela Current Commission (BCC) and its member states have identified a number of Ecologically or Biologically Significant Areas (EBSAs) both spanning the border between Namibia and South Africa and along the South African West, South and East Coasts (**Figure 61**), with the intention of implementing improved conservation and protection measures within these sites. South Africa currently has 11 EBSAs solely within its national jurisdiction with a further four having recently been proposed. It also shares five trans-boundary EBSAs with Namibia (3) and Mozambique (2). The principal objective of these EBSAs is identification of features of higher ecological value that may require enhanced conservation and management measures. They currently carry no legal status. The impact management and conservation zones within the EBSAs are under review and currently constitute a subset of the biodiversity priority areas map (see next section); EBSA conservation zones equate to Critical Biodiversity Areas (CBAs), whereas impact management zones equate to Ecological Support Area (ESAs). The relevant sea-use guidelines accompanying the CBA areas would apply.

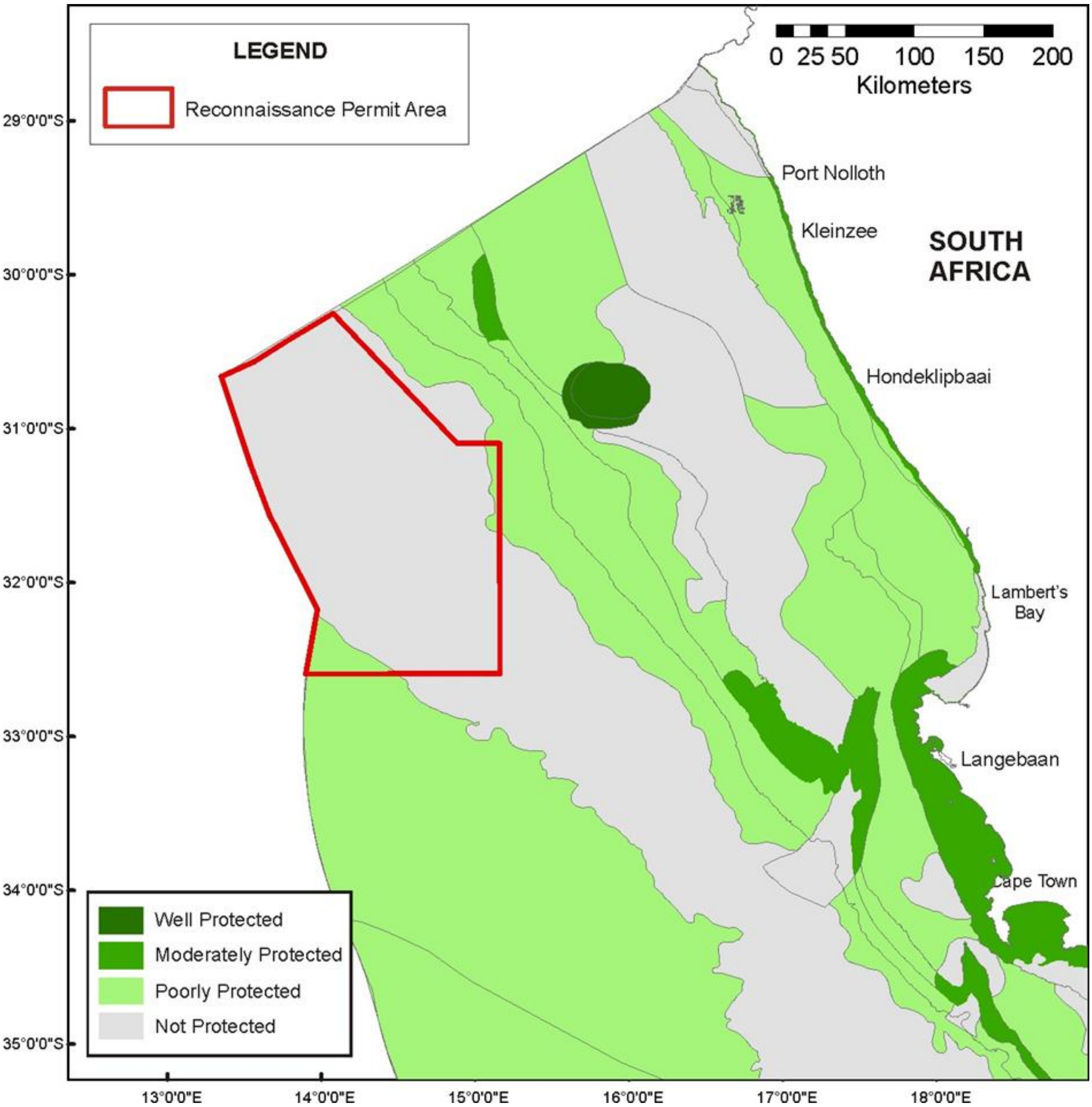


Figure 61: The survey area in relation to protection levels of 150 marine ecosystem types.

Summaries of the EBSAs in and around the Survey area included below

- The **Orange Seamount and Canyon Complex**, occurs at the western continental margin of southern Africa, spanning the border between South Africa and Namibia. On the Namibian side, it includes Tripp Seamount and a shelf-indenting canyon. The EBSA comprises shelf and shelf-edge habitat with hard and unconsolidated substrates, including at least eleven offshore benthic habitat types of which four habitat types are 'Threatened', one is 'Critically endangered' and one 'Endangered'. The Orange Shelf Edge EBSA is one of few places where these threatened habitat types are in relatively natural/pristine condition. The local habitat heterogeneity is also thought to contribute to the Orange Shelf Edge being a persistent hotspot of species richness for demersal fish species. Although focussed primarily on the conservation of benthic biodiversity and threatened benthic habitats, the EBSA also considers the pelagic habitat, which is characterized by medium productivity, cold to moderate Atlantic temperatures and moderate chlorophyll levels related to the eastern limit of the Benguela upwelling on the outer shelf.
- The **Orange Cone transboundary EBSA** lies inshore of the Survey area and spans the mouth of the Orange River. The estuary is biodiversity-rich but modified, and the coastal area includes many 'Critically endangered', 'Endangered' and 'Vulnerable' habitat types (with the area being particularly

important for the 'Critically Endangered' Namaqua Sandy Inshore, Namaqua Inshore Reef and Hard Grounds and Namaqua Intermediate and Reflective Sandy Beach habitat types). The marine environment experiences slow, but variable currents and weaker winds, making it potentially favourable for reproduction of pelagic species. An ecological dependence for of river outflow for fish recruitment on the inshore Orange Cone is also likely. The Orange River Mouth is a transboundary Ramsar site and falls within the Tsau//Khaeb (Sperrgebiet) National Park. It is also under consideration as a protected area by South Africa and is an Important Bird and Biodiversity Area.

- The **Namaqua Fossil Forest EBSA**, which lies ~210 km inshore of the Survey area, is a small seabed outcrop composed of fossilized yellowwood trees at 136-140 m depth, approximately 30 km offshore on the west coast of South Africa. A portion of the EBSA comprised the Namaqua Fossil Forest MPA. The fossilized tree trunks form outcrops of laterally extensive slabs of rock have been colonized by fragile, habitat-forming Scleractinia corals and a newly described habitat-forming sponge species. The EBSA thus encompasses a unique feature with substantial structural complexity that is highly vulnerable to benthic impacts.
- The **Childs Bank and Shelf Edge EBSA**, which lies ~40 km inshore of the Survey area, is a unique submarine bank feature rising from 400 m to -180 m on the western continental margin on South Africa. This area includes five benthic habitat types, including the bank itself, the outer shelf and the shelf edge, supporting hard and unconsolidated habitat types. Childs Bank and associated habitats are known to support structurally complex cold-water corals, hydrocorals, gorgonians and glass sponges; species that are particularly fragile, sensitive and vulnerable to disturbance, and recover slowly.
- The **Namaqua Coastal Area EBSA,** which lies ~190 km inshore of the Survey area and encompasses the Namaqua Coastal Area MPA, is characterized by high productivity and community biomass along its shores. The area is important for several threatened ecosystem types represented there, including two 'Endangered' and four 'Vulnerable' ecosystem types, and is important for conservation of estuarine areas and coastal fish species.
- The **Cape Canyon and Associated Islands EBSA** lies ~135 km east of the Survey area. The EBSA includes the Benguela Muds MPA and the Cape Canyon, which is thought to hosts fragile habitat-forming species. The area is considered important for pelagic fish, foraging marine mammals and several threatened seabird species and serves to protect nine 'Endangered' and 12 'Vulnerable' ecosystem types, and two that are 'Near Threatened'. There are several small coastal MPAs within the EBSA.
- The proposed **Seas of Good Hope EBSA** is located at the coastal tip of Africa, wrapping around Cape Point and Cape Agulhas. It extends from the coast to the inner shelf, and includes key islands (Seal Island, Dyer Island and Geyser Rocks), two major bays (False Bay and Walker Bay), and is of key importance for threatened species and habitats. The threatened habitats include coastal, inshore and inner shelf ecosystem types. The important life-history stages supported by the area are breeding and/or foraging grounds for a myriad of top predators, including sharks, whales, and seabirds, some of which are threatened species. This EBSA is also the place where the Benguela and Agulhas Currents meet.
- The **Benguela Upwelling System** is a transboundary EBSA is globally unique as the only cold-water upwelling system to be bounded in the north and south by warm-water current systems and is characterized by very high primary production (>1 000 mg C.m-2.day-1). It includes important spawning and nursery areas for fish as well as foraging areas for threatened vertebrates, such as sea- and shorebirds, turtles, sharks, and marine mammals. Another key characteristic feature is the diatomaceous mud-belt in the Northern Benguela, which supports regionally unique low-oxygen benthic communities that depend on sulphide oxidising bacteria.

8.6.5 BIODIVERSITY PRIORITY AREAS

The National Coastal and Marine Spatial Biodiversity Plan comprises a map of Critical Biodiversity Areas (CBAs), Ecological Support Area (ESAs) and accompanying sea-use guidelines. The CBA Map presents a spatial plan for the marine environment, designed to inform planning and decision-making in support of sustainable development. The sea-use guidelines enhance the use of the CBA Map in a range of planning and decision-making processes by indicating the compatibility of various activities with the different biodiversity priority areas so that the broad management objective of each can be maintained. The intention is that the CBA Map (CBAs and ESAs) and sea-use guidelines inform the MSP Conservation Zones and management regulations, respectively.

The 3D survey area overlaps with areas mapped as Critical Biodiversity Area 1 (CBA 1): Natural and Critical Biodiversity Area 2: (CBA 2) Natural. Approximately 39.2 % of the proposed 3D survey area is covered by CBA 1 and CBA 2 (see **Figure 62**). CBA 1 indicates irreplaceable or near-irreplaceable sites that are required to meet biodiversity targets with limited, if any, option to meet targets elsewhere, whereas CBA 2 are "best design sites" and there are often alternative areas where targets can be met; however, these will be of higher cost to other sectors and / or will be larger areas.

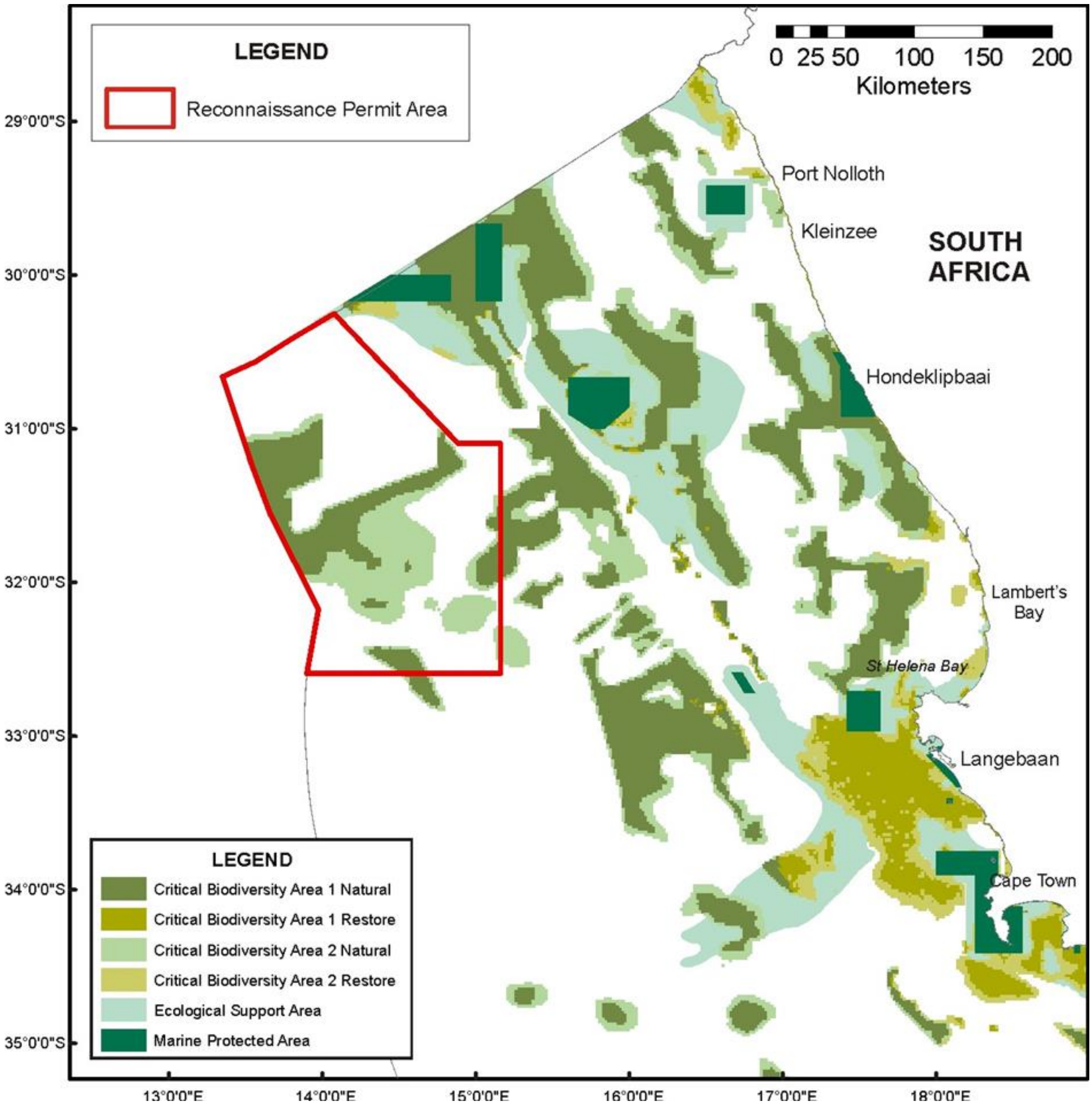


Figure 62: The survey area in relation to CBAs and ESAs.

Regardless of how CBAs are split, CBAs are generally areas of low use and with low levels of human impact on the marine environment but can also include some moderately to heavily used areas with higher levels of human impact. Given that some CBAs are not in natural or near-natural ecological condition, but still have very high biodiversity importance and are needed to meet biodiversity feature targets, CBA 1 and CBA 2 were split into two types based on their ecological condition. CBA Natural sites have natural / near-natural ecological condition, with the management objective of maintaining the sites in that natural / near natural state; and CBA Restore sites have moderately modified or poorer ecological condition, with the management objective to improve ecological condition and, in the long-term, restore these sites to a natural/near-natural state, or as close to that state as possible. ESAs include all portions of EBSAs that are not already within MPAs or CBAs, and a 5-km buffer area around all MPAs (where these areas are not already CBAs or ESAs), with the exception of the eastern edge of Robben Island MPA in Table Bay where a 1.5-km buffer area was applied.

Activities within these management zones are classified into those that are “compatible”, those that are “not compatible”, and those that have “restricted compatibility”. In terms of this, non-invasive (e.g. seismic surveys) and invasive (e.g. exploration wells) exploration activities are classified as having “restricted compatibility”. Activities with restricted compatibility require a detailed assessment to determine whether the recommendation is that they should be permitted (general), permitted subject to additional regulations (consent), or prohibited, depending on a variety of factors. Petroleum production is, however, classified as “not compatible” in CBAs, but may be compatible, subject to certain conditions, in ESAs. However, according to the National Coastal and Marine Spatial Biodiversity Plan for the coast and ocean around the South African mainland states that petroleum production may be possible in CBAs using lateral drilling or other techniques that do not result in biodiversity impacts. According to the plan if significant petroleum resources are identified in these areas the selection of the site as a CBA could also be re-evaluated, although this would require alternative CBAs to be identified to meet biodiversity targets.

8.6.5.1 IMPORTANT BIRD AREAS (IBAS)

There are numerous coastal Important Bird Areas (IBAs) in the general project area. These are all located well inshore of the Survey area and should in no way be directly affected by the proposed seismic surveys. Various marine IBAs have also been proposed in South African and Namibian territorial waters, with a candidate trans-boundary marine IBA suggested off the Orange River mouth and a further candidate marine IBA suggested in international waters west of the Cape Peninsula (**Figure 63**). There is no overlap of the Survey area with any of these Marine IBAs.

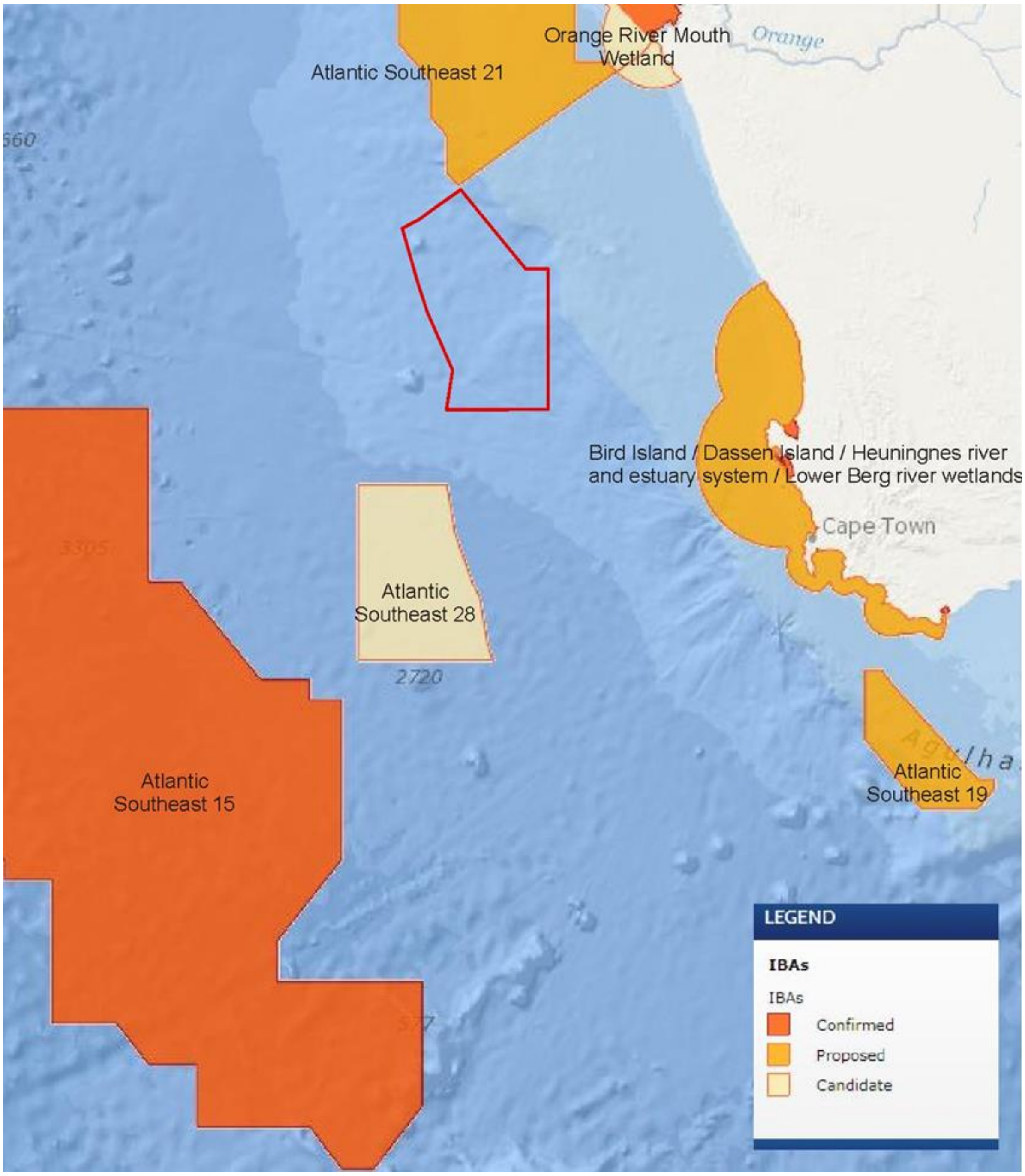


Figure 63: The Survey area in relation to coastal and marine IBAs in South Africa and Namibia.

8.6.5.2 IMPORTANT MARINE MAMMAL AREAS (IMMAS)

Important Marine Mammal Areas (IMMAs) were introduced in 2016 by the IUCN Marine Mammal Protected Areas Task Force to support marine mammal and marine biodiversity conservation. Complementing other marine spatial assessment tools, including the EBSAs and Key Biodiversity Areas (KBAs), IMMAs are identified on the basis of four main scientific criteria, namely species or population vulnerability, distribution and abundance, key life cycle activities and special attributes. Designed to capture critical aspects of marine mammal biology, ecology and population structure, they are devised through a biocentric expert process that is independent of any political and socio-economic pressure or concern. IMMAs are not prescriptive but comprise an advisory, expert-based classification of areas that merit monitoring and place-based protection for marine mammals and broader biodiversity.

Although much of the West Coast of South Africa has not yet been assessed with respect to its relevance as an IMMA, the coastline from the Olifants River mouth on the West Coast to the Mozambiquan border overlaps with three declared IMMAs (**Figure 64**) namely the:

- Southern Coastal and Shelf Waters of South Africa IMMA (166 700 km^2),
- Cape Coastal Waters IMMA (6 359 km^2), and
- South East African Coastal Migration Corridor IMMA (47 060 km^2).

These are described briefly below based on information provided in IUCN-Marine Mammal Protected Areas Task Force (2021) (www.marinemammalhabitat.org).

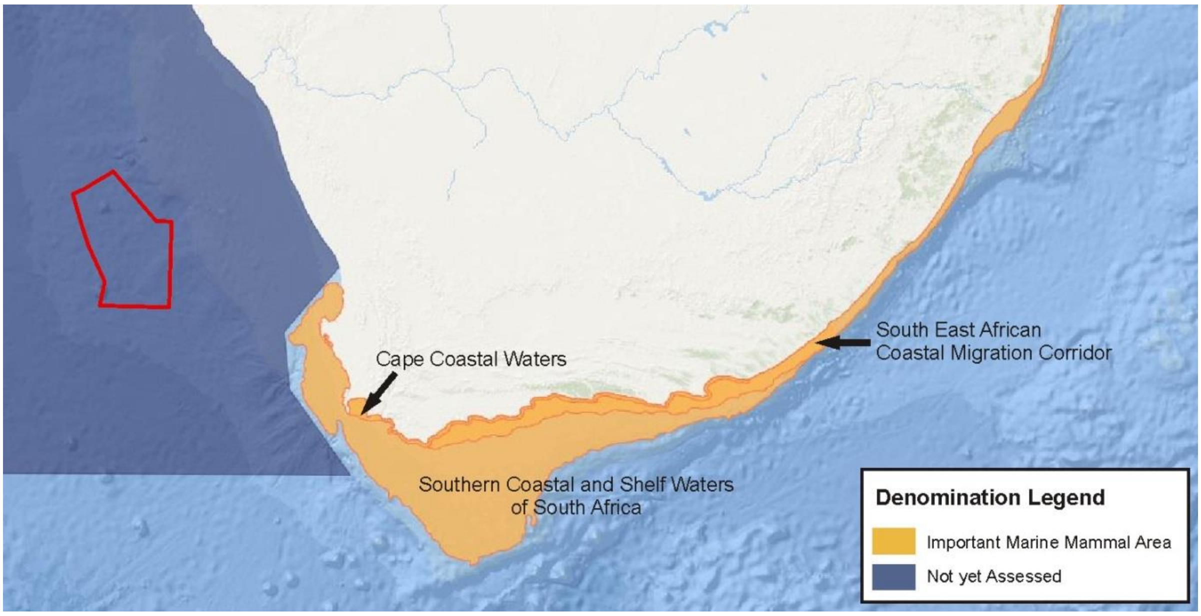


Figure 64: Survey area in relation to coastal and marine IMMAs.

The 166 700 km^2 **Southern Coastal and Shelf Waters of South Africa IMMA** extends from the Olifants River mouth to the mouth of the Cintsa River on the Wild Coast. Qualifying species are the Indian Ocean Humpback dolphin, Bryde's whale, Indo-Pacific bottlenose dolphin, Common dolphin and Cape fur seal. The IMMA covers the area supporting the important 'sardine run' and the marine predators that follow and feed on the migrating schools as well as containing habitat that supports an important diversity of marine mammal species (Criterion D2) including the Indian Ocean humpback dolphin, the inshore form of Bryde's whale, Indo-Pacific bottlenose dolphin, common dolphin, Cape fur seal, humpback whales, killer whales and southern right whales.

The **Cape Coastal Waters IMMA** extends from Cape Point to Woody Cape at Algoa Bay and extends over some 6 359 km2. It serves as one of the world's three most important calving and nursery grounds for southern right whales, which occur in the extreme nearshore waters (within 3 km of the coast) from Cape Agulhas to St. Sebastian Bay between June and November (Criterion B2, C1). Highest densities of cow-calf pairs occur between Cape Agulhas and the Duivenhoks River mouth (Struisbaai, De Hoop, St Sebastian Bay), while unaccompanied adult densities peak in Walker Bay and False Bay. The IMMA also contains habitat that supports an important diversity of marine mammal species including the Indian Ocean humpback dolphin and Indo-Pacific bottlenose dolphin.

The **South East African Coastal Migration Corridor IMMA** extends some 47 060 km^2 from Cape Agulhas to the Mozambiquan border and serves as the primary migration route for C1 substock of Southern Hemisphere humpback whales (Criterion C3). On their northward migration between June and August, they are driven closer to shore due to the orientation of the coast with the Agulhas Current, whereas during the southward migration from September to November, they remain further offshore (but generally within 15 km of the coast) utilising the southward flowing Agulhas Current as far west as Knysna. The IMMA also contains habitat that supports an important diversity of marine mammal species including the Indian Ocean humpback dolphin, Common dolphin, Indo-Pacific bottlenose dolphin, Spinner dolphin, Southern Right whale, and killer whale.

There is no overlap of the Survey area with these IMMAs as it falls within the area along the West Coast of South Africa that has not yet been assessed.

8.7 SOCIO-ECONOMIC

This section provides and overview of the socio-economic environment for the study area. The majority of this information has been sourced from the Social Impact Assessment undertaken by Equispectives (Pty) Ltd, included in **Appendix C**.

8.7.1 POPULATION

The baseline description of the population will take place on three levels, namely provincial, district and local. Impacts can only truly be comprehended by understanding the differences and similarities between the different levels. The baseline description will focus on the municipal areas along the west coast that are most likely to be affected by the proposed project.

8.7.1.1 POPULATION AND HOUSEHOLD SIZES

According to the Census 2022, the population of South Africa is approximately 62 million and has shown an increase of about 19.8% since 2011. The household density for the country is estimated on approximately 3.48 people per household, indicating an average household size of 3-4 people for most households, which is down from the 2011 average household size of 3.58 people per household. Smaller household sizes are in general associated with higher levels of urbanisation.

The greatest increase in population since 2011 has been in the Swartland and Saldanha Bay Local Municipalities (**Table 24**) and the increases were well above the national average. The greatest increase in population since 2011 has been in the Richtersveld Local Municipality where Port Nolloth is located where the population has more than doubled. The Kamiesberg Local Municipality where Hondeklip Bay is located, saw the greatest decrease in population between 2011 and 2016. Population density refers to the number of people per square kilometre and the population density on a national level has increased from 42.45 people per km2 in 2011 to 45.63 people per km^2 in 2016. The City of Cape Town had the highest population density in 2016, and the Kamiesberg Local Municipality the lowest. **Figure 65** gives a comparison of the population density. The municipalities in the rural areas in the Northern Cape are the least densely populated, while the metropolitan areas in Cape Town have the highest population density. **Figure 66** shows the number of people per ward. The wards in the rural areas tend to have less people spread over a greater area, while in the urban areas there are more people in a much smaller area.

Table 24: Population density and growth estimates ((sources: Census 2011, Census 2022).

Area	Size in km^2	Population 2011	Population 2016	Population density 2011	Population density 2016	Growth in population (%)
Northern Cape	**372,889**	**1,145,861**	**1,355,945**	**3.07**	**3.64**	**18.33**
Namakwa DM	*126,836*	*115,842*	*148,935*	*0.91*	*1.17*	*28.57*
Richtersveld LM	9,608	11,982	24,235	1.25	2.52	102.26
Nama Khoi LM	17,990	47,041	67,089	2.61	3.73	42.62

Area	Size in km²	Population 2011	Population 2016	Population density 2011	Population density 2016	Growth in population (%)
Kamiesberg LM	14,208	10,187	15,130	0.72	1.06	48.52
Western Cape	**129,462**	**5,822,734**	**7,433,020**	**44.98**	**57.41**	**27.66**
West Coast DM	*31,118*	*391766*	*497,394*	*12.59*	*15.98*	*26.96*
Matzikama LM	12,981	67147	69,043	5.17	5.32	2.82
Cederberg LM	8,007	49,768	55,108	6.22	6.88	10.73
Bergrivier LM	4,407	61,897	70,276	14.05	15.95	13.54
Saldanha Bay LM	2,015	99,193	154,635	49.23	76.74	55.89
Swartland LM	3,708	113,762	148,331	30.68	40.00	30.39
City of Cape Town Metropolitan	*2,441*	*3,740,026*	*4,772,846*	*1,532.17*	*1955.28*	*27.62*

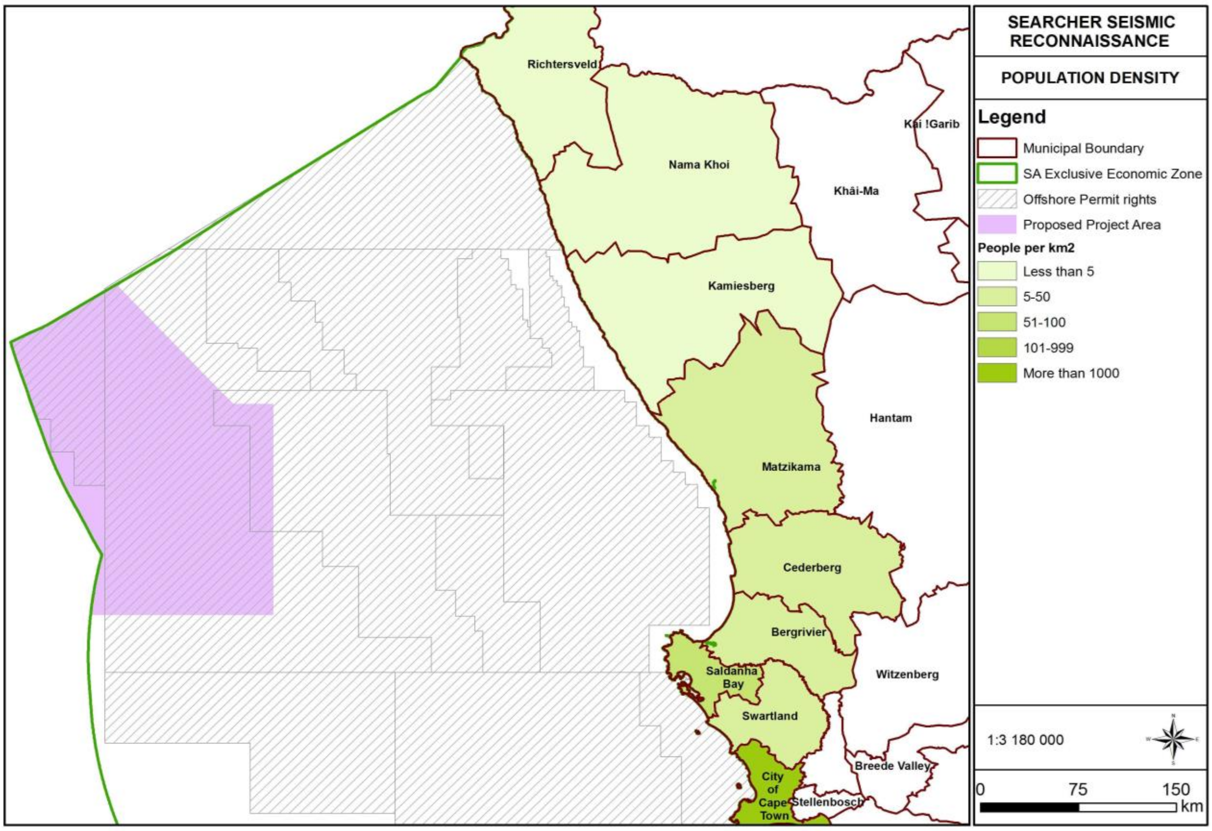


Figure 65: Population density (Census, 2022)

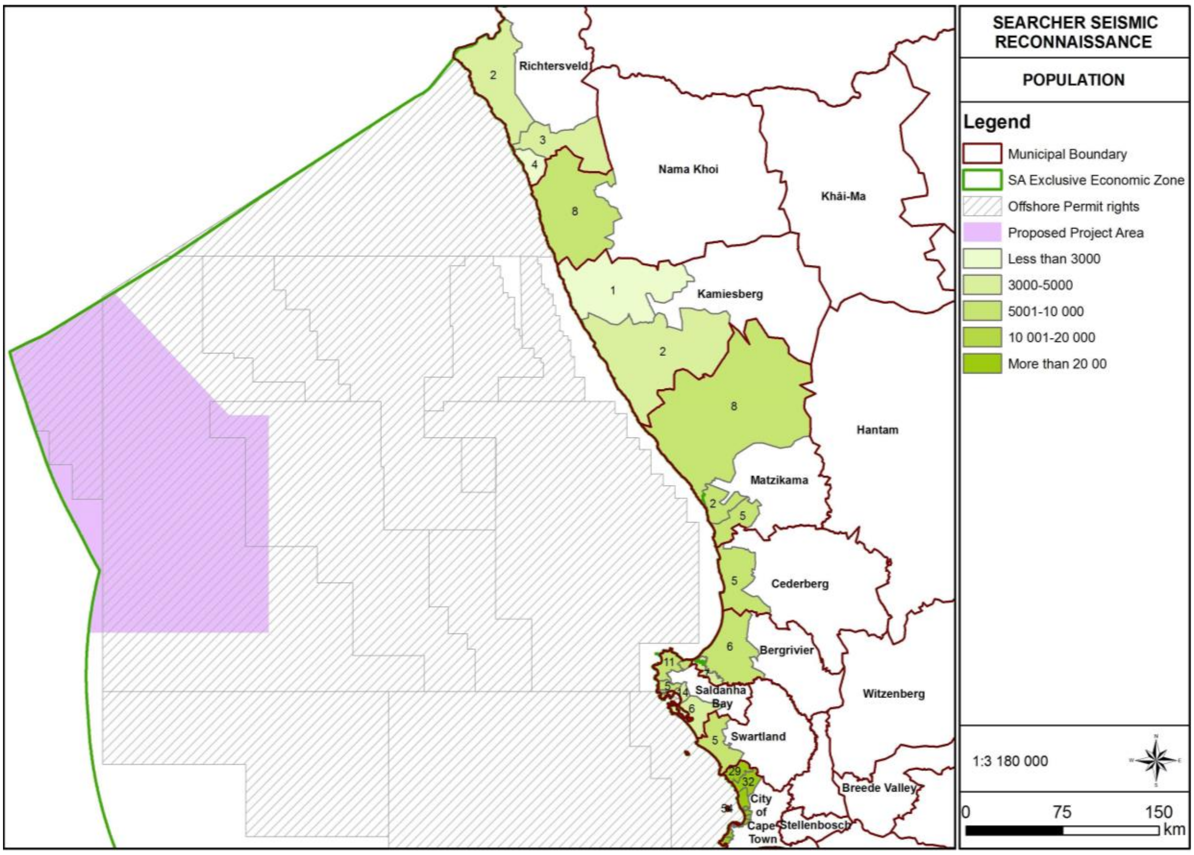


Figure 66: People per ward (Census, 2022).

The number of households in the study area has increased on all levels (**Table 25**). The proportionate increase in households were greater than the increase in population on all levels. The greatest proportional increases in households were in the Saldanha Bay Local Municipality. The average household size has shown a decrease in the local municipalities located in the Western Cape, except in the Matzikama Local Municipality, which means there are more households, but with less members. In the local municipalities located in the Northern Cape the household sizes have increased.

Table 25: Household sizes and growth estimates (sources: Census 2011, Census 2022)

Area	Households 2011	Households 2016	Average household size 2011	Average household size 2016	Growth in households (%)
Northern Cape	**301,405**	**333,553**	**3.80**	**4.07**	**10.67**
Namakwa DM	*33,856*	*33,947*	*3.42*	*4.39*	*0.27*
Richtersveld LM	3,543	5,643	3.38	4.29	59.27
Nama Khoi LM	13,193	14,579	3.57	4.60	10.51
Kamiesberg LM	3,143	3,576	3.24	4.23	13.78
Western Cape	**1,634,000**	**2,264,032**	**3.56**	**3.28**	**38.56**
West Coast DM	*106,781*	*150,840*	*3.67*	*3.30*	*41.26*
Matzikama LM	18,835	19,101	3.57	3.61	1.41
Cederberg LM	13,513	15,912	3.68	3.46	17.75
Bergrivier LM	16,275	20,412	3.80	3.44	25.42
Saldanha Bay LM	28,835	50,559	3.44	3.06	75.34
Swartland LM	29,324	44,856	3.88	3.31	52.97

City of Cape Town Metropolitan	*1,068,573*	*1,452,845*	*3.50*	*3.29*	*35.96*

Figure 67 shows the number of households per ward. The wards in the Kamiesberg Local Municipality have the fewest people per ward. The total dependency ratio is used to measure the pressure on the productive population and refer to the proportion of dependents per 100 working-age population. As the ratio increases, there may be an increased burden on the productive part of the population to maintain the upbringing and pensions of the economically dependent. A high dependency ratio can cause serious problems for a country as the largest proportion of a government's expenditure is on health, social grants and education that are most used by the old and young population.

On provincial and district level the total and youth dependency ratios have decreased between 2011 and 2022 while the age dependency ratios have increased, indicating an aging population. In 2022 the Kamiesberg Local Municipality had the highest total dependency ratio (**Table 26**), while in the Cederberg Local Municipality had the lowest. Employed dependency ratio refers to the proportion of people dependent on the people who are employed, and not only those of working age. The employed dependency ratio for the Kamiesberg and Nama Khoi Local Municipalities in 2011 were the highest. This suggests high levels of poverty in these areas. This suggests high levels of poverty in these areas. **Figure 68** and **Figure 69** show the total and employed dependency ratios on a ward level.

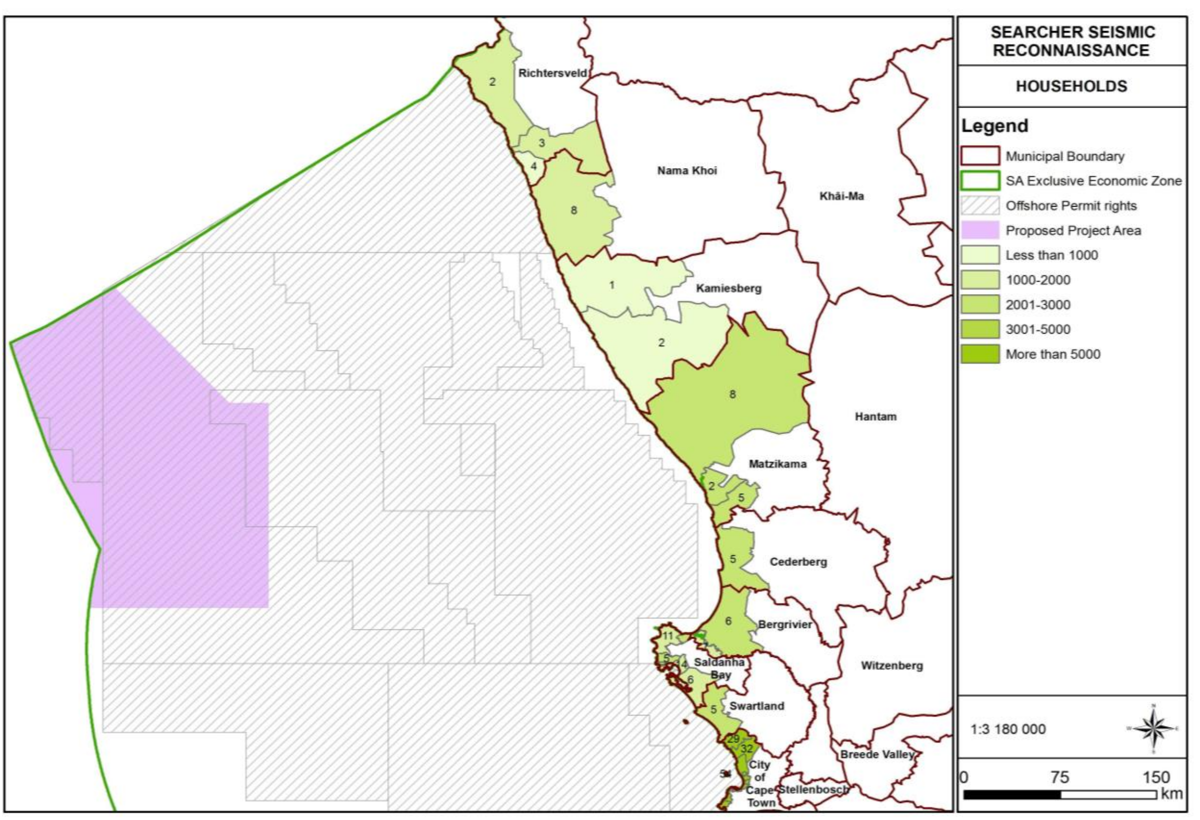


Figure 67: Households per ward (source: Census 2022).

Table 26: Total dependency ratios (source: Census 2011, Census 2022).

Area	Total dependency	Youth dependency	Aged dependency	Employed dependency
Northern Cape	55.75	46.94	8.80	75.32
Northern Cape 2022	52.56	42.45	10.10	
Namakwa DM	*51.23*	*39.01*	*12.22*	*70.92*

Area	Total dependency	Youth dependency	Aged dependency	Employed dependency
Namakwa DM 2022	*48.35*	*34.21*	*14.14*	
Richtersveld LM	*42.51*	*33.96*	*8.55*	*61.38*
Richtersveld LM 2022	*45.07*	*35.01*	*10.06*	
Ward 2	36.82	32.89	3.93	56.70
Ward 3	39.54	32.95	6.59	64.57
Ward 4	48.60	35.93	12.67	63.98
Nama Khoi LM	*49.45*	*37.16*	*12.29*	*73.74*
Nama Khoi LM 2022	*46.71*	*31.38*	*15.34*	
Ward 8	45.05	35.42	9.63	76.99
Kamiesberg LM	*57.89*	*41.84*	*16.05*	*78.37*
Kamiesberg LM 2022	*51.59*	*33.87*	*17.72*	
Ward 1	54.81	40.19	14.62	79.04
Ward 2	48.90	33.04	15.86	69.06
Western Cape	44.96	36.44	8.52	65.47
Western Cape 2022	42.24	31.90	10.34	
West Coast DM	*45.92*	*37.14*	*8.78*	*63.98*
West Coast DM 2022	*44.06*	*33.76*	*10.30*	
Matzikama LM	*49.39*	*40.05*	*9.34*	*64.55*
Matzikama LM 2022	*46.49*	*37.00*	*9.48*	
Ward 2	48.60	38.35	10.24	67.26
Ward 5	46.38	33.96	12.41	53.32
Ward 8	53.71	41.14	12.57	71.99
Cederberg LM	*46.99*	*37.59*	*9.40*	*62.75*
Cederberg LM 2022	*39.55*	*31.08*	*8.46*	
Ward 5	51.76	38.06	13.70	69.48
Bergrivier LM	*46.89*	*36.62*	*10.27*	*61.61*
Bergrivier LM 2022	*44.70*	*32.28*	*12.42*	
Ward 6	46.60	37.11	9.49	65.08
Ward 7	55.44	23.94	31.50	68.70
Saldanha Bay LM	*43.96*	*36.41*	*7.54*	*65.36*
Saldanha Bay LM 2022	*44.30*	*34.01*	*10.29*	
Ward 1	39.71	36.79	2.91	68.76
Ward 3	29.02	23.68	5.35	74.04
Ward 5	39.28	27.63	11.66	54.39
Ward 6	59.99	25.93	34.06	61.44
Ward 11	44.91	32.19	12.73	63.50
Ward 12	45.16	41.60	3.56	67.57
Ward 14	42.82	34.92	7.90	54.68
Swartland LM	*44.68*	*36.21*	*8.47*	*64.27*
Swartland LM 2022	*44.11*	*33.72*	*10.39*	
Ward 5	50.76	33.31	17.44	58.03

Area	Total dependency	Youth dependency	Aged dependency	Employed dependency
City of Cape Town Metropolitan	***43.61***	***35.65***	***7.97***	***65.39***
City of Cape Town Metropolitan 2022	***41.04***	***31.64***	***9.40***	
Ward 4	35.95	31.80	4.16	52.38
Ward 23	38.49	26.83	11.66	47.23
Ward 29	47.25	40.95	6.30	69.98
Ward 32	44.89	41.04	3.85	68.39
Ward 54	39.01	16.17	22.84	51.04
Ward 55	41.63	26.22	15.41	56.16
Ward 74	40.68	33.04	7.63	58.62
Ward 107	40.60	28.96	11.64	46.30
Ward 113	36.71	26.07	10.64	47.93
Ward 115	26.32	14.33	12.00	60.94

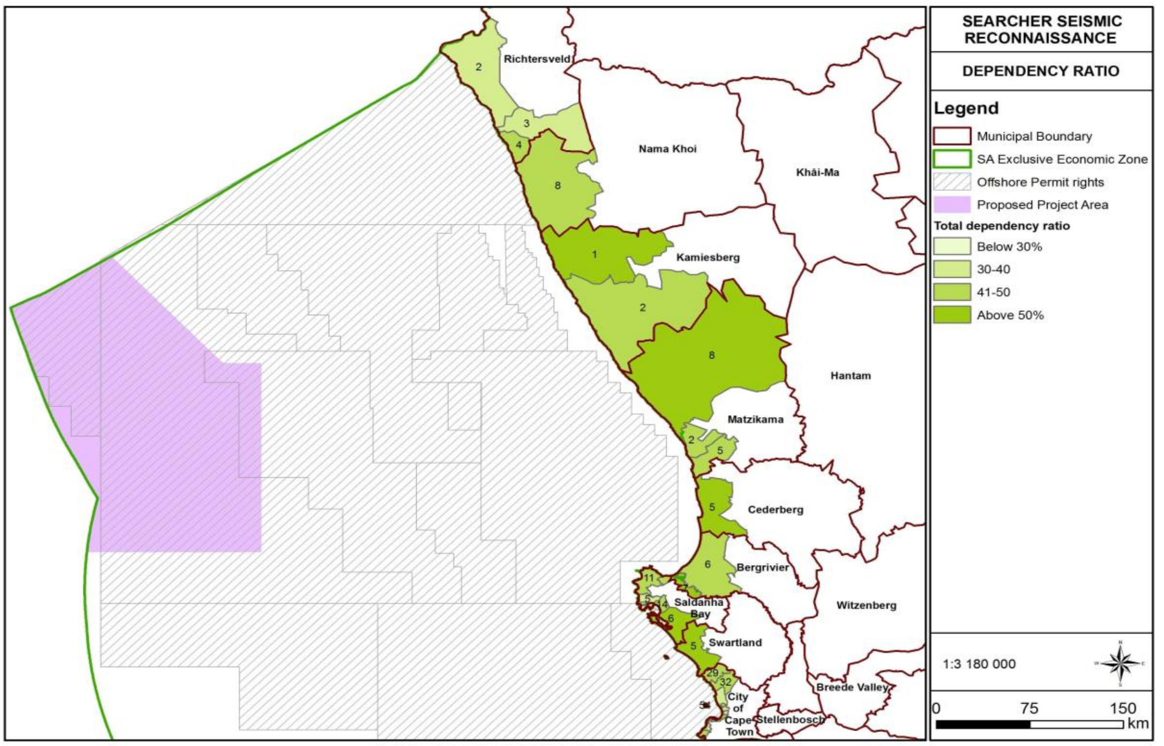


Figure 68: Total dependency ratios (source: Census 2011).

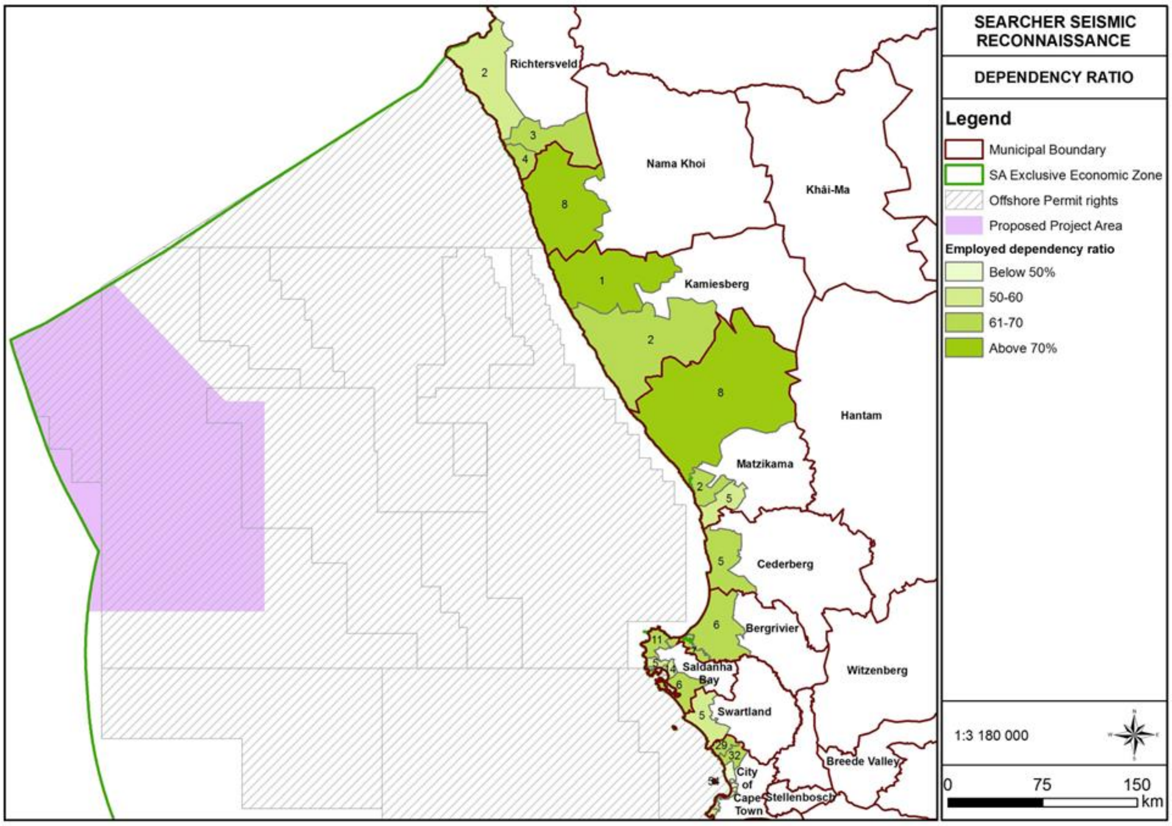


Figure 69: Employed dependency ratio (source: Census 2011).

Poverty is a complex issue that manifests itself in economic, social, and political ways and to define poverty by a unidimensional measure such as income or expenditure would be an oversimplification of the matter. Poor people themselves describe their experience of poverty as multidimensional. The South African Multidimensional Poverty Index (SAMPI) (Statistics South Africa, 2014) assess poverty on the dimensions of health, education, standard of living and economic activity using the indicators child mortality, years of schooling, school attendance, fuel for heating, lighting, and cooking, water access, sanitation, dwelling type, asset ownership and unemployment.

The poverty headcount refers to the proportion of households that can be defined as multi-dimensionally poor by using the SAMPI's poverty cut-offs (Statistics South Africa, 2014). The poverty headcount has increased on all levels since 2011, indicating an increase in the number of multi-dimensionally poor households. Poverty statistics based in Census 2022 are not yet available.

The intensity of poverty experienced refers to the average proportion of indicators in which poor households are deprived. The intensity of poverty has increased slightly on all levels. The intensity of poverty and the poverty headcount is used to calculate the SAMPI score. A higher score indicates a very poor community that is deprived on many indicators. The SAMPI score has decreased in the Northern Cape (**Table 27**) as well as the Northern Cape municipalities included in the study. In the Nama Khoi Local Municipality the score remained the same although there was a slight increase in the intensity of the poverty. In the Western Cape the SAMPI score decreased on a provincial level, but in the West Coast District Municipality it has increased.

Table 27: Poverty and SAMPI scores (sources: Census 2011 and Community Survey 2016).

Area	Poverty headcount 2011 (%)	Poverty intensity 2011 (%)	SAMPI 2011	Poverty headcount 2016 (%)	Poverty intensity 2016 (%)	SAMPI 2016
Northern Cape	**7.1**	**42.1**	**0.030**	**6.6**	**42**	**0.028**
Namakwa DM	*3.2*	*40.2*	*0.013*	*2.8*	*41.6*	*0.012*

Richtersveld LM	3.1	39.9	0.012	1.9	38.3	0.007
Nama Khoi LM	2.5	40.4	0.010	2.5	41.7	0.010
Kamiesberg LM	5.1	40	0.020	3	39	0.012
Western Cape	**3.6**	**42.6**	**0.015**	**2.7**	**40.1**	**0.011**
West Coast DM	*2*	*41.9*	*0.008*	*2.9*	*44.5*	*0.013*
Matzikama LM	3.4	42.4	0.014	0.8	42.5	0.003
Cederberg LM	2.8	42.9	0.012	3.6	45.7	0.016
Bergrivier LM	1	43.7	0.004	1.6	41.5	0.007
Saldanha Bay LM	2.2	41	0.009	6.7	45.4	0.030
Swartland LM	1	40.6	0.004	0.9	39.9	0.004
City of Cape Town Metropolitan	*3.9*	*42.8*	*0.017*	*2.6*	*39.3*	*0.010*

8.7.1.2 POPULATION COMPOSITION, AGE, GENDER AND HOME LANGUAGE

The majority of the people living in wards adjacent to the ocean are classified as belonging to the Coloured population group (**Figure 70**). The Coloured population group include Khoe and San people who in general find this classification offensive and they do not identify as such. The Kamiesberg Local Municipality has the highest average age (33.17 years) while the Saldanha Bay Local Municipality has the lowest (29.86 years). Average age varies on a ward level. The gender distribution is more or less equal in most municipal areas, except for the Richtersveld Local Municipality where there is a bias towards males. This is most likely due to mining activities that are taking place in the area. On a ward level, most people have Afrikaans as home language (**Figure 71**).

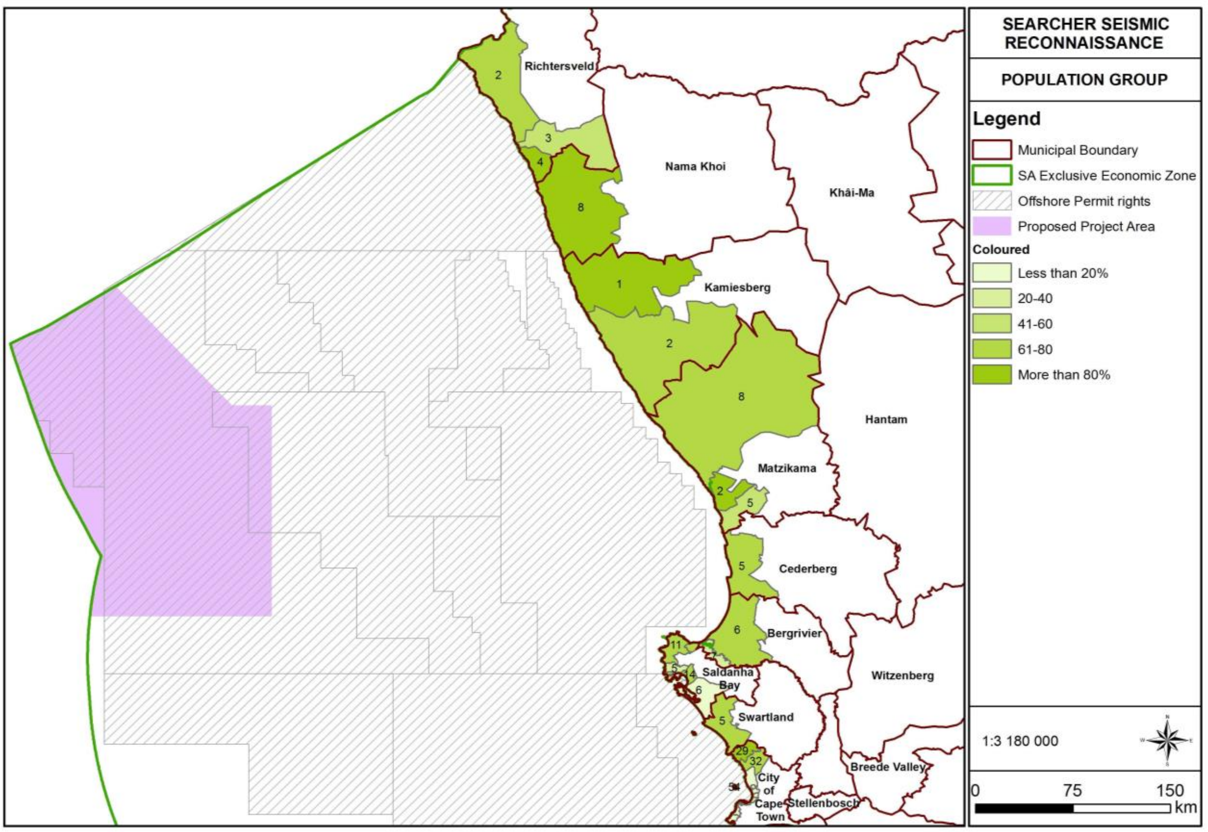


Figure 70: Classified as Coloured (shown in percentage, source: Census 2011)

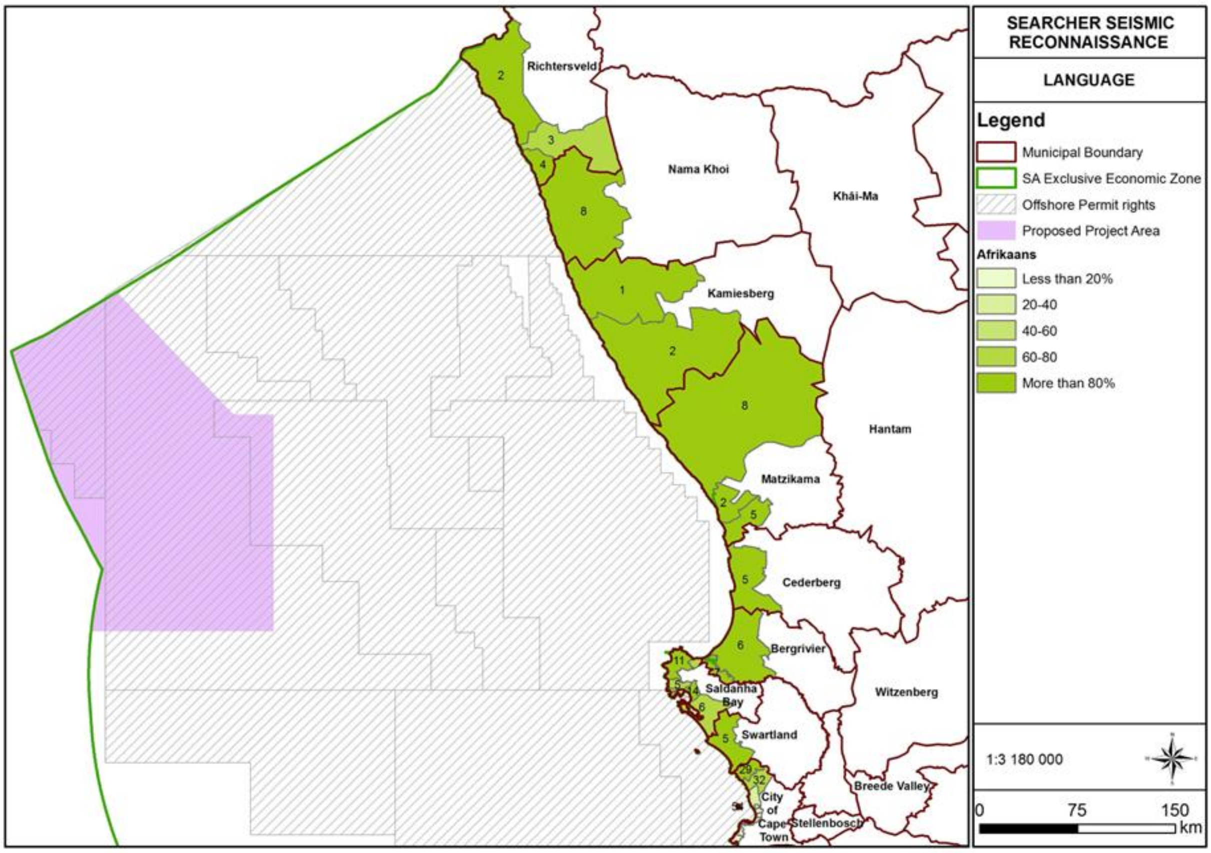


Figure 71: Home language Afrikaans (shown in percentage, source; Census 2011)

8.7.1.3 EDUCATION

In 2011 the highest proportion of people who did not complete high school is in the Saldanha Bay (73.59%) and the Swartland (72.83%) Local Municipalities while the Matzikama (32.7%) and Nama Khoi (37.37%) Local Municipalities have the lowest proportion of people that did not complete high school (**Figure 72**). Census 2022 shows that the highest proportion of adults older than 20 years who did not complete high school were in the Kamiesberg Local Municipality (67.06%), compared to 50.25% in the Saldanha Bay and 50.81% in the Swartland Local Municipalities.

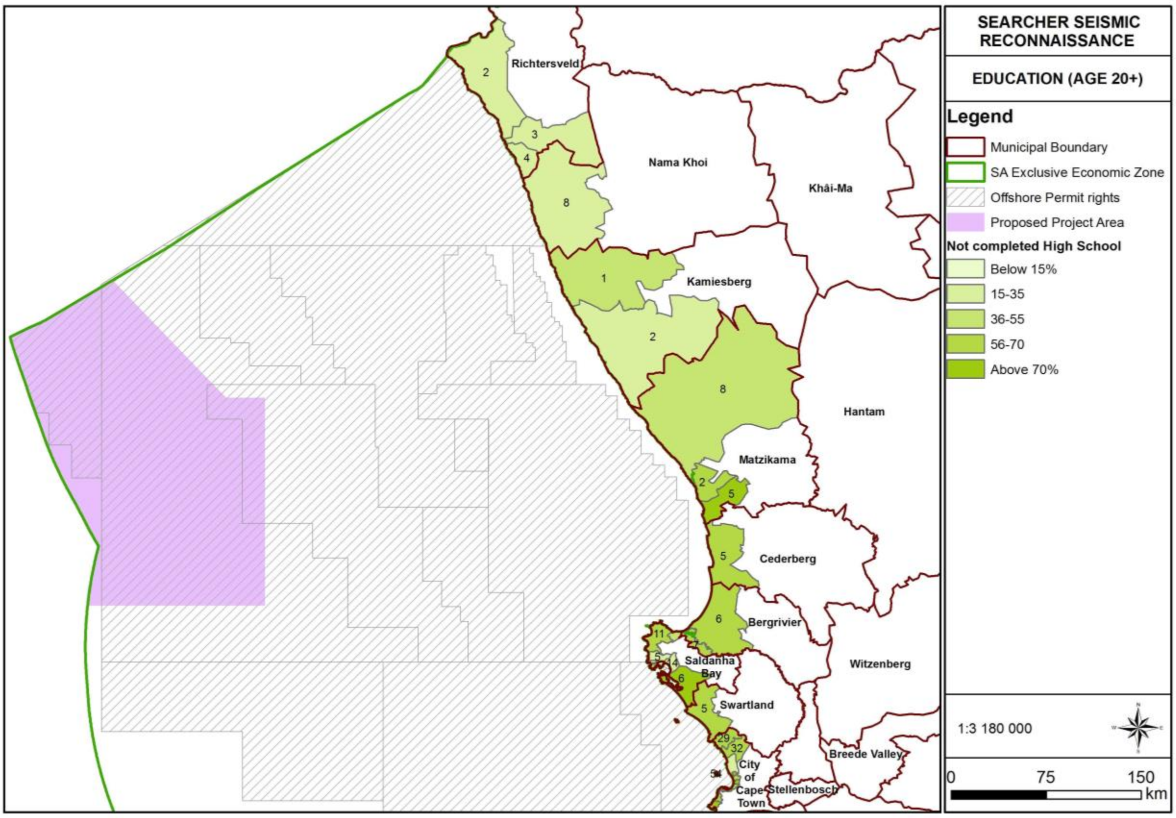


Figure 72: Proportion of people that did not complete secondary school (shown in percentage, source: Census 2011).

8.7.1.4 EMPLOYMENT

In 2011 the area with the highest proportion of unemployed people was ward 1 in the Kamiesberg Local Municipality where Hondeklip Bay is located (**Figure 73**). The proportion of unemployed people include those actively seeking for work as well as discouraged work seekers. The majority of people who are working, is employed in the formal sector.

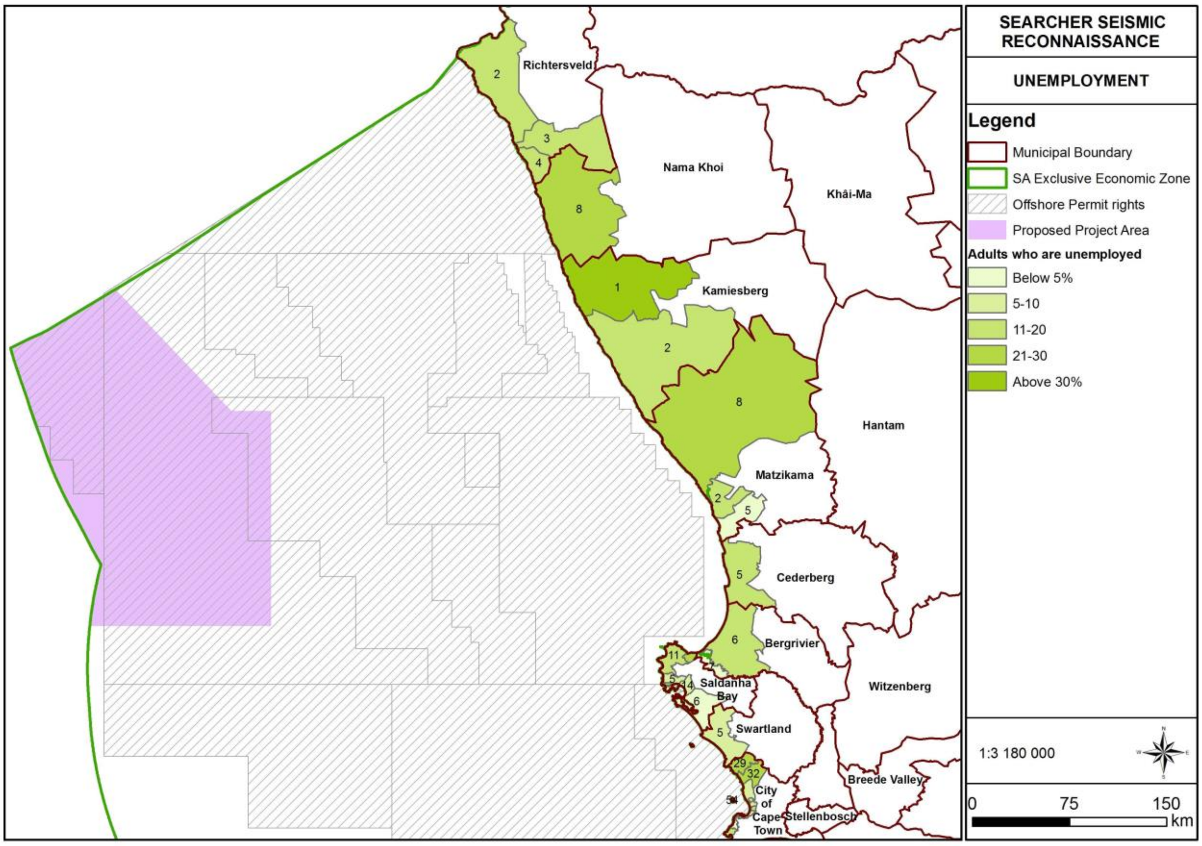


Figure 73: Proportion of adults that are unemployed (shown in percentage, source: Census 2011).

8.7.1.5 HOUSEHOLD INCOME

In 2011 almost a third of households on municipal level had an annual household income of R19 600 or less, with great variation between wards (**Figure 74**). Statistics South Africa (2015) has calculated the Food Poverty Line (FPL) for the Northern Cape Province as R310 per capita per month for 2011 where the FPL is the Rand value below which individuals are unable to purchase or consume enough food to supply them with the minimum per-capita-per-day energy requirement for good health. The FPL is one of three poverty lines, the others being the upper bound poverty line (UBPL) and the lower bound poverty line (LBPL). The LBPL and UBPL both include a non-food component. Individuals at the LBPL do not have enough resources to consumer or purchase both adequate food and non-food items and are forced to sacrifice food to obtain essential non-food items, while individuals at the UBPL can purchase both adequate food and non-food items. The LBPL for the Northern Cape Province was R457 per capita per month in 2011 and the UBPL R705 per capita per month respectively. The FPL for Western Cape was R352 per capita per month, the LBPL was R545 and the UPL was R804. Based on this, a household with four members needed an annual household income of approximately R17 000 in 2011 to be just above the FPL. When comparing this with the SAMPI data it seems as if there are more households below the poverty lines in the area than who are multi-dimensionally poor. This is due to the poverty lines using a financial measure and do not take into consideration payment in kind and livelihood strategies such as subsistence farming. If these were to be converted into a Rand value, the poverty line picture may have a closer resemblance to the SAMPI data.

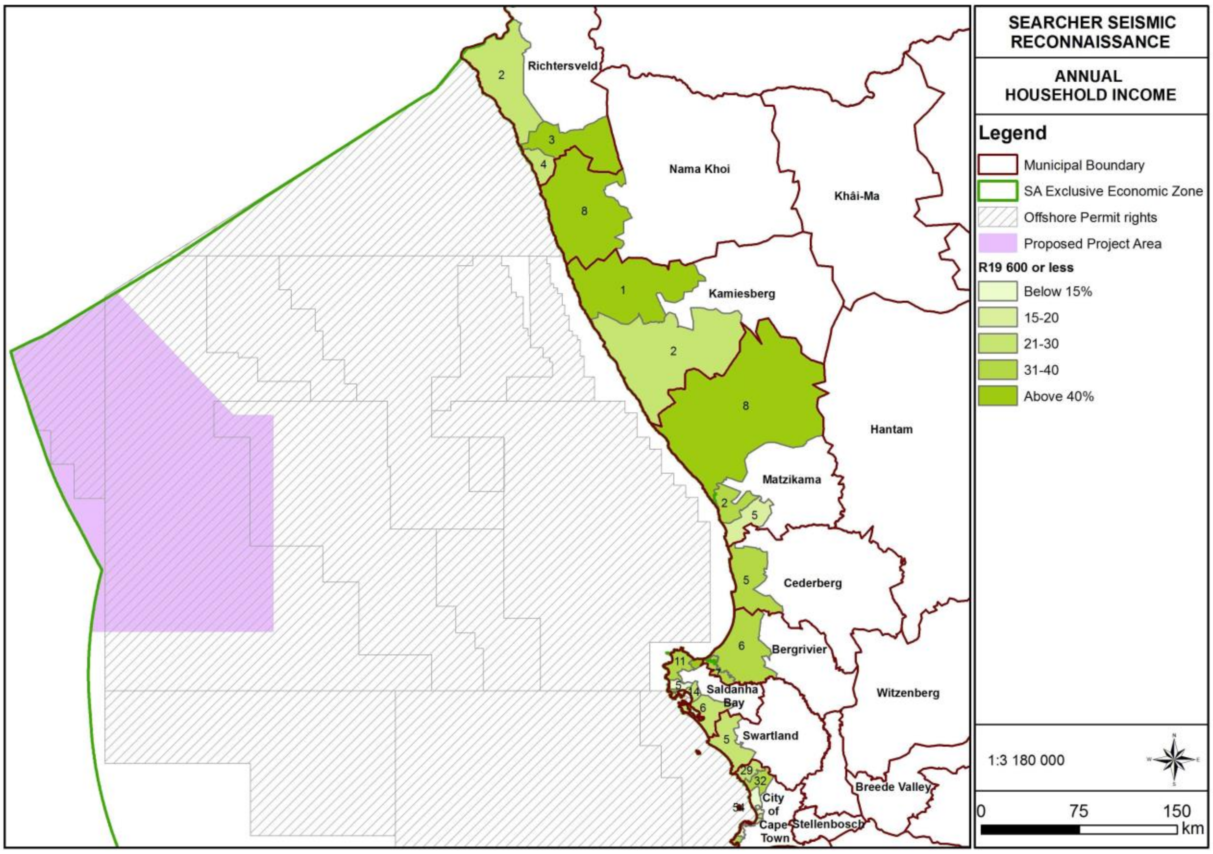


Figure 74: Proportion of households with an annual income of R19 600 or less (shown in percentage, source: Census 2011).

8.7.1.6 HOUSING

The majority of households are situated in areas that are classified as urban, except in the Matzikama Local Municipality (**Figure 75**). The majority of people live in formal dwellings that that are houses or structures that are on a separate stand or yard. The incidence of informal dwellings is relatively low, except for Ward 1 of the Saldanha Bay Local Municipality where the majority of people live in informal dwellings. Wards 32 and 74 also have a relatively large proportion of households living in informal dwellings. Census 2022 shows that the Cederberg Local Municipality had the highest incidence of people (18.01%) living in informal dwellings either in someone's backyard or on an individual stand (**Figure 75** and **Figure 76**).

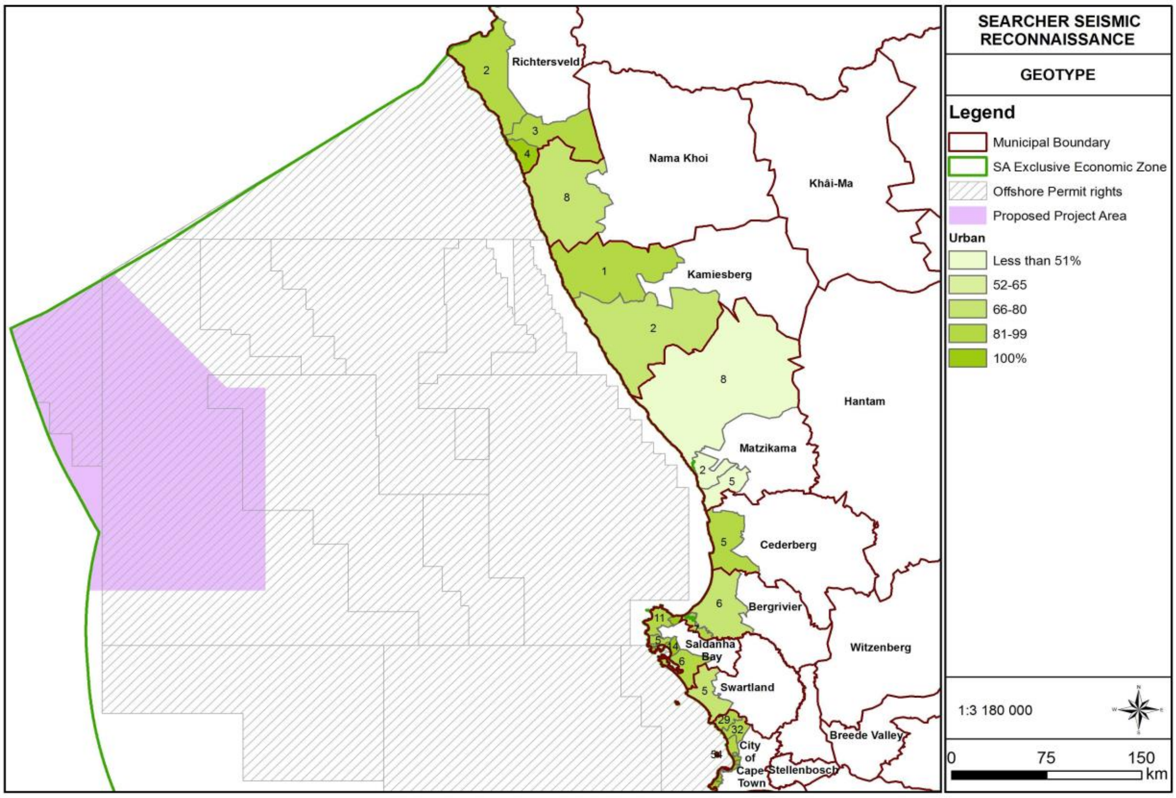


Figure 75: Proportion of households that live in urban areas

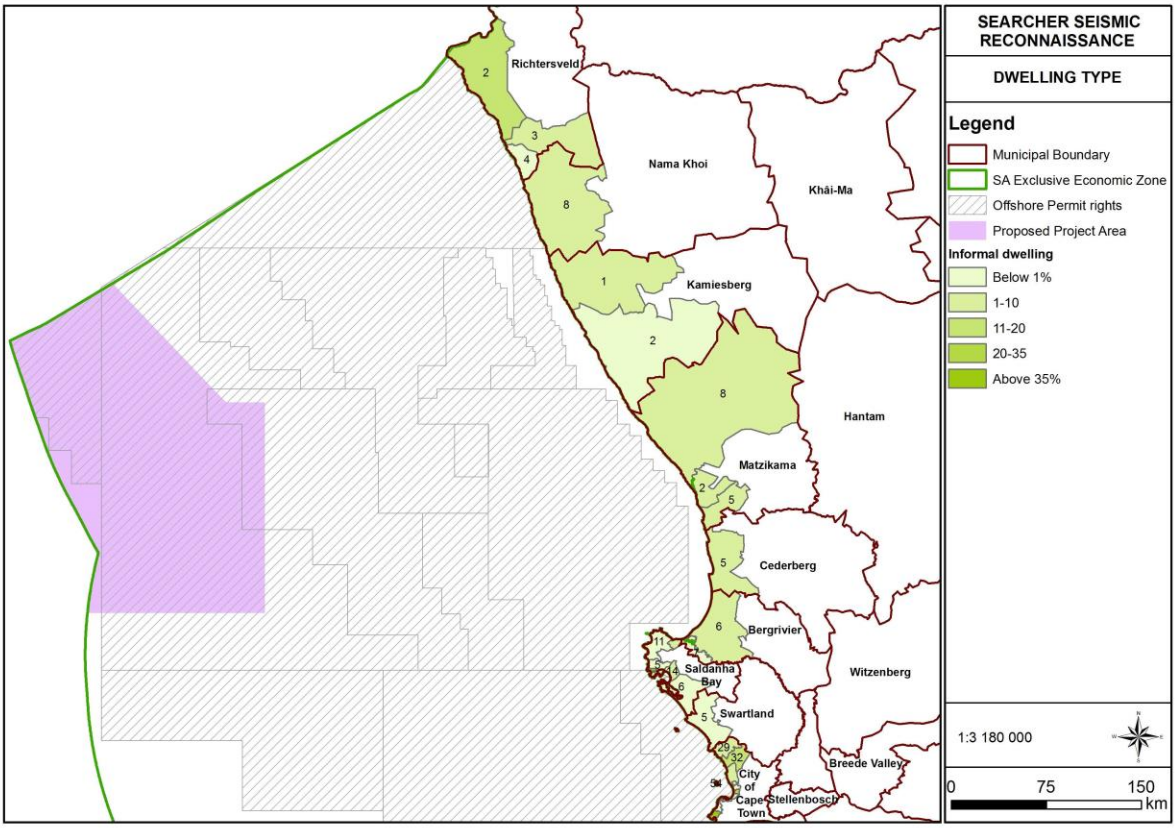


Figure 76: Proportion of households that live in informal dwellings.

8.7.1.7 HOUSEHOLD SIZE

The average household size in the wards vary between 1.96 people per household and 4.86 people per household (**Figure 77**). In the local municipalities located in the Northern Cape showed an increase in household sizes since 2011. This can indicate more families moving to the area, or people moving in together due to financial constraints. The average household size in the wards vary between 1.96 people per household and 4.86 people per household.

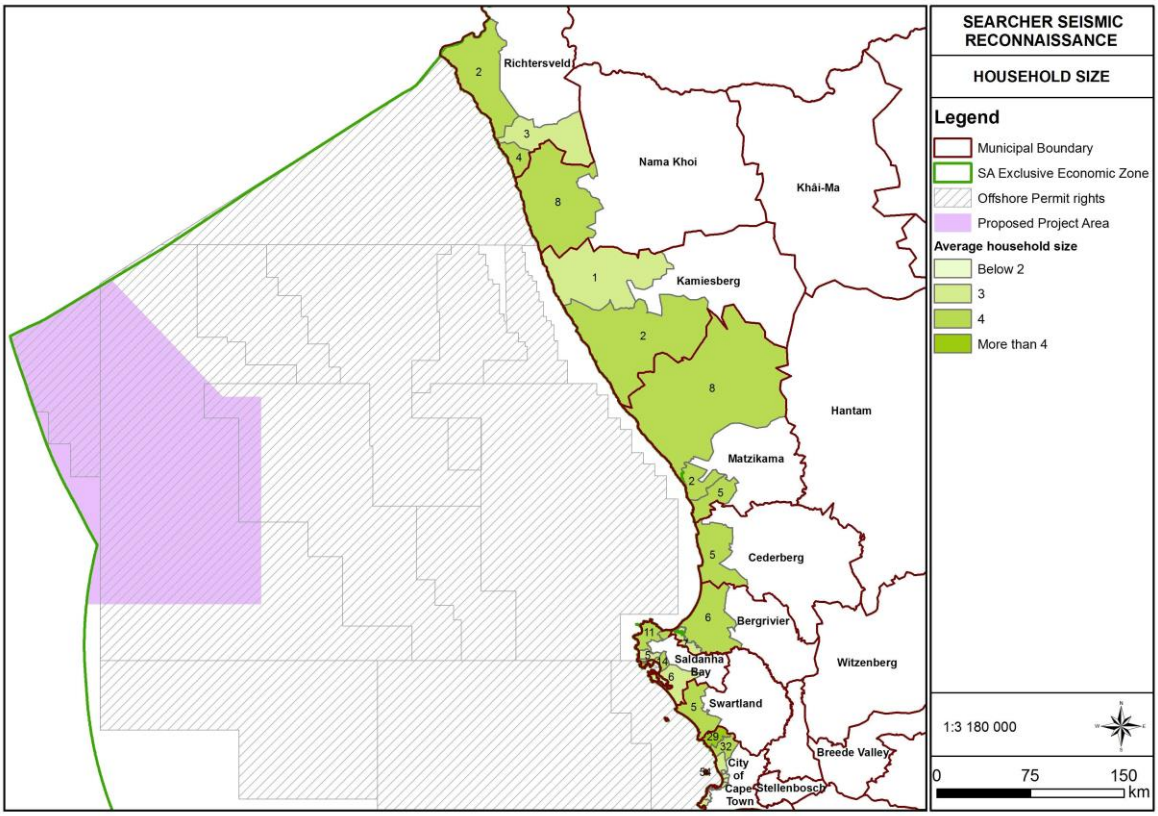


Figure 77: Average household sizes (source: Census 2011).

8.7.1.8 ACCESS TO WATER AND SANITATION

Access to piped water, electricity and sanitation relate to the domain of Living Environment Deprivation as identified by Noble et al. (2006). Most households get their water from a regional or local water scheme, with the lowest incidence in 2011 in Ward 1 of the Kamieskroon Local Municipality where Hondeklip Bay is located (**Figure 78**). In 2022 the Cederberg Local Municipality had the lowest proportion of households (81.88%) that get their water from a regional or local water scheme. The incidence of access to piped water inside the dwelling varies and tend to be lower in the Northern Cape municipalities (**Figure 79**). In 2022, the incidence of households with access to piped water inside the dwelling were more that 80% on a local municipal level, except for the Kamiesberg LM where the incidence was 46.38%.

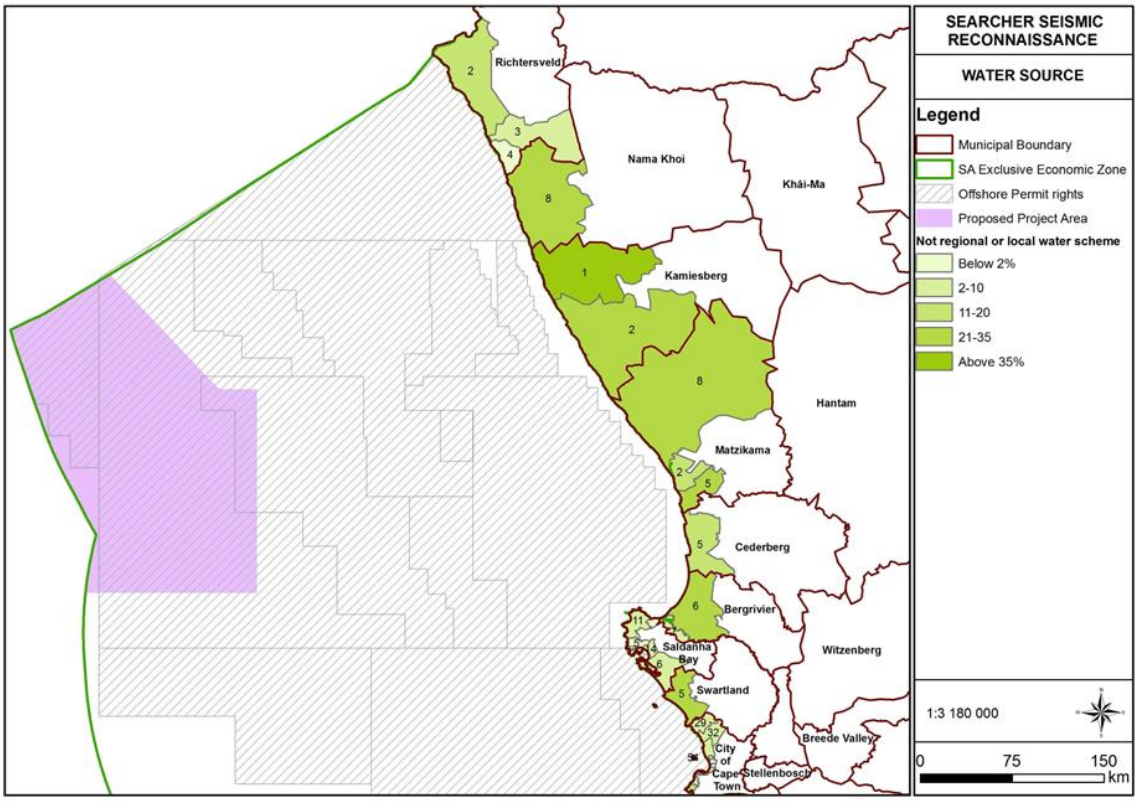


Figure 78: Proportion of households that does not get water from a regional or local water scheme (shown in percentage, source: Census 2011).

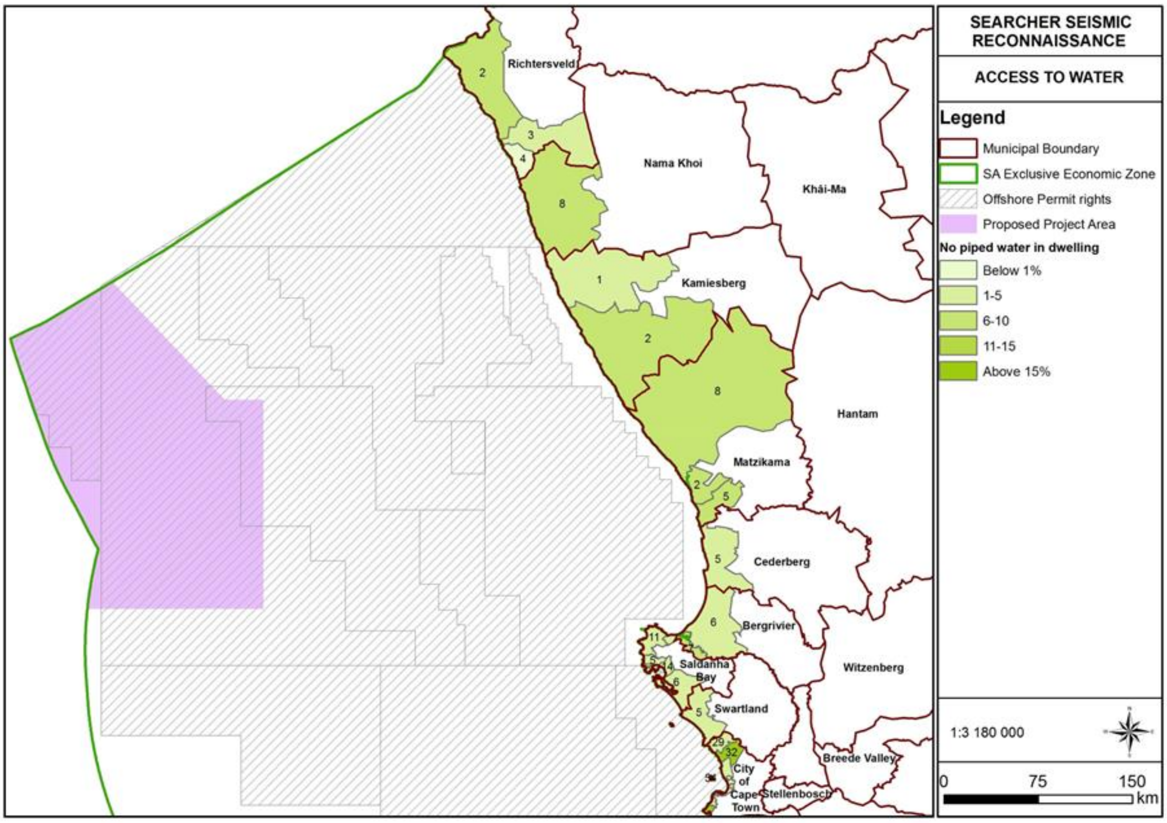


Figure 79: Proportion of households that does not have piped water in the dwelling (shown in percentage, source: Census 2011).

8.7.1.9 ENERGY

Electricity is seen as the preferred lighting source (Noble et al., 2006) and the lack thereof should thus be considered a deprivation. Even though electricity as an energy source may be available, the choice of energy for cooking may be dependent on other factors such as cost. The majority of households have access to electricity for lighting purposes (**Figure 80**) but a lower proportion use electricity for heating **(Figure 81**) and cooking (**Figure 82**) purposes.

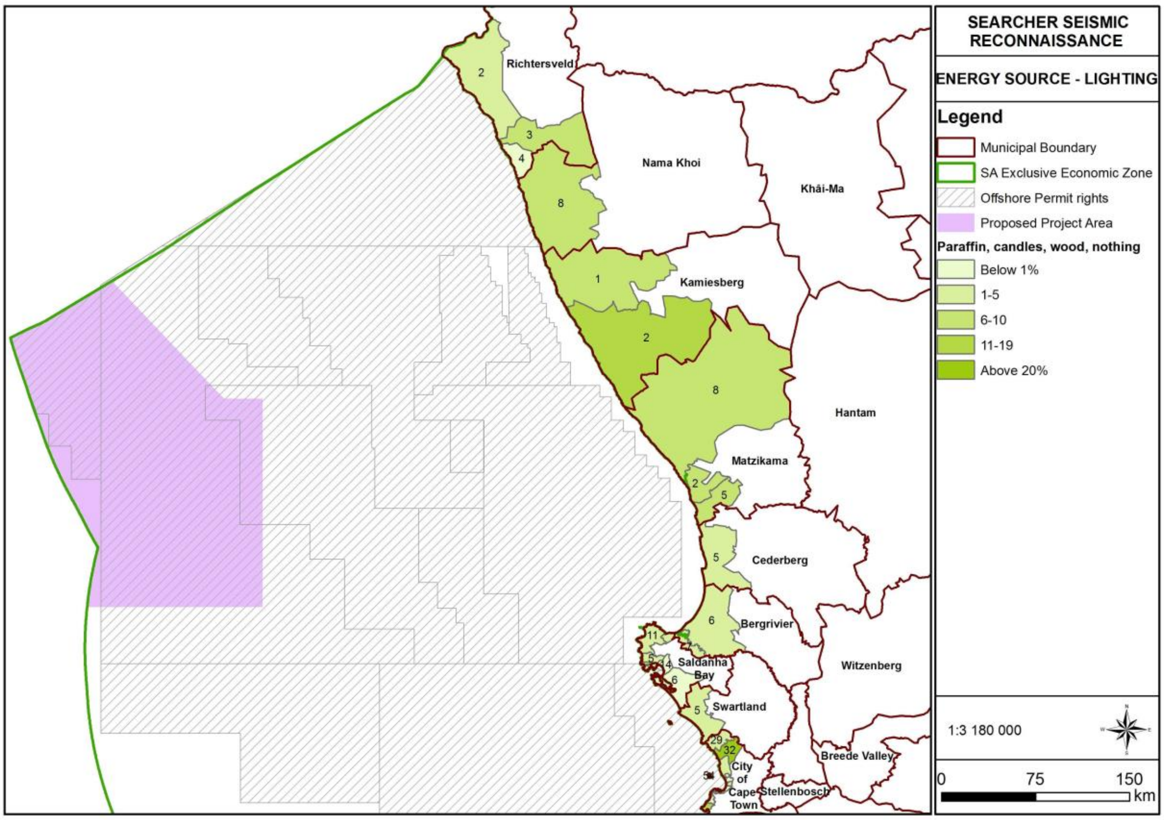


Figure 80: Proportion of households that use paraffin, candles, wood or nothing for lighting purposes (shown in percentage, source: Census 2011).

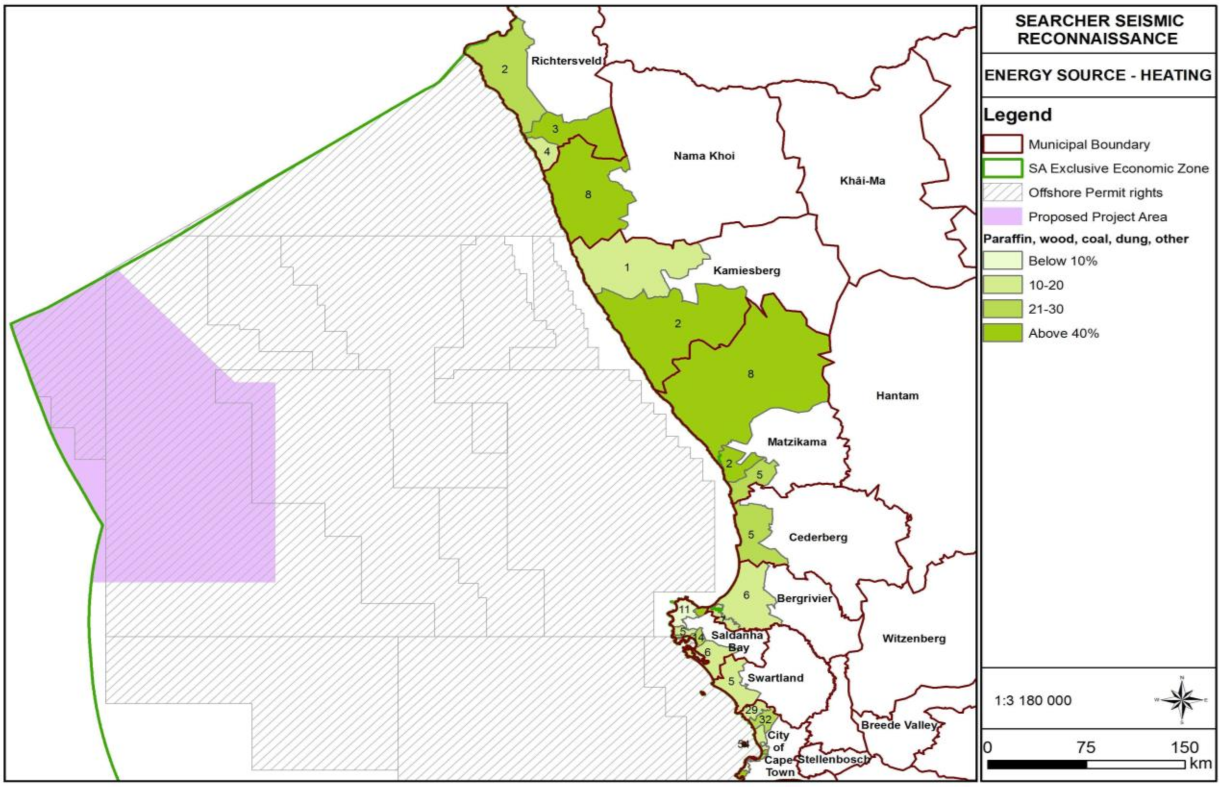


Figure 81: Proportion of households that use paraffin, wood, coal, dung or something else for heating purposes (shown in percentage, source: Census 2011).

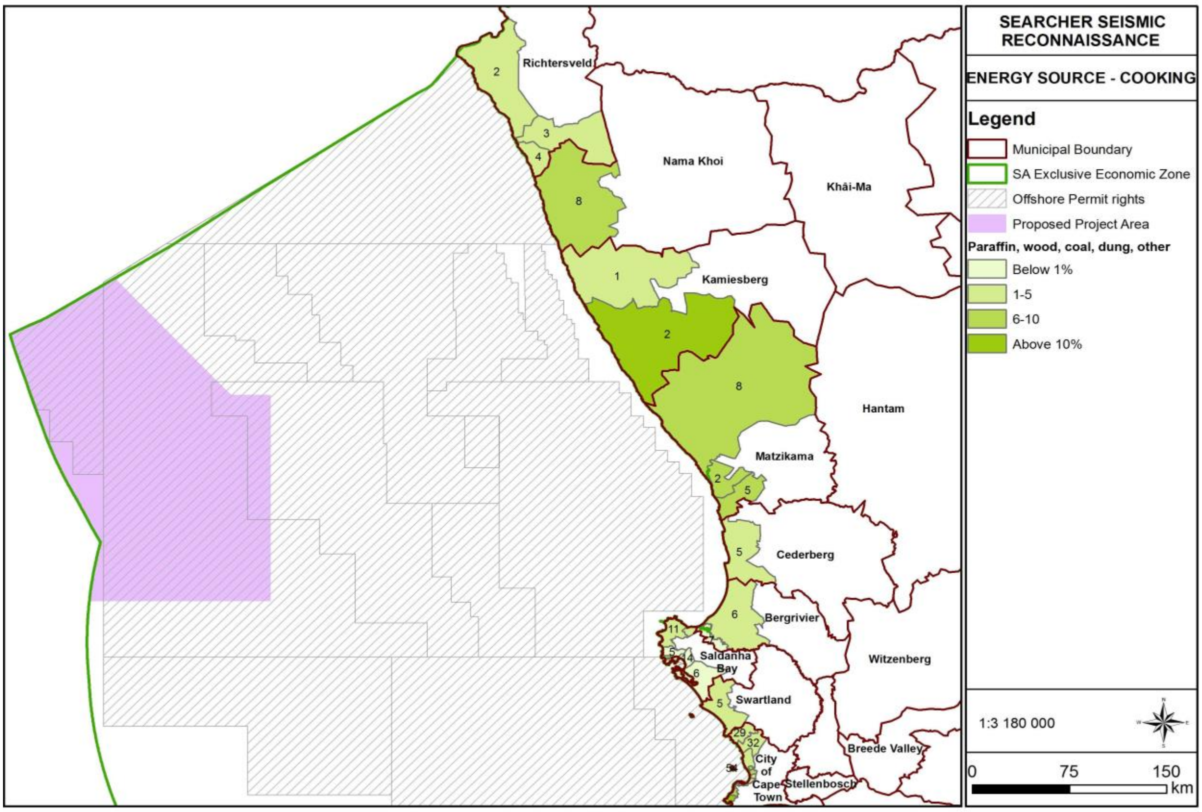


Figure 82: Proportion of households that use paraffin, wood, coal, dung or something else for cooking purposes (shown in percentage, source: Census 2011).

8.7.2 SHIPPING DENSITY

A large number of vessels navigate the major shipping lanes along the South African Coastline. Approximately 96% of the country's exports are conveyed by sea through eight commercial ports. These ports are the conduits for trade between South Africa and its southern African partners as well as hubs for traffic to and from Europe, Asia, the Americas and the east and west coasts of Africa. **Figure 83** provides an indication of the shipping density along the South African Coast. It can be observed that the shipping density is generally medium – high over the majority of the proposed 3D survey area.

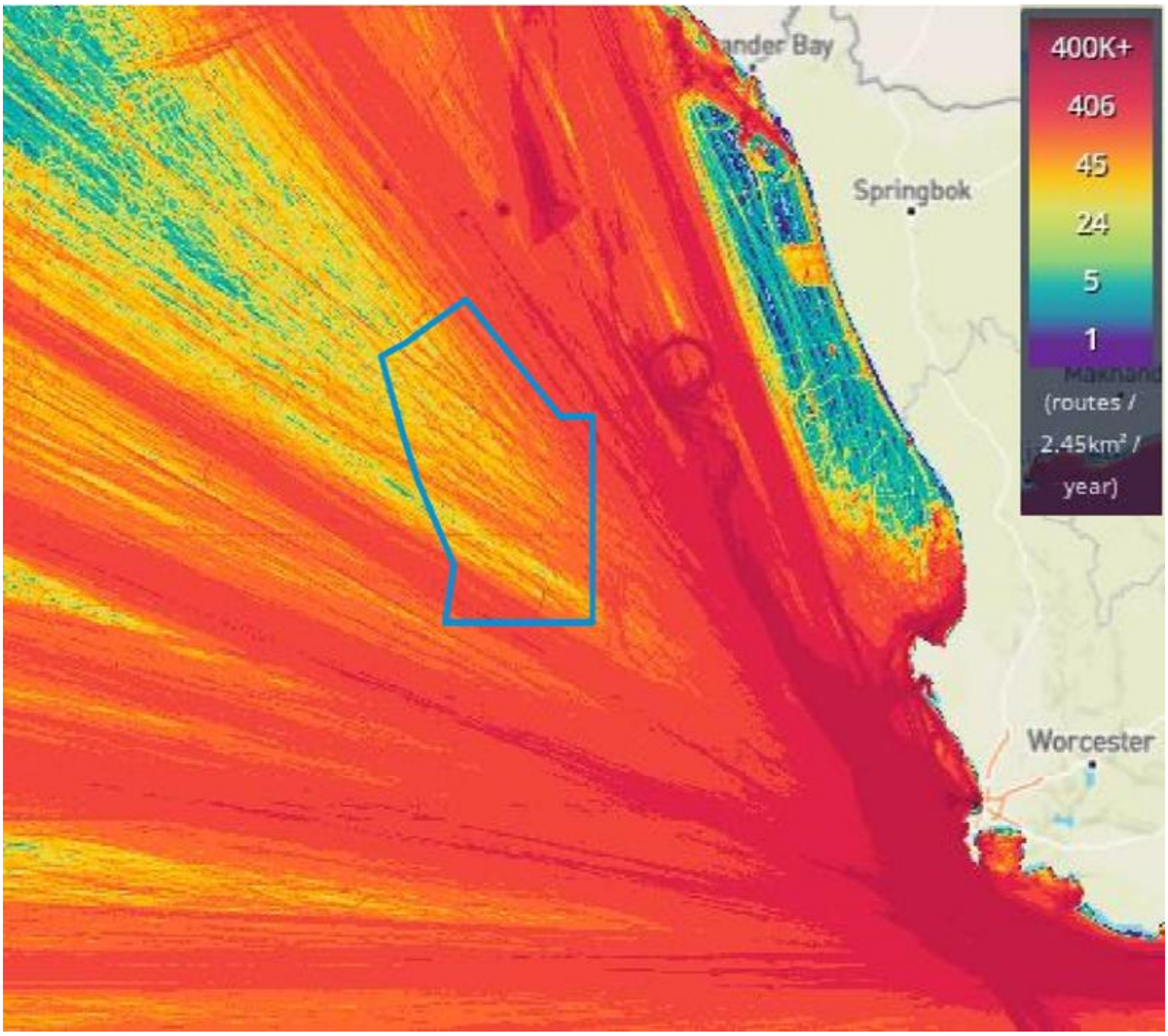


Figure 83: Shipping traffic density along the South African Coast.

8.8 CULTURAL AND HERITAGE RESOURCES

This section provides and overview of the socio-economic environment for the study area. The information has been sourced from the Heritage Impact Assessment undertaken by PGS Heritage (Pty) Ltd included in **Appendix C**.

Marine resources have a long history of human exploitation. Evidence from archaeological sites suggest that the West Coast region was occupied from the Early Stone Age (ESA) through to the Middle Stone Age (MSA) and Later Stone Age (LSA), up until the arrival of early European settlers from the 18th century onwards. There are numerous sites (including shell middens, stratified cave deposits, rock art, stone tools, and fish traps) recorded along the coast that demonstrate that the rocky shorelines were attractive to hunter-gatherers through time. Much of what we know about settlement, subsistence strategies and diet along the coast is linked to these shorelines. Whilst gorges and stone sinkers are probably the best evidence for technical fishing equipment in the LSA, marine shell middens also demonstrate that the coastal zone was particularly favoured by LSA people (Deacon, 1995).

8.8.1 SHELL MIDDENS

Marine shell middens have been identified within 1km of the coastline, near estuaries and in dune fields which lie adjacent to rock shores. While pre-historic people likely favoured the rocky shorelines for ease of access to marine resources, middens have also been found further inland, where people would have been able to exploit additional resources such as game life and fresh water.

In some instances, these shell middens are associated with domestic artefactual debris which suggests that they in fact represent occupation sites of long duration. Whilst the opposite can be said for midden sites that do not contain a formal stone artefact component, and instead may represent visits of short duration. These pre-historic people were the ancestors of the San and Khoikhoi.

8.8.2 STONE FISH TRAPS

The remains of fish traps (visvywers; stone-walled tidal fish traps) have been recorded along the South African coastline from St Helena Bay to Mossel Bay. Along the south-western coastline, these traps, which use "the tidal range to allow fish to enter pre-built enclosures and be trapped at low tide", provide evidence of early fishing techniques. The preserved fish traps vary in shape, size, and spatial complexity. Identifying the architects of these traps is, however, a contentious issue.

Initially, researchers believed that the fish traps on the south coast were ancient maritime resource systems that originated among LSA people after 2000 years ago with the arrival of Khoikhoi herders. More recent research suggests that the development of fish traps along the southern and western coasts dates to the 19th century. Furthermore, these structures may have been introduced by European farmers as part of the farming-fishing system when intensive exploitation of inshore fish by local farmers occurred. In 1987, Graham Avery recorded a tidal fish trap in Mauritzbaai, south of Jacobsbaai. Hart and Halkett (1992) have also identified the remains of at least six traps in the intertidal zone at Wilde Varkens Valley, St Helena Bay. According to archaeologists, several shell middens in the Vredenburg Peninsula are associated with both San and Khoikhoi groups who were harvesting the shorelines and estuaries of the West Coast in a sustainable and patterned manner (Parkington et al. 1988).

8.8.3 INDIGENOUS PEOPLES

Before the colonial era, there were several diverse ancient tribes who traversed the valleys and plains of the present-day West Coast region of South Africa. The origins of the West Coast fishing communities can be traced back to the San and Khoikhoi peoples who lived within this region. Together, the Khoi and the San are the First Peoples of South Africa. In 1928, a German physical anthropologist Leonard Schultze, created the term 'Khoisan', to stress the similarities between the Khoikhoi and the San (Le Fleur and Jansen, 2013; Secorun, 2018).

The settlers used the term 'Bushmen' when referring to the San, and many of whom the colonists' called 'Bushmen' were, in fact, Khoikhoi or former Hottentot. Today, this term is considered derogatory, and instead, scholars would rather refer to hunters and herders together as 'Khoisan'.[h] It should be noted that although Khoi and San Peoples may share some experiences, culturally, they remain two distinct groups, and the general preference amongst both Khoi and San people is to be called by their clan names.

8.8.3.1 THE SAN[i]

During almost the entire Holocene period, small groups of San hunter-gatherers were present in southern Africa. The San are the direct descendants of the first peoples of southern Africa.[j] It should be noted that the term "San" is used to cover over a dozen distinct hunter-gatherer groups who speak distinctive "click" languages (incl. the Khwe, !Xun, Ju'hoansi, Naro, !nuu and other groups). These groups lived across Namibia, South Africa, Botswana, and Zimbabwe. The San were small groups of nomadic people who lived by the ethos of "all people are equal".

[h] https://www.sahistory.org.za/article/khoisan

[i] *The Khoikhoi and the early Dutch settlers called these groups Sonqua (literally 'San') .*

[j] *https://www.hr-dp.org/files/2015/07/06/G0516746.pdf*

They hunted and gathered resources and did not keep livestock. It is generally agreed amongst academics that the San were the first inhabitants of the Cape region.

During the latter part of the Holocene, there were hunter-gatherers living on the West Coast who made seasonal use of the coastal resources (Parkington and Hall, 1987). Several archaeological sites, including Duyker Eiland, which is in Britannia Bay, confirmed the importance of shellfish, seals, marine birds, crayfish, and beached whales as a food source for the local inhabitants during this time (Robertshaw, 1979).

8.8.3.1.1 THE INTRODUCTION OF THE KHOIKHOI

For thousands of years, the Khoikhoi[k] people have occupied and moved around Southern Africa as nomadic herders. The Khoikhoi were large groups of nomadic herders who owned substantial herds (incl. cattle and sheep) and migrated for pasture, water, and food resources. It is understood that Khoikhoi peoples have a spiritual connection to land, where land is perceived as a gift from nature to be cared for.

Note that the Khoikhoi term is an umbrella term which refers to different tribes. The Khoikhoi people comprise four historical groupings: the Griqua, Nama, Koranna and Cape Khoi (incl. further subgroupings). Today, the Nama people are primarily located in the Northern Cape. The Griqua are in the Western Cape, Eastern Cape, KwaZulu Natal and Gauteng, and various other parts of the country. The Korana people, live primarily in Kimberly and the Free State. The Cape Khoi are in the Western and Eastern Cape

Evidence suggests that around 2000 years ago, the pastoralist Khoikhoi entered South Africa along the West Coast into the Cape region (Smith, 1987, Sealy and Yates 1994; Henshilwood, 1996; Avery, 1975; Schweitzer, 1979; Deacon et al., 1978;). They brought a new way of life, from its northern origins, to South Africa. The Khoikhoi introduced domesticated livestock and new material culture (incl. pottery) into the region. They relied more on sheep as a meat resource and hunted and gathered (Schapera, 1933). Groups living close to the coast would also exploit shellfish, seals, and other marine resources. The St Helena Bay (Slipper Bay) region appears to have provided the Khoikhoi with invaluable resources, including whale meat obtained via 'cetacean traps[l].

One of the most important West Coast pastoralist sites, Kasteelberg, is an open-air archaeological site located 4km from the coast. It provides evidence of occupation by herders between 1800 and 1600 years ago (Klein, 1986). The occupants of the site focused on harvesting seals and the presence of sheep bones also indicated that the inhabitants were most likely herding domestic stock (Klein, 1986; Smith, 2006). It is thought that the indigenous people in the Cape populated a region from Northern Namibia to the Cape of Good Hope and from the Atlantic Ocean to the Fish River in the East. The area between Saldanha and Vredenburg was occupied by the *CochoQua* and the *ChariGuriQua* (GuriQua) group occupied the lower Berg River area which included St Helena Bay and regions around Picketberg. Some researchers choose to use the term Peninsular Khoikhoi" when referring to the *Gorachoquas, Goringhaiquas* and the *Goringhaiconas* ("strandlopers") and "Surrounding Khoikhoi" for *the Cochoqua, Chainouqua* and *Hessequa* (see Brink, 2000; Nienaber, 1989; Wilson, 1990).

In the pre-colonial era, the relations between the Khoikhoi and the San were relatively stable due to a mutual acknowledgement of territories. Although the San and Khoikhoi seemed to have co-existed for a period, it appears that, to some degree, the San groups were displaced (Elphick, 1977; Parkington et al. 1986). It's assumed that the Khoikhoi moved into areas that had previously been utilised by the San, thus forcing the San to move into more isolated coastal regions (Manhire, 1987). The San's "settlement and subsistence strategy changed from one based on the large-band occupation of open areas and the hunting of large game towards the more intensive utilisation of rock shelters, in small groups and a foraging-based economy" (Barnard, 1992). Unfortunately, indigenous groups who lived on the coast were the first people to be severely impacted by colonial oppression (Boezak, 2017).

8.8.3.2 COLONIAL DISPOSSESSION

First contact between indigenous pastoralist groups and Europeans occurred during the 15th and 16th centuries when Portuguese mariners would sail down the coast. Before the Dutch East India Company's ('VOC') governance over the southernmost tip of Africa, European merchants and travellers en route to or from Asia would call in at the natural harbour of Saldanha Bay for refreshment. Encampments were also set up along the

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[k] *Note that the use of the terminology of Khoikhoi or Khoekhoe is used by various scholars and writers. This report will be using Khoikhoi as the standard.*

[l] "Places where whales often strand themselves along the shore are known as 'cetacean traps'. These are areas where minima in the earth's magnetic field cross the shoreline, and where there are offshore reefs." (http://www.sawestcoast.com/history.html)

coast by survivors of shipwrecks, and in their journals, they would recall how they met and traded with indigenous groups. Written records reveal that in 1497, the GuriQua and the San (SonQua) witnessed the arrival and departure of Vasco da Gama in St Helena Bay. Although the Saldanha Bay harbour was more sheltered than Table Bay and allowed for the crews to trade livestock from the Khoikhoi in the area there was not enough fresh water available to allow for the establishment of large permanent settlements.

It was only in 1652 that the VOC decided to occupy the Cape and establish the first permanent European settlement in South Africa. The VOC established a station at Table Bay to supply Company fleets travelling between Europe and the Indies with refreshments (i.e., meat, wheat, vegetables, and freshwater) (Ward, 2009). When the Dutch colonists arrived, they encountered several Khoikhoi groups. The largest concentration of Khoikhoi lived in the lush pasture lands of the south-western Cape region.

Initially, the relationship between the Dutch and the Khoikhoi was one of cooperation, and the VOC established trading agreements with local chiefs to get regular supplies of fresh meat (Elphick, 1977). As the colony grew, the VOC decided to decrease their dependency on local trade with the Khoikhoi. Their alternative plan was to give land to free burghers to supply meat and grain to the Company.

Khoikhoi and San lives were impacted upon by both internal strife and direct conflict with the Europeans over the disregard of traditional customs, the privatisation of land, and exhausting indigenous resources (i.e., overfishing and farming). As the Dutch took over more of the Khoikhoi's grazing land for farms, much of the Khoikhoi and San peoples' traditional lands were dispossessed. In 1657, the Goringhaiqua tribe were ordered to move to the east of the Liesbeeck boundary and this 'eviction' event would be instrumental for the first war against colonial intrusion (Bredekamp and Newton-King, 1984). The First Khoikhoi-Dutch War lasted the whole of 1659.

According to Sleigh (1993: 148), "In 1672, two sons of the weakened Peninsular Khoisan chiefs signed a contract, which they probably did not fully understand, and sold huge tracts of land from Table Bay to Saldanha Bay in the North and to the Hottentots Hollands mountains in the East to the VOC for an incredible low price (which they did not even fully receive)".

After a few more instances of territories being ignored and further land appropriation, another war of resistance was initiated by the Cochoqua, and the Second Khoikhoi-Dutch War commenced (1673-1677). This led to more Khoikhoi groups being forced to relocate to areas further up the coast. According to writings of early settlers, it appears that some San groups, who pursued a hunting and foraging lifestyle, may have still resided in the mountainous regions of the Cape where they were less likely to clash with the Khoi or Dutch settlers. Regions that were less desirable for the colonists, such as Namaqualand, became places of refuge for the San and Khoikhoi who were able to continue many aspects of their traditional ways of life in this area for some time.

In 1713, the small-pox epidemic led to the death of many Khoikhoi people living in the south-western Cape. The surviving Khoisan became assimilated as domestic/farm workers due to the high demand for labour by the Dutch. In rural areas, the Khoisan were forced into what was referred to as semi-bonded labour. By the late 18th century, the Cape settler colony's territories incorporated the Berg (c. 1700), Olifants (1750), and Buffels (1798) rivers.

8.8.3.3 THE HISTORY OF FISHING ON THE WEST COAST

This section describes the history of fishing along the West Coast of South Africa.

8.8.3.3.1 17TH CENTURY

During the 17th century, the VOC established an outpost at St Helena Bay. From 1670, free burgers started to fish regularly in St Helena Bay. They introduced methods to the region that were not previously available to indigenous fishermen, such as metal hooks, boats, nets and bulk processing and storage.

8.8.3.3.2 18TH CENTURY

During the 18th century, the Cape settler's economy was primarily based on slave labour which was imported from Asia and East Africa. The agricultural sector which was maintained by free burghers (freed from Company service) was not stable and due to the trade of the Khoikhoi's livestock being intermittent, the settlers had to make alternative arrangements for food resources. This led to Robben Island being exploited for seals, penguins, and seabirds. Large rural landowners established private coastal fishing posts to supply marine resources to the Company; the local region; passing ships and for export. Soon, Dassen Island, Saldanha Bay and St Helena Bay developed as significant centres to supply the VOC with additional resources to sustain the growing number of people in the Cape colony, including the substantial number of slaves kept by the Company. According to Sleigh (1993), the slaves were given salted fish, seal meat, penguin, and bird eggs whilst the rest of the colony preferred to consume meat.

According to Marincowitz (1985: 40–46) "With exclusive land grants closing the north-western frontier, from the 1740s growing numbers of ex-slaves, dispossessed Khoekhoe, failed farmers, evicted tenants and bywoners (tenant farmers), new immigrants and fugitives from colonial and military justice moved onto the beaches of the west coast". Early fishing, sealing and whaling activities, by European and American whalers, around Saldanha Bay, especially near Marcus Island/Outer Bay and at Salamander Point, have been extensively documented in the archival/historical record. Although the inshore whale population declined after 1830, processing continued at Donkergat in Saldanha Bay.

8.8.3.3.3 19TH CENTURY

By the mid-19th century, scattered subsistence communities had emerged along the West Coast. Before the arrival of industrial fisheries, residents in St Helena Bay employed basic fishing technology (small-scale line fishing, beach seine nets and rowing boats) and fishing activities were informally organized by boat and net owners.

Malay slaves and other residents moved into the region to work as farm labourers. Over time, the unique fishing skills of enslaved Malay people intermingled with the fishing skills of the indigenous people. This led to the establishment of small fishing villages along the West Coast (incl. Saldanha, Langebaan and St Helena Bay).

After the emancipation of slaves, new laws were introduced to control both the freedom of movement and independent livelihoods of people who did not own land. This forced fishermen on the West Coast "to either develop artisanal skills, become wage labourers or squat on coastal government land to eke out a living from small-scale production and seasonal work".

Using business capital in both the local and international markets, entrepreneurs were able to lease Crown land and establish coastal industries along the West Coast. By the 1880s, a Cape Town-based trading company, Stephan Brothers, was able to monopolise the West Coast trade. The company bought the main grain shipping points along the West Coast, including the southern shore of St Helena Bay, where they established Laaiplek (translates to 'loading place') at the mouth of the Berg River.

8.8.3.3.4 20TH CENTURY

Although the local fishing industry on the West Coast employed a substantial number of locals at the start of the 20th century, the industry is associated with a history of hardship. The industry's collapse in the mid-20th century left numerous West Coast communities impoverished. Despite all the obstacles thrown at them, the West Coast fishing communities were resilient and continued their fishing tradition throughout the 20th century.

Historically, small-scale fishers have constantly had to compete against big scale fisheries. For example, Piketberg coastal fisheries used a method of fishing called beach seining to supply inland farmers with cheap ration fish. When there was a decline in snoek sources further south, Italian immigrant fishermen from Cape Town travelled up the West Coast on boats with set nets. Ultimately, their method of fishing impacted the supply of fish for the sedentary fishermen.

By 1900, the Stephan Brothers company were in control of nearly every suitable bay from Saldanha Bay to Lamberts Bay. They also owned numerous farms which were often acquired in exchange for debt. In 1909, the company negotiated an agreement with the State to establish an Exclusive Trek Seine Fishing Zone along the Malmesbury coast. This move meant that the company was able to dominate a new manufacturing industry which further exacerbated resource owners and local fishermen.

During World War One, there was a crayfish canning boom in the Cape. The sourcing of crayfish moved rapidly up the West Coast during this period. By the early 1920s, the overexploitation of crayfish resulted in an exhaustion of crayfish stocks and West Coast factories were forced to close. This meant that the small-scale seine fishermen, and fishermen who netted in the backwaters, were left even more vulnerable to the financial depression of the 1930s.

Then, in 1934, in an act of retaliation, "Saldanha Bay fishermen invaded the Piketberg area on motorboats carrying Italian lampara nets and, with the support of Government, wiped out the non-motorised Berg River inshore fisheries run by consortiums of farmers, fishery owners and canners". In 1951, increasing catches along the West Coast, meant that both skippers and fishermen yielded good financial returns. By 1955, South Africa had the largest fishing industry in the southern hemisphere.

With the Apartheid system arriving, the indigenous identity of the Khoisan was further disrupted through the Race Classification Act and the Populations Registration Act. The Khoisan were forcibly categorised as "Coloured". This label further dispossessed the people from their heritage. Under the Group Areas Act (1950) the towns of the West Coast were divided into segregated residential and business areas. The forced removals marked yet another era of forced removals from areas that indigenous people occupied. Despite the discrimination, the communities continued their tradition of fishing that had been passed on through the generations of fisher families.

8.8.4 INTANGIBLE HERITAGE

Intangible heritage' (also referred to as 'Living Heritage') is a term which is used to describe "aesthetic, spiritual, symbolic or other social values people may associate with a site, as well as rituals, music, language, know-how, oral traditions and the cultural spaces in which these 'living heritage' traditions are played out." Through its efforts to safeguard Intangible heritage The United Nations Educational, Scientific and Cultural Organization (UNESCO) and its member states developed the Convention for the Safeguarding of the Intangible Cultural Heritage (ICHC). The following section is extracted from a UNESCO webpage that explains the importance of Intangible Heritage:

"While fragile, intangible cultural heritage is an important factor in maintaining cultural diversity in the face of growing globalization. An understanding of the intangible cultural heritage of different communities helps with intercultural dialogue and encourages mutual respect for other ways of life.

The importance of intangible cultural heritage is not the cultural manifestation itself but rather the wealth of knowledge and skills that is transmitted through it from one generation to the next. The social and economic value of this transmission of knowledge is relevant for minority groups and for mainstream social groups within a State, and is as important for developing States as for developed ones.

Intangible heritage is:

- Traditional, contemporary, and living at the same time: intangible cultural heritage does not only represent inherited traditions from the past but also contemporary rural and urban practices in which diverse cultural groups take part.
- Inclusive: we may share expressions of intangible cultural heritage that are similar to those practised by others. Whether they are from the neighbouring village, from a city on the opposite side of the world, or have been adapted by peoples who have migrated and settled in a different region, they all are intangible cultural heritage: they have been passed from one generation to another, have evolved in response to their environments and they contribute to giving us a sense of identity and continuity, providing a link from our past, through the present, and into our future. Intangible cultural heritage does not give rise to questions of whether or not certain practices are specific to a culture. It contributes to social cohesion, encouraging a sense of identity and responsibility which helps individuals to feel part of one or different communities and to feel part of society at large.
- Representative: intangible cultural heritage is not merely valued as a cultural good, on a comparative basis, for its exclusivity or its exceptional value. It thrives on its basis in communities and depends on those whose knowledge of traditions, skills and customs are passed on to the rest of the community, from generation to generation, or to other communities.
- Community-based: intangible cultural heritage can only be heritage when it is recognized as such by the communities, groups or individuals that create, maintain and transmit it – without their recognition, nobody else can decide for them that a given expression or practice is their heritage."

In this assessment, marine-related intangible cultural heritage and people's connection to the ocean is relevant. This type of heritage incorporates the unique ethos and identity of specific places linked with fishing villages; oral history; popular memory; cultural traditions; indigenous knowledge systems, rituals, beliefs, and practices (e.g., fishing techniques) associated with the ocean.

In some cultures, the ocean is regarded as a spiritual realm filled with healing powers and also a means to connect to one's ancestors. Gabie (2014) explains how water is the Khoisan's "...'source of life, a sense of belonging and their permanence to nature'. Water is vital for various rituals and cleansing ceremonies. According to Boswell and Thornton (2021), the Khoisan "advocate for deep connections and complementarity between humans and nature, recognising the agency and 'direction' provided by nature to humanity".

Considering that the ICHC emphasises the declaration and listing of forms of Intangible Heritage, it can lead to a diminished recognition of intangible heritage not listed or formally recognised. The ICHC requires a State Party to develop an inventory of intangible heritage within their country or territory and then take measures to safeguarding with community participation. As Smith (2015) argues, the European Authorised Heritage Discourse within UNESCO emphasises the declaration and the importance of heritage and things as defined by experts or those entities and nation states promoting their discourse. The ICHC, however, did provide the opportunity for communities on a sub-national level to promote and give legitimacy to their intangible heritage. Unfortunately, the ICHC and its operational standards place the responsibility of assessment, nomination, and listing on the State Parties. This leads to a gatekeeper process in which these Parties can decide and control what is listed and nominated through their national discourse to the detriment of the community or grouping. The Khoisan has historical experienced marginalisation and stigmatisation since the onset of colonialisation in Southern Africa.

Natural Justice (2016) submitted that strides were made in the recognition and legitimising of the Khoisan. However, entrenched continuing historic race classifications and the lack of leadership recognition through such issues as the dragging finalisation of the Traditional and Khoi-San Leadership Bill is robbing these communities of a voice and standing within the larger South African landscape. This speaks to the recognition of their culture that is inclusive of tangible and intangible heritage.

9 ENVIRONMENTAL IMPACT ASSESSMENT

9.1 IMPACT ASSESSMENT METHODOLOGY

The impact significance rating methodology, as provided by EIMS, is guided by the requirements of the NEMA EIA Regulations 2014 (as amended). The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence I of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/ likelihood (P) of the impact occurring. This determines the environmental risk. In addition, other factors, including cumulative impacts and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall significance (S). The impact assessment will be applied to all identified alternatives. Where possible, mitigation measures will be recommended for impacts identified.

9.1.1 DETERMINATION OF ENVIRONMENTAL RISK

The significance (S) of an impact is determined by applying a prioritisation factor (PF) to the environmental risk (ER). The environmental risk is dependent on the consequence I of the particular impact and the probability (P) of the impact occurring. Consequence is determined through the consideration of the Nature (N), Extent I, Duration (D), Magnitude (M), and reversibility I applicable to the specific impact.

For the purpose of this methodology the consequence of the impact is represented by:

$$\boldsymbol{C} = \frac{(\boldsymbol{E} + \boldsymbol{D} + \boldsymbol{M} + \boldsymbol{R}) * \boldsymbol{N}}{\boldsymbol{4}}$$

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in **Table 28** below.

Table 28: Criteria for Determining Impact Consequence.

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property boundary),
	3	Local (i.e. the area within 5 km of the site),
	4	Regional (i.e. extends between 5 and 50 km from the site
	5	Provincial / National (i.e. extends beyond 50 km from the site)
Duration	1	Immediate (<1 year)
	2	Short term (1-5 years),
	3	Medium term (6-15 years),
	4	Long term (the impact will cease after the operational life span of the project),
	5	Permanent (no mitigation measure of natural process will reduce the impact after construction).

Aspect	Score	Definition
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected),
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected),
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way),
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease), or
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease).
Reversibility	1	Impact is reversible without any time and cost.
	2	Impact is reversible without incurring significant time and cost.
	3	Impact is reversible only by incurring significant time and cost.
	4	Impact is reversible only by incurring prohibitively high time and cost.
	5	Irreversible Impact

Once the C has been determined the ER is determined in accordance with the standard risk assessment relationship by multiplying the C and the P. Probability is rated/ scored as per **Table 29.**

Table 29: Probability Scoring.

Probability	1	Improbable (the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <25%),
	2	Low probability (there is a possibility that the impact will occur; >25% and <50%),
	3	Medium probability (the impact may occur; >50% and <75%),
	4	High probability (it is most likely that the impact will occur- > 75% probability), or
	5	Definite (the impact will occur),

The result is a qualitative representation of relative ER associated with the impact. ER is therefore calculated as follows:

ER= C x P

Table 30: Determination of Environmental Risk.

Consequence	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15

	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
	Probability					

The outcome of the environmental risk assessment will result in a range of scores, ranging from 1 through to 25. These ER scores are then grouped into respective classes as described in **Table 31**.

Table 31: Significance Classes.

Risk Score	Description
< 10	Low (i.e. where this impact is unlikely to be a significant environmental risk).
≥ 10; < 20	Medium (i.e. where the impact could have a significant environmental risk),
≥ 20	High (i.e. where the impact will have a significant environmental risk).

The impact ER will be determined for each impact without relevant management and mitigation measures (pre-mitigation), as well as post implementation of relevant management and mitigation measures (post-mitigation). This allows for a prediction in the degree to which the impact can be managed/mitigated.

9.1.2 IMPACT PRIORITISATION

Further to the assessment criteria presented in the section above, it is necessary to assess each potentially significant impact in terms of:

1. Cumulative impacts; and
2. The degree to which the impact may cause irreplaceable loss of resources.

To ensure that these factors are considered, an impact prioritisation factor (PF) will be applied to each impact ER (post-mitigation). This prioritisation factor does not aim to detract from the risk ratings but rather to focus the attention of the decision-making authority on the higher priority/significance issues and impacts. The PF will be applied to the ER score based on the assumption that relevant suggested management/mitigation impacts are implemented.

Table 32: Criteria for Determining Prioritisation.

Cumulative Impact (CI)	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.
	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/ definite that the impact will result in spatial and temporal cumulative change.
	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.

Irreplaceable Loss of Resources (LR)	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.
	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in **Table 32**. The impact priority is therefore determined as follows:

Priority = CI + LR

The result is a priority score which ranges from 2 to 6 and a consequent PF ranging from 1 to 1.5 (Refer to **Table 33**).

Table 33: Determination of Prioritisation Factor.

Priority	Ranking	Prioritisation Factor
2	Low	**1**
3	Medium	**1.125**
4	Medium	**1.25**
5	Medium	**1.375**
6	High	**1.5**

In order to determine the final impact significance, the PF is multiplied by the ER of the post mitigation scoring. The ultimate aim of the PF is an attempt to increase the post mitigation environmental risk rating by a full ranking class, if all the priority attributes are high (i.e. if an impact comes out with a medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential and significant potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a high significance).

Table 34: Environmental Significance Rating.

Value	Description
< -10	Low negative (i.e. where this impact would not have a direct influence on the decision to develop in the area).
≥ -10 < -20	Medium negative (i.e. where the impact could influence the decision to develop in the area).
≥ -20	High negative (i.e. where the impact must have an influence on the decision process to develop in the area).
0	No impact

Value	Description
< 10	Low positive (i.e. where this impact would not have a direct influence on the decision to develop in the area).
≥ 10 < 20	Medium positive (i.e. where the impact could influence the decision to develop in the area).
≥ 20	High positive (i.e. where the impact must have an influence on the decision process to develop in the area).

The significance ratings and additional considerations applied to each impact will be used to provide a quantitative comparative assessment of the alternatives being considered. In addition, professional expertise and opinion of the specialists and the environmental consultants will be applied to provide a qualitative comparison of the alternatives under consideration. This process will identify the best alternative for the proposed project.

9.2 IMPACTS IDENTIFIED

This Section presents the impacts that have been assessed for the BA. Potential environmental impacts were identified by the EAP, the appointed specialists, as well as the preliminary input from the public. The impacts are included in **Table 35** below. It should be noted that this report was made available to I&AP's for review and comment to ensure their comments and concerns were able to be addressed in this final BA Report now being submitted to the PASA/DMRE for adjudication.

The Impacts were assessed in terms of nature, significance, consequence, extent, duration and probability in line with the methodology described in Section 9.1 above. The impact assessment matrix (including pre- and post-mitigation assessment) is included in Appendix D. Without proper mitigation measures and continual environmental management, most of the identified impacts may potentially become cumulative, affecting areas outside of their originally identified zone of impact. The potential cumulative impacts have been identified, evaluated, and mitigation measures suggested and have been updated during the investigation.

When considering cumulative impacts, it is important to bear in mind the scale at which different impacts occur. There is potential for a cumulative effect at a broad scale, such as regional deterioration of air quality, as well as finer scale effects occurring in the area surrounding the activity. The main impacts which have a cumulative effect on a regional scale are related to the transportation vectors that they act upon. For example, air movement patterns result in localised air quality impacts having a cumulative effect on air quality in the region. Similarly, water acts as a vector for distribution of impacts such as contamination across a much wider area than the localised extent of the impacts source. At a finer scale, there are also impacts that have the potential to result in a cumulative effect, although due to the smaller scale at which these operate, the significance of the cumulative impact is lower in the broader context.

Table 35: Impacts Identified and Assessed during the BA.

#	Impact	Phase
1	Impacts of seismic noise on mysticetes and odontocetes	Operation
2	Impacts of seismic noise on seals	Operation
3	Impacts of seismic noise on turtles	Operation

#	Impact	Phase
4	Impacts of seismic noise on diving seabirds	Operation
5	Impacts of seismic noise to pelagic fish	Operation
6	Impacts of seismic noise to marine invertebrates	Operation
7	Impacts of seismic noise to plankton and ichthyoplankton	Operation
8	Disturbance and behavioural changes in seabirds, seals, turtles and cetaceans due to vessel noise	Operation
9	Disturbance and behavioural changes in seabirds, seals, turtles and cetaceans due to noise of support aircraft	Operation
10	Disturbance and behavioural changes in pelagic fauna due to vessel lighting	Operation
11	Impacts of marine biodiversity through the introduction of non-native species in ballast water and on ship hulls	Operation
12	Impacts of normal vessel discharges on marine fauna	Operation
13	Impacts on turtles and cetaceans due to ship strikes, collision and entanglement with towed equipment	Operation
14	impacts on benthic and pelagic fauna due to accidental loss of equipment to the seabed or the water column	Operation
15	Impacts of an operational spill or collision on marine fauna	Operation
16	Exclusion from fishing grounds	Operation
17	Impact of sound on catch rates	Operation
18	Loss of Equipment	Operation
19	Accidental Release of diesel / oil	Operation
20	Impacts on cultural heritage	Operation
21	Impacts on livelihoods	Operation
22	Impacts on sense and spirit of place	Operation
23	Impacts on social licence to operate	Operation
24	Community expectations	Operation
25	Social unrest	Operation
26	Uncertainty	Operation

#	Impact	Phase
27	Concerns about cumulative impacts	Operation
28	Further marginilization of vulnerable groups	Operation
29	Stakeholder Fatigue (public engagements)	Pre-operation, Operation and Post-operation

9.3 DESCRIPTION AND ASSESSMENT OF IMPACTS

The following potential impacts were identified during the BA based on the methodology described above. The impact assessment matrix is included in **Appendix D** and the below subsections describe each impact in more detail.

No separate noise impact assessment ratings are included in this report. The noise modelling results from the noise (acoustic) assessment are used entirely to inform the other specialist impacts, specifically the impacts on marine ecology and fisheries. Refer to **Section 11.1.1**.

9.3.1 IMPACTS ON MARINE ECOLOGY

This section provides a description of the Marine Ecological Impacts identified by in the Marine Ecological Study. For a more detailed description of the impacts, please refer to the Marine Ecological Assessment undertaken by Pisces Environmental Services (Pty) Ltd included in **Appendix C**.

9.3.1.1 ACOUSTIC IMPACTS OF SEISMIC SURVEYS ON MARINE FAUNA

The ocean is a naturally noisy place, and marine animals are continually subjected to both physically produced sounds from sources such as wind, rainfall, breaking waves and natural seismic noise, or biologically produced sounds generated during reproductive displays, territorial defence, feeding, or in echolocation.

Acoustic cues are thought to be important to many marine animals in the perception of their environment as well as for navigation purposes, predator avoidance, and in mediating social and reproductive behaviour. Anthropogenic sound sources in the ocean can thus be expected to interfere directly or indirectly with such activities thereby affecting the physiology and behaviour of marine organisms. Of all human-generated sound sources, the most persistent in the ocean is the noise of shipping. Depending on size and speed, the sound levels radiating from vessels range from 160 to 220 dB re 1 µPa at 1 m. Especially at low frequencies between 5 to 100 Hz, vessel traffic is a major contributor to noise in the world's oceans, and under the right conditions, these sounds can propagate hundreds of kilometres thereby affecting very large geographic areas.

As the survey area is located within the main offshore shipping routes that pass around southern Africa, the shipping noise component of the ambient noise environment is expected to be significant within and around the proposed 3D survey area. For the duration of the survey an exclusion zone would be established around the survey vessel. Given the significant local shipping traffic and relatively strong metocean conditions specific to the area, ambient noise levels are expected to be 90–130 dB re 1 µPa for the frequency range 10 Hz – 10 kHz.

The seismic sources used in modern seismic surveys produce some of the most intense non-explosive sound sources used by humans in the marine environment. However, the transmission and attenuation of seismic sound is probably of equal or greater importance in the assessment of environmental impacts than the produced source levels themselves, as transmission losses and attenuation are very site specific, and are affected by propagation conditions, distance or range, water and receiver depth and bathymetrical aspect with respect to the source array. In water depths of 25 – 50 m seismic sources are often audible above ambient noise levels to ranges of 50 – 75 km, and with efficient propagation conditions such as experienced on the continental shelf or in deep oceanic water, detection ranges can exceed 100 km and 1,000 km, respectively. The signal character of seismic source pulses also change considerably with propagation effects. Reflective boundaries include the sea surface, the sea floor and boundaries between water masses of different temperatures or salinities, with each of these preferentially scattering or absorbing different frequencies of the source signal. This results in the received signal having a different spectral makeup from the initial source signal. In shallow water (<50 m) at ranges exceeding 4 km from the source, signals tend to increase in length from <30 milliseconds, with a frequency peak between 10-100 Hz and a short rise time, to a longer signal of 0.25-0.75 seconds, with a downward frequency sweep of between 200 – 500 Hz and a longer rise time.

In contrast, in deep water received levels vary widely with range and depth of the exposed animals, and exposure levels cannot be adequately estimated using simple geometric spreading laws. McCauley *et al* found that the received levels fell to a minimum between 5 – 9 km from the source and then started increasing again at ranges between 9 – 13 km, so that absolute received levels were as high at 12 km as they were at 2 km, with the complex sound reception fields arising from multi-path sound transmission.

Acoustic pressure variation is usually considered the major physical stimulus in animal hearing, but certain taxa are capable of detecting either or both the pressure and particle velocity components of a sound. An important component of hearing is the ability to detect sounds over and above the ambient background noise. Auditory masking of a sound occurs when its' received level is at a similar level to background noise within the same frequencies. The signal to noise ratio required to detect a pure tone signal in the presence of background noise is referred to as the critical ratio.

The auditory thresholds of many species are affected by the ratio of the sound stimulus duration to the total time (duty cycle) of impulsive sounds of <200 millisecond duration. The lower the duty cycle the higher the hearing threshold usually is. Although seismic sound impulses are extremely short and have a low duty cycle at the source, received levels may be longer due to the transmission and attenuation of the sound (as discussed above).

Below follows a brief review of the impacts of seismic surveys on marine faunal communities. This information is largely drawn from McCauley (1994), McCauley et al. (2000), the Generic EMPr for Oil and Gas Prospecting off the Coast of South Africa and the very comprehensive review by Cetus Projects (2007), supplemented by more recent peer-reviewed literature available on the WWW. While the discussion and assessments focus primarily on marine mammals, the effects on pelagic and benthic invertebrates, fish, turtles and seabirds are also covered briefly.

9.3.1.1.1 NOISE IMPACT ON WHALES AND DOLPHINS

The potential impact of seismic survey noise on whales and dolphins could include physiological injury to individuals, behavioural avoidance of individuals (and subsequent displacement from key habitat), masking of important environmental or biological sounds and indirect effects due to effects on predators or prey.

Information available on behavioural responses of toothed whales and dolphins to seismic surveys is more limited than that for baleen whales. No seasonal patterns of abundance are known for odontocetes occupying the proposed 3D survey area but several species are considered to be year-round residents. Furthermore, a number of toothed whale species have a more pelagic distribution thus occurring further offshore, with species diversity and encounter rates likely to be highest on the shelf slope. The impact of seismic survey noise on the behaviour of toothed whales is considered to be of high intensity across the proposed survey area and for the duration of the survey (immediate – 4 months). The overall consequence will however not vary between species and will be medium.

Baleen whales appear to vocalise almost exclusively within the frequency range of the maximum energy of seismic survey noise, while toothed whales vocalise at frequencies higher than these. As the by-product noise in the mid- and high frequency range (up to and exceeding 15 kHz) can travel far (at least 8 km), masking of communication sounds produced by whistling dolphins and blackfish is likely. In the migratory baleen whale species, vocalisation increases once they reach the breeding grounds and on the return journey in November/December when accompanied by calves. Although most mother-calf pairs tend to follow a coastal route southwards, there is no clear migration corridor and humpbacks can be spread out widely across the shelf and into deeper pelagic waters. Vocalisation of southward migrating whales may thus potentially be regionally comparatively high on commencement of operations in December, reducing thereafter. However, masking of communication signals is likely to be limited by the low duty cycle of seismic pulses. Should the survey overlap with the key migration and breeding period when there is a high likelihood of encountering migrating Humpback whales (including possible mother-calf pairs) and no other mitigation measures are in place, the intensity of impacts on baleen whales is likely to be high (mother-calf pairs) over the survey area and immediate-term duration (4 months), and of medium intensity (species specific) in the case of toothed whales over the survey area) and duration (immediate – 4 months). The consequence for both mysticetes and odontocets would be medium.

As with other vertebrates, the assessment of indirect effects of seismic surveys on resident odontocete cetaceans is limited by the complexity of trophic pathways in the marine environment. Although the fish and cephalopod prey of toothed whales and dolphins may be affected by seismic surveys, impacts will be highly localised and small in relation to the feeding ranges of cetacean species. Although the majority of baleen whales will undertake little feeding within breeding-ground waters along the southern African west coast and rely on blubber reserves during their migrations there is increasing evidence that some species (fin whales, southern rights and humpbacks) are using upwelling areas off the South African West Coast as summer feeding grounds. The upwelling zone off Cape Columbine has become an important summer feeding area, and baleen whales have been reported to feed inshore of the Survey area between St Helena Bay and Cape Town. Any indirect effects on their food source would thus be of very low intensity over the survey area and duration (immediate – 4 months) and therefore of very low consequence. In the case of odontocetes, the broad ranges of prey species (in relation to the avoidance patterns of seismic surveys of such prey species) suggest that indirect impacts due to effects on prey would similarly be of low intensity over the survey area and duration (immediate – 4 months) and therefore of very low consequence.

The potential impacts cannot be eliminated due to the nature of the seismic sound source required during surveying. The proposed mitigation measures, which are essentially designed to keep animals out of the immediate area of impact and thereby reduce the risk of deliberate injury to marine mammals would reduce the intensity of most impacts to medium, and the residual impacts will reduce to low consequence and low significance, except for the effects on prey which remains of very low significance.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Impacts of seismic noise on mysticetes and odontocetes	Operation	Medium	Low	Low
Mitigation Measures				
• Please refer to **Section 11.4.1** for detailed mitigation measures for cetaceans. Key mitigation measures include: • Application of the mitigation hierarchy; • Pre-survey planning; • Passive acoustic monitoring and MMOs; • Seismic source testing and pre-start protocols; and • Vessel and aircraft operations to avoid sensitive areas.				

9.3.1.1.2 NOISE IMPACT ON SEALS

The potential impact of seismic survey noise on seals could include physiological injury to individuals, behavioural avoidance of individuals (and subsequent displacement from key habitat), masking of important environmental or biological sounds and indirect effects due to effects on predators or prey. The Cape fur seal that occurs off the West Coast forages over the continental shelf to depths of over 200 m and is thus highly likely to be encountered in the proposed 3D survey area.

Seals occur at numerous breeding and non-breeding sites on the mainland, namely at Buchu Twins and Cliff Point near Alexander Bay, Robeiland near Kleinzee, Strandfontein Point, Elephant Rocks, at various emergent reefs around Cape Columbine, Robbesteen near Duynefontein and at Duikerklip and Seal Island on the Cape Peninsula. Seals are highly mobile animals with a general foraging area covering the continental shelf up to 120 nautical miles (~220 km) offshore, with bulls ranging further out to sea than females. Seals are therefore unlikely to be encountered in the proposed 3D survey area. Their sensitivity to the proposed seismic operations is considered to be low. However, considering the recent mass mortality of seals along much of the South and West Coasts, every precaution should be taken to avoid further stresses to these populations.

Although partial avoidance (to less than 250 m) of operating seismic sources has been recorded for some seal species, Cape fur seals appear to be relatively tolerant to loud noise pulses and, despite an initial startle reaction, individuals quickly reverted back to normal behaviour. The potential impact of seal foraging behaviour changing in response to seismic surveys is thus considered to be of very low intensity as they are known to show a tolerance to loud noises. Furthermore, as the duration of the impact would be limited to the immediate-term (4 months) and be restricted to the survey area, the potential for behavioural avoidance of seals is considered to be of very low consequence.

The use of underwater sounds for environmental interpretation and communication by Cape fur seals is unknown, although masking is likely to be limited by the low duty cycle of seismic pulses (37.5 m interval between consecutive discharge-points for 3D). The potential impact of masking of sounds and communication in seals due to seismic surveys is considered to be of very low intensity as they are known to show a tolerance to loud noises. As the duration of the impact would be limited to the immediate-term (4 months) and be restricted to the survey area, the potential for masking of sounds is considered to be of very low consequence.

As with other vertebrates, the assessment of indirect effects of seismic surveys on Cape fur seals is limited by the complexity of trophic pathways in the marine environment. The impacts are difficult to determine and would depend on the diet make-up of the species (and the flexibility of the diet), and the effect of seismic surveys on the diet species. Seals typically forage on small pelagic shoaling fish prey species that occur inshore of the 200 m depth contour or associated with oceanic features such as Child's Bank. Furthermore, the broad ranges of fish prey species (in relation to the avoidance patterns of seismic surveys of such prey species) and the extended foraging ranges of Cape fur seals suggest that indirect impacts due to effects on predators or prey would be of very low intensity, would be limited to the immediate-term (4 months) and be restricted to the survey area. The potential for effects of seismic surveys on prey species is thus considered to be of very low consequence.

With the implementation of the typical 'soft-start' procedures, the residual impacts would all remain of very low environmental risk and very low significance.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Impacts of seismic noise on seals	Operation	Low	Low	Low
Mitigation Measures				
• Implement a "soft-start" procedure of a minimum of 20 minutes' duration on initiation of the seismic source if during daylight hours it is confirmed visually by the MMO during the pre-acquisition watch (60 minutes) that there are no seals within 500 m of the seismic source. • In the case of fur seals being observed within the mitigation zone, which may occur commonly around the vessel, delay "soft-starts" for at least 10 minutes until it has been confirmed that the mitigation zone is clear of all seal activity. However, if after a period of 10 minutes seals are still observed within 500 m of the seismic sources, the normal "soft-start" procedure should be allowed to commence for at least a 20-minute duration. Seal activity should be carefully monitored during				

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
“soft-starts” to determine if they display any obvious negative responses to the seismic source and gear or if there are any signs of injury or mortality as a direct result of the seismic activities. • Terminate seismic source on observation of any obvious mortality or injuries to seals when estimated by the MMO to be as a direct result of the survey.				

9.3.1.1.3 NOISE IMPACTS ON TURTLES

The potential effects of seismic surveys on turtles include:

- Physiological injury (including disorientation) or mortality from seismic noise;
- Behavioural avoidance of seismic survey areas;
- Masking of environmental sounds and communication; and
- Indirect impacts due to effects on predators or prey.

The leatherback and loggerhead turtles that occur in offshore and coastal waters around southern Africa, and likely to be encountered in the Survey area are considered regionally ‘Critically Endangered’ and ‘Endangered’, respectively, in the List of Marine Threatened or Protected Species (TOPS) as part of the NEMBA. Following nesting in December-January, loggerhead turtles migrate back to their foraging grounds along the East and South Coasts. Hatchlings of both species emerge from their nests from mid-January to mid-March with most dispersing south-westward within the Agulhas Current. The Agulhas Current migration corridor will therefore be very active with migrating sea turtles between January and April, some of which may be distributed along the West Coast through mass transport of Agulhas Current water into the southeast Atlantic by warm core rings. Despite their extensive distributions and feeding ranges, the numbers of adult and neonate turtles encountered in the Survey area may therefore be seasonally high, particularly in the Child’s Bank and Orange Shelf Edge MPAs, and the Orange Seamount and Canyon Complex transboundary EBSA, which may be frequented by leatherbacks on their migrations. Consequently, the sensitivity of turtles to seismic noise is considered to be high, particularly neonates and juveniles as they are unable to actively avoid seismic sounds and consequently are more susceptible to seismic noise.

As the breeding areas for Leatherback turtles in Gabon occur over 1 500 km to north of the proposed 3D survey area, and on the northeast coast of South Africa, turtles encountered during the survey are likely to be adults migrating to foraging grounds, and dispersing neonates and juveniles. Although turtles have extensive distributions and feeding ranges, the number of turtles encountered in the survey area is expected to be low. Despite their low numbers in the survey area, the intensity of potential physiological injury would be thus rated as high. However, the duration of the impact on the population would be limited to the immediate-term (4 months) and be restricted to the survey area. The potential physiological injury or mortality of turtles is considered to be of medium consequence.

Using the root-mean-square (RMS) SPL criteria of 175 dB re 1 µPa, the Underwater Noise Modelling Study undertaken for the current project identified that the maximum threshold distance for behavioural disturbance for turtles caused by the immediate exposure to individual pulses was predicted to be within 1 140 m from the 3D array. Turtles can therefore hear seismic sounds at a considerable distance and may respond by altering their swimming/basking behaviour or alter their migration route. However, as the number of turtles encountered during the proposed 3D survey is expected to be low, the impact of seismic sounds on turtle behaviour would be of low intensity and would persist only for the duration of the survey (immediate – 4 months) and be restricted to the survey area. The impact of seismic noise on turtle behaviour is thus deemed to be of very low consequence.

As with other vertebrates, the assessment of indirect effects of seismic surveys on turtles is limited by the complexity of trophic pathways in the marine environment. The leatherback turtles eat pelagic prey, primarily jellyfish. The low numbers and the broad ranges of potential prey species and extensive ranges over which most turtles feed suggest that indirect impacts would be of very low intensity, persisting only for the duration of the survey (immediate – 4 months), and restricted to the survey area. The impact would therefore be of very low consequence.

With the implementation of the mitigation measures above, the residual impact on potential physiological injury would reduce to low. The other impacts would remain of very low significance.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Impacts of seismic noise on turtles	Operation	Medium	Low	Low
Mitigation Measures				

- Implement a "soft-start" procedure of a minimum of 20 minutes' duration on initiation of the seismic source if during daylight hours it is confirmed visually by the MMO during the pre-acquisition watch (60 minutes) that there are no turtles within 500 m of the seismic source.
- In the case of turtles being observed within the mitigation zone, delay the "soft-start' until animals are outside the 500 m mitigation zone.
- Terminate seismic source on:
    - Observation of turtles within the 500 m mitigation zone.
    - Observation of any obvious mortality or injuries to turtles when estimated by the MMO to be as a direct result of the survey.
    - For turtles, terminate source until such time as the animals are outside of the 500 m mitigation zone (seismic "pause", no soft-start required). If visual confirmation is not possible, implement a seismic pause of 4 minutes.
- Avoid surveying within 100 m of critical foraging habitats (e.g. seamounts or convergence zones).

9.3.1.1.4 NOISE IMPACTS ON SEABIRDS

Potential impacts of seismic pulses to diving birds could include physiological injury, behavioural avoidance of seismic survey areas and indirect impacts due to effects on prey. The seabird species are all highly mobile and would be expected to flee from approaching seismic noise sources at distances well beyond those that could cause physiological injury, but initiation of a sound source at full power in the immediate vicinity of diving seabirds could result in injury or mortality where feeding behaviour override a flight response to seismic survey sounds. The potential for physiological injury or behavioural avoidance in non-diving seabird species, being above the water and thus not coming in direct contact with the seismic pulses, is considered negligible and will not be discussed further here.

Should an encounter with diving pelagic seabirds occur, the potential physiological impact on individual pelagic and coastal diving birds would be of high intensity, but as the likelihood of encountering large numbers of diving seabirds is low, due to their extensive distributions and feeding ranges the intensity is considered medium. Furthermore, the duration of the impact on the population would be limited to the immediate-term (4 months) and be restricted to the survey area. The potential for physiological injury is therefore considered to be of low consequence.

Due to the extensive distribution and feeding ranges of pelagic seabirds, the impact for pelagic seabirds would thus be of low intensity within the survey area over the duration of the survey period (immediate – 4 months). For African Penguins and Cape Gannets, the impact for would thus be of high intensity, but as the likelihood of encountering large numbers in offshore areas is low, the intensity is considered medium. Similarly, for pelagic seabirds the impact would be of high intensity, but due to their extensive distributions and feeding ranges, the likelihood of encountering significant numbers is low, and the intensity is therefore considered medium. The duration of the impact on the population would be limited to the immediate-term (4 months) and be restricted to the survey area. The behavioural avoidance of feeding areas by diving seabirds is thus considered to be of very low consequence and for coastal diving seabirds to be of low consequence.

Although seismic surveys have been reported to affect fish catches up to 30 km from the sound source, with effects persisting for a duration of up to 10 days, for the current project relatively low behavioural risks are expected for fish species at far-field distances (1 000s of metres). This could have implications for plunge-diving seabirds such as African Penguins that forage in restricted areas within a given radius of their breeding sites. Similarly, pelagic seabirds that feed around seamounts may also be affected. As the survey area is located beyond the foraging range of African penguins and Cape gannets, and Tripp Seamount is located ~50 km north of the proposed survey area, seismic effects on the prey species of coastal seabirds, or pelagic seabirds that feed around seamounts is not expected. The impact on potential food sources for pelagic and coastal diving seabirds would thus be of very low intensity within the survey area over the duration of the survey period (immediate – 4 months). The broad ranges of potential fish prey species (in relation to potential avoidance patterns of seismic surveys of such prey species) and extensive ranges over which most seabirds feed suggest that indirect impacts would be of very low consequence.

The impact on potential food sources for pelagic seabirds would thus be of very low intensity within the survey area (local) over the duration of the survey period (4 months). The broad ranges of potential fish prey species (in relation to potential avoidance patterns of seismic surveys of such prey species) and extensive ranges over which most seabirds feed suggest that indirect impacts would be of very low consequence.

With the implementation of the mitigation measures, the residual impact on potential physiological injury or behavioural avoidance by seabirds, masking of sounds and indirect impacts on food sources would remain very low.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Impacts of seismic noise on diving seabirds	Operation	Low	Low	Low
Mitigation Measures				
• Implement a "soft-start" procedure of a minimum of 20 minutes' duration on initiation of the seismic source if during daylight hours it is confirmed visually by the MMO during the pre-shoot watch (60 minutes) that there are no penguins or feeding aggregations of diving seabirds within 500 m of the seismic source. • In the case of penguins or feeding aggregations of diving seabirds being observed within the mitigation zone, delay the 'soft-start' until animals are outside the 500 m mitigation zone. • Terminate seismic source on observation of penguins and feeding aggregations of diving seabirds within the 500 m mitigation zone. • For penguins and feeding aggregations of diving seabirds, terminate source until such time as the animals are outside of the 500 m mitigation zone (seismic "pause", no soft-start required). If visual confirmation is not possible implement a seismic pause of 4 minutes.				

9.3.1.1.5 NOISE IMPACTS ON FISH

Fish hearing has been reviewed by numerous authors including Popper and Fay (1973), Hawkins (1973), Tavolga et al. (1981), Lewis (1983), Atema et al. (1988), and Fay (1988) (amongst others). Fish have two different systems to detect sounds namely 1) the ear (and the otolith organ of their inner ear) that is sensitive to sound pressure and 2) the lateral line organ that is sensitive to particle motion. Certain species utilise separate inner ear and lateral line mechanisms for detecting sound; each system having its own hearing threshold, and it has been suggested that fish can shift from particle velocity sensitivity to pressure sensitivity as frequency increases. More recently, Popper & Hawkins (2018) determined that most fish (and all elasmobranchs) primarily detect particle motion.

In fish, the proximity of the swim-bladder to the inner ear is an important component in the hearing as it acts as the pressure receiver and vibrates in phase with the sound wave. Vibrations of the otoliths, however, result from both the particle velocity component of the sound as well as stimulus from the swim-bladder. The resonant frequency of the swim-bladder is important in the assessment of impacts of sounds as species with swim-bladders of a resonant frequency similar to the sound frequency would be expected to be most susceptible to injury. Although the higher frequency energy of received seismic impulses needs to be taken into consideration, the low frequency sounds of seismic surveys would be most damaging to swim-bladders of larger fish. The lateral line is sensitive to low frequency (between 20 and 500 Hz) stimuli through the particle velocity component of sound and would thus be sensitive to the low frequencies of seismic sources, which most energy at 20-150 Hz.

The sound waves produced during seismic surveys are low frequency, with most energy at 20-150 Hz (although significant contributions may extend up to 500 Hz) and overlap with the range at which fish hear well. A review of the available literature suggests that potential impacts of seismic pulses to fish (including sharks) species could include physiological injury and mortality, behavioural avoidance of seismic survey areas, reduced reproductive success and spawning, masking of environmental sounds and communication, and indirect impacts due to effects on predators or prey.

The greatest risk of physiological injury from seismic sound sources is for species that establish home ranges on shallow- or deep-water reefs or congregate in areas to spawn or feed, and those displaying an instinctive alarm response to hide on the seabed or in the reef rather than flee. Such species would be associated with the seabed (at >1 500 m) or with Child's Bank or Tripp Seamount. The fish most likely to be encountered on the shelf, beyond the shelf break and in the offshore waters of the proposed 3D survey area are the large migratory pelagic species. In many of the large pelagic species, the swim-bladders are either underdeveloped or absent, and the risk of physiological injury through damage of this organ is therefore lower. However, many of the large pelagic fish and shark species likely to occur in the offshore regions characterising the Orange Basin are considered globally 'Vulnerable' (e.g. bigeye tuna, blue marlin, Oceanic Whitetip shark, dusky shark, great white shark, longfin mako), 'Endangered' (e.g. shortfin mako, whale shark) and 'Critically Endangered' (Southern bluefin tuna). However, the numbers of individuals encountered during the survey are likely to be low, even when these species are en route to or from recognised feeding grounds associated with Tripp Seamount or Child's Bank where greater concentrations of pelagic fish can be expected. The sensitivity of fish to seismic noise is considered to be high sensitivity.

Physical damage may lead to delayed mortality as reduced fitness is associated with higher vulnerability to predators and decreased ability to locate prey. Reduced heart rate (bradycardia) in response to the particle motion component of the sound from the seismic source, indicative of an initial flight response has also been reported. Popper (2008) concludes that as the vast majority of fish exposed to seismic sounds will in all likelihood be some distance from the source, where the sound level has attenuated considerably, only a very small number of animals in a large population will ever be directly killed or damaged by sounds from seismic source arrays. Consequently, direct physical damage from exposure to high level sound from seismic sources was not considered an issue that required special mitigation.

Child's Bank and Tripp Seamount lie ~80 km east and ~50 km north of the proposed 3D survey area, and any demersal species associated with these important fishing banks would receive the seismic noise within the far-field range, and outside of distances at which physiological injury or avoidance would be expected. Impacts on demersal species are thus deemed of very low intensity across the survey area and for the survey duration (immediate) and are considered to be of very low consequence.

Behavioural responses such as deflection from migration paths or avoidance of seismic survey areas and changes in feeding behaviours of some fish to seismic sounds have been documented at received levels of about 130 – 180 dB re 1 μPa. Behavioural effects are generally short-term, however, with duration of the effect being less than or equal to the duration of exposure, although these vary between species and individuals, and are dependent on the properties of the received sound. The potential impact on individual fish behaviour could therefore be of high intensity (particularly in the near-field of the seismic source array). Impacts to behavioural responses would be limited to the survey duration (immediate), and the survey area. Consequently, it is considered to be of medium consequence.

The spawning areas of the small pelagic shoaling species are distributed on the continental shelf and along the shelf edge from Lambert's Bay to Mossel Bay, with the major spawning grounds for most species (anchovy, round herring, horse mackerel, chub mackerel) located east of Cape Point and hake spawning occurring on the western Agulhas Bank. There is therefore no overlap of the proposed 3D survey area with the migration routes and spawning areas of these commercially important species. If behavioural responses to seismic noise result in deflection from coastal migration routes or disturbance of spawning, further impacts may occur that may affect recruitment to fish stocks. The intensity of effect in these cases will depend on the biology of the species and the extent of the dispersion or deflection. Despite the current low biomass of sardine, particularly west of Cape Agulhas, recent successive years of low recruitment and the dependence of future recruitment on successful West Coast spawning the intensity of the potential impact of the 3D survey can be considered very low for the duration of the survey (immediate) as the survey area lies well offshore of these West Coast spawning areas and is not known to be a spawning area for large pelagic species. The impact is thus considered to be of very low consequence.

While some nearshore reef species are known to produce isolated sounds or to call in choruses, communication and the use of environmental sounds by fish off the South African West Coast are unknown. Demersal species in abyssal and continental slope habitats or associated with Child's Bank or Tripp Seamount would receive the seismic noise in the far field and vocalisation, should it occur, is unlikely to be masked. Impacts arising from masking of sounds are thus expected to be of very low intensity due to the duty cycle of seismic surveys in relation to the more continuous biological noise. Such impacts would occur across the survey area and for the duration of the survey (4 months). The impact is thus considered to be of very low consequence.

The assessment of indirect effects of seismic surveys on fish is limited by the complexity of trophic pathways in the marine environment. The impacts are difficult to determine and would depend on the diet make-up of the fish species concerned and the effect of seismic surveys on the diet species. Indirect impacts of seismic surveying could include attraction of predatory species such as sharks, tunas or diving seabirds to pelagic shoaling fish species stunned by seismic noise. In such cases, where feeding behaviour overrides a flight response to seismic survey sounds, injury or mortality could result if the seismic sound source is initiated at full power in the immediate vicinity of the feeding predators. Little information is available on the feeding success of large migratory fish species in association with seismic survey noise. The pelagic shoaling species that constitute the main prey item of migratory pelagic species typically occur inshore of the 200 m depth contour. Although large pelagic species are known to aggregate around seamounts to feed, considering the extensive range over which large pelagic fish species can potentially feed in relation to the survey area, and the low abundance of pelagic shoaling species that constitute their main prey across most of the 3D survey area the intensity of the impact would be low, restricted to the survey area and persisting over the immediate-term only (4 months). The impact would thus be of very low consequence.

The potential impacts cannot be eliminated due to the nature of the seismic sound source required during surveying. The location of the proposed survey area well to the west of the 'ring-fenced' area and proposed mitigation measures, which are essentially designed to keep animals out of the immediate area of impact and thereby reduce the risk of deliberate injury to fish, reduces the intensity of the impacts relating to physiological injury / mortality to medium, the residual impact will reduce to low consequence and be of low significance. All other impacts on fish remain of low significance.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Impacts of seismic noise to pelagic fish	Operation	Medium	Low	Low
Mitigation Measures				

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance

- Implement a "soft-start" procedure of a minimum of 20 minutes' duration on initiation of the seismic source if during daylight hours it is confirmed visually by the MMO during the pre-shoot watch (60 minutes) that there are no slow swimming large pelagic fish within 500 m of the seismic source.
- Terminate seismic source on
    - Observation of slow swimming large pelagic fish (including whale sharks, basking sharks, manta rays and devil rays) within the 500 m mitigation zone.
    - Observation of any obvious mass mortalities of fish (specifically large shoals of tuna or surface shoaling small pelagic species such as sardine, anchovy and mackerel) when estimated by the MMO to be as a direct result of the survey.
- For slow swimming large pelagic fish, terminate source until such time as the animals are outside of the 500 m mitigation zone (seismic "pause", no soft-start required). If visual confirmation is not possible implement a seismic pause of 4 minutes.

9.3.1.1.6 NOISE IMPACTS ON MARINE INVERTEBRATES

Many marine invertebrates have tactile organs or hairs (termed mechanoreceptors), which are sensitive to hydro-acoustic near-field disturbances, and some have highly sophisticated statocysts, which have some resemblance to the ears of fishes and are thought to be sensitive to the particle acceleration component of a sound wave in the far-field. Potential impacts of seismic pulses on invertebrates would include physiological injury or mortality in the immediate vicinity of the sound source, and behavioural avoidance. Masking of environmental sounds and indirect impacts due to effects on predators or prey have not been documented and are highly unlikely and are thus not discussed further here.

As the proposed 3D survey area is located in waters in excess of 1 500 m depth, the received noise by benthic invertebrates at the seabed would be within the far-field range, and outside of distances at which physiological injury would be expected. The impact is therefore deemed of very low intensity across the survey area and for the four-month survey duration (immediate) and is therefore considered to be of very low consequence.

The potential impact of seismic noise on physiological injury or mortality and behavioural avoidance of pelagic cephalopods could potentially be of high intensity to individuals, but as distribution of mobile neritic and pelagic squid is naturally spatially highly variable and the numbers of giant squid likely to be encountered is low, the intensity would be considered low across the survey area and for the survey duration (immediate – 4 months) resulting in a very low consequence.

With the implementation of the typical 'soft-starts', the residual impact on potential behavioural avoidance by cephalopods would remain of negligible significance.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Impacts of seismic noise to marine invertebrates	Operation	Low	Low	Low
Mitigation Measures				

- Terminate seismic source on observation of any obvious mass mortalities of squid when estimated by the MMO to be as a direct result of the survey.

9.3.1.1.7 NOISE IMPACT ON PLANKTON

As the movement of phytoplankton and zooplankton is largely limited by currents, they are not able to actively avoid the seismic vessel and thus are likely to come into close contact with the sound sources, potentially experiencing multiple exposures during acquisition of adjacent lines. Potential impacts of seismic pulses on plankton would include physiological injury or mortality in the immediate vicinity of the seismic source.

Phytoplankton, zooplankton and ichthyoplankton abundances across most of the survey area are thus expected to be comparatively low, and (if they occur) have a highly patchy distribution and seasonally high abundances. Although plankton distribution is naturally temporally and spatially variable and natural mortality rates are high, the overall sensitivity is considered medium due to the potentially reduced reproductive success in some of the small pelagic species.

As the 3D survey is scheduled for the summer survey window (start December to end May), there will be some temporal overlap with the peak spawning products of commercially important species. However, as plankton distribution is naturally temporally and spatially variable and natural mortality rates are high, and the survey area lies west of the West Coast northward egg and larval drift and return migration of recruits, any impacts would be of low intensity for phytoplankton and zooplankton, but of medium intensity for ichthyoplankton. Although the impact is restricted to within a few hundred metres of the seismic source, it would extend over the entire survey area. Should impacts occur, they would persist over the immediate-term (days) in the case of phytoplankton and zooplankton only due to the rapid natural turn-over rate of these plankton communities but would persist over the short-term in the case of ichthyoplankton (particularly the sardine stock, which is experiencing successive years of low recruitment). The consequence of the impact would therefore be very low for phytoplankton and zooplankton but medium for ichthyoplankton. As plankton abundances in the offshore waters of the proposed 3D survey area will be negligible, the consequence of the impact would be very low.

The impact of seismic noise on phytoplankton and zooplankton, considering the medium sensitivity and very low consequence, is thus deemed to be of very low significance both with and without mitigation. Due to the medium consequence and medium sensitivity of ichthyoplankton, but the low likelihood of the impact occurring in offshore waters, the impacts are deemed to be of medium significance.

This potential impact cannot be eliminated due to the nature of the seismic sound source required during surveying. With the implementation of the above mitigation measure, the residual impact would reduce to very low significance.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Noise impact on Plankton	Operation	Medium	Low	Low
Mitigation Measures				
• As the proposed survey area is located far offshore, it is not deemed necessary to implement mitigation measures to avoid the key spring spawning periods thereby mitigating potential impacts on plankton to some degree. In addition, Searcher has agreed to avoid the key "ring fenced" fishing and spawning areas to the south-east of the survey area identified during previous consultation with the commercial fishing sector. No other direct mitigation measures for potential impacts on plankton and fish egg and larval stages are feasible or deemed necessary.				

9.3.1.2 OTHER IMPACTS OF SEISMIC SURVEYS ON MARINE FAUNA

9.3.1.2.1 IMPACTS OF NON-SEISMIC NOISE (VESSEL AND HELICOPTER NOISE)

The presence and operation of the seismic vessel and support vessels during transit to the survey area, during the proposed survey and during demobilisation will introduce a range of underwater noises into the surrounding water column that may potentially contribute to and/or exceed ambient noise levels in the area.

Crew transfers by helicopter from Cape Town or a suitable location nearby to the survey vessel, if required (preferred alternative is via the support vessel) will generate noise in the atmosphere that may disturb coastal species such as seabirds and seals. Noise source levels from helicopters are expected to be around 109 dB re 1µPa at the most noise-affected point.

The taxa most vulnerable to disturbance by underwater noise are turtles, and large migratory pelagic fish and marine mammals. Some of the species potentially occurring in the survey area, are considered regionally or globally 'Critically Endangered' (e.g. southern bluefin tuna, leatherback turtles and blue whales), 'Endangered' (e.g. Black-Browed and Yellow-Nosed Albatross, Subantarctic Skua, whale shark, shortfin mako shark, fin and sei whales), 'Vulnerable' (e.g. bigeye tuna, blue marlin, loggerhead turtles, oceanic whitetip shark, dusky shark, great white shark, longfin mako and sperm whale, Bryde's and humpback whales) or 'Near Threatened' (e.g. striped marlin, blue shark, longfin tuna/albacore and yellowfin tuna). Although species listed as 'Critically Endangered' or 'Endangered' may potentially occur in the survey area, due to their extensive distributions their numbers are expected to be low. Based on the low numbers of listed species, the sensitivity is considered to be medium.

As the proposed survey area falls within with the main offshore shipping routes that pass around southern Africa, the shipping noise component of the ambient noise environment is expected to be the dominant component within and around the survey area. Given the significant local shipping traffic and relatively strong metocean conditions specific to the area, ambient noise levels are expected to be 90 – 130 dB re 1 µPa for the frequency range 10 Hz – 10 kHz. The noise generated by the survey vessel, thus falls within the hearing range of most fish and marine mammals, and would be audible for considerable ranges before attenuating to below threshold levels. However, unlike the noise generated by the sound source, underwater noise from vessels is not considered to be of sufficient amplitude to cause direct harm to marine life, even at close range. Due to their extensive distributions, the numbers of pelagic species (large pelagic fish, turtles and cetaceans) encountered during the proposed seismic surveys is expected to be low and consequently the intensity of potential physiological injury or behavioural disturbance as a result of vessel noise would be rated as low. Furthermore, the duration of the impact on the populations would be limited to the immediate-term (4 months) and extend regionally between the survey area and the logistics base. The potential physiological injury or behavioural disturbance as a result of vessel noise would thus be of very low consequence.

Indiscriminate low altitude flights over whales, seals, seabird colonies and turtles by helicopters used to support the seismic vessel could thus have an impact on behaviour and breeding success. The intensity of disturbance would depend on the distance and altitude of the aircraft from the animals (particularly the angle of incidence to the water surface) and the prevailing sea conditions and could range from low to high intensity for individuals but of low intensity for the populations as a whole. As such impacts would be PROVINCIAL (although temporary in nature – a few minutes while the helicopter passes overhead) to the flight path and immediate-term (4 months), impacts would be of very low consequence.

In the unlikely event that helicopters are required for crew changes or medivac, the generation of noise from helicopters cannot be eliminated. Similarly the generation of vessel noise cannot be eliminated. The proposed mitigation, specifically maintaining the regulated altitude over the coastal zone and MPAs and flying perpendicular to the coast would reduce the intensity of the impact to very low, but the residual impact will remain of very low consequence and of low significance. Without mitigation measures for vessel noise, the residual impact of vessel noise would remain very low. Aircraft and vessel noise would, however, likely contribute to the growing suite of cumulative acoustic impacts to marine fauna in the area, but assessing the population level consequences of multiple smaller and more localised stressors is difficult.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Impacts of vessel noise on marine fauna	Operation	Low	Low	Low

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Impacts of support aircraft noise on marine fauna	Operation	Low	Low	Low
Mitigation Measures				
• Pre-plan flight paths to ensure that no flying occurs over coastal seal colonies and seabird nesting areas. • Avoid extensive low-altitude coastal flights by ensuring that the flight path is perpendicular to the coast, as far as possible. • Brief all pilots on the ecological risks associated with flying at a low level along the coast or above marine mammals.				

9.3.1.2.2 IMPACT OF VESSEL LIGHTING ON PELAGIC FAUNA

The survey activities would be undertaken in the offshore marine environment, more than 100 km offshore, far removed from any sensitive coastal receptors (e.g. bird or seal colonies), but could still directly affect migratory pelagic species (pelagic seabirds, turtles, marine mammals and fish) transiting through the Survey area. The strong operational lighting used to illuminate the survey vessel at night may disturb and disorientate pelagic seabirds feeding in the area. Operational lights may also result in physiological and behavioural effects of fish and cephalopods as these may be drawn to the lights at night where they may be more easily preyed upon by other fish and seabirds.

Due to their extensive distributions, the numbers of pelagic species (large pelagic fish, turtles and cetaceans) encountered during the proposed 3D survey is expected to be low. Due to anticipated numbers and the proximity of survey area to the main traffic routes, the increase in ambient lighting in the offshore environment would be of low intensity and regional in extent (although limited to the area in the immediate vicinity of the vessel) over the immediate-term (4 months). For support vessels travelling from Saldanha Bay/Cape Town increase in ambient lighting would likewise be restricted to the immediate vicinity of the vessel over the short-term. The potential for behavioural disturbance as a result of vessel lighting would thus be of very low consequence.

With the implementation of the mitigation measures above, the residual impact would remain very low.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Impact of vessel lighting	Operation	Low	Low	Low
Mitigation Measures				
• The lighting on the survey and support vessels should be reduced to a minimum compatible with safe operations whenever and wherever possible. Light sources should, if possible and consistent with safe working practices, be positioned in places where emissions to the surrounding environment can be minimised. • Keep disorientated, but otherwise unharmed, seabirds in dark containers for subsequent release during daylight hours. Ringed/banded birds should be reported to the appropriate ringing/banding scheme (details are provided on the ring).				

9.3.1.2.3 BALLAST WATER DISCHARGES AND HULL FOULING

Artificial structures deployed at sea serve as a substrate for a wide variety of larvae, cysts, eggs and adult marine organisms. The transportation of equipment from one part of the ocean to another would therefore also facilitate the transfer of the associated marine organisms. Survey vessels, seismic equipment and support vessels are used and relocated all around the world. Similarly, the ballasting and de-ballasting of these vessels may lead to the introduction of exotic species and harmful aquatic pathogens to the marine ecosystems.

The marine invertebrates that colonize the surface of vessels can easily be introduced to a new region, where they may become invasive by outcompeting and displacing native species. Marine invasive species are considered primary drivers of ecological change in that they create and modify habitat, consume and outcompete native fauna, act as disease agents or vectors, and threaten biodiversity. Once established, an invasive species is likely to remain in perpetuity.

Ballast water is discharged subject to the requirements of the International Maritime Organisation's (IMO) 2004 International Convention for the Control and Management of Ships' Ballast Water and Sediments. The Convention aims to prevent the spread of harmful aquatic organisms from one region to another, by establishing standards and procedures for the management and control of ships' ballast water and sediments. The Convention stipulates that all ships are required to implement a Ballast Water Management Plan and that all ships using ballast water exchange will do so at least 200 nautical miles from nearest land in waters of at least 200 m deep; the absolute minimum being 50 nautical miles from the nearest land. Project vessels would be required to comply with this requirement.

The discharge of ballast water from the survey and support vessels would take place in the vicinity of the survey area, which is located more than 40 km offshore, far removed from any sensitive coastal receptors (e.g. sessile benthic invertebrates, endemic neritic and demersal fish species). In addition, due to the water depths in the survey area (~1 000 m up to 3 600 m), colonisation by invasive species on the seabed is considered unlikely. Thus, the sensitivity of benthic receptors in the offshore waters of the Orange Basin is therefore considered very low.

In terms of hull fouling, the survey area is located along one of the main traffic routes that pass around southern Africa. Thus, the introduction of invasive species into South African waters due to hull fouling of project vessels is unlikely to add to the current risk that exists due to the numerous vessels that operate in or pass through South African coastal waters, through and inshore of the survey area, on a daily basis.

Considering the location of the survey area and compliance with the IMO guidelines for ballast water, the impact related to the introduction of alien invasive marine species is considered to be of medium intensity (due to it having a minimal effect on receptors) in the immediate-term (due to invasive species not able to establish) and of regional extent. Thus, the consequence is, therefore, considered to be low. With the implementation of the mitigation measures above, the residual impact would reduce to negligible.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Ballast water discharges	Operation	Low	Low	Low
Mitigation Measures				
• Avoid the unnecessary discharge of ballast water. • Use filtration procedures during loading in order to avoid the uptake of potentially harmful aquatic organisms, pathogens and sediment that may contain such organisms. • Ensure that routine cleaning of ballast tanks to remove sediments is carried out, where practicable, in mid-ocean or under controlled arrangements in port or dry dock, in accordance with the provisions of the ship's Ballast Water Management Plan.				

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
• Ensure all infrastructure (e.g. arrays, streamers, tail buoys etc) that has been used in other regions is thoroughly cleaned prior to deployment.				

9.3.1.2.4 ROUTINE VESSEL DISCHARGES

The discharge of wastes to sea could create local reductions in water quality, both during transit to and within the survey area. Deck and machinery space drainage may result in small volumes of oils, detergents, lubricants and grease, the toxicity of which varies depending on their composition, being introduced into the marine environment. Sewage and gallery waste will place a small organic and bacterial loading on the marine environment, resulting in an increased biological oxygen demand.

These discharges will result in a local reduction in water quality, which could impact marine fauna in a number of different ways:

- Physiological effects: Ingestion of hydrocarbons, detergents and other waste could have adverse effects on marine fauna, which could ultimately result in mortality.
- Increased food source: The discharge of galley waste and sewage will result in an additional food source for opportunistic feeders, speciality pelagic fish species.
- Increased predator – prey interactions: Predatory species, such as sharks and pelagic seabirds, may be attracted to the aggregation of pelagic fish attracted by the increased food source.

The taxa most vulnerable to waste discharges are pelagic seabirds, turtles, and large migratory pelagic fish and marine mammals. Some of the species potentially occurring in the survey area, are considered regionally or globally 'Critically Endangered' (e.g. southern bluefin tuna, leatherback turtles and blue whales), 'Endangered' (e.g. Black-Browed and Yellow-Nosed Albatross, whale shark, shortfin mako shark, fin and sei whales), 'Vulnerable' (e.g. bigeye tuna, blue marlin, loggerhead turtles, oceanic whitetip shark, dusky shark, great white shark, longfin mako and sperm, Bryde's and humpback whales) or 'Near Threatened' (e.g. striped marlin, blue shark, longfin tuna/albacore and yellowfin tuna). Although species listed as 'Critically Endangered' or 'Endangered' may potentially occur in the survey area, due to their extensive distributions their numbers are expected to be low. Based on the low numbers of listed species, the sensitivity is considered to be medium.

The contracted survey / support vessels will have the necessary sewage treatment systems in place, and the vessel will have oil/water separators and food waste macerators to ensure compliance with MARPOL 73/78 standards. MARPOL compliant discharges would therefore introduce relatively small amounts of nutrients and organic material to oxygenated surface waters, which will result in a minor contribution to local marine productivity and possibly of attracting opportunistic feeders. The intermittent discharge of sewage is likely to contain a low level of residual chlorine following treatment but given the relatively low total discharge and rapid dilution in surface waters this is expected to have a minimal effect on seawater quality.

Furthermore, the survey area is suitably far removed from sensitive coastal receptors and the dominant wind and current direction will ensure that any discharges are rapidly dispersed north-westwards and away from the coast. There is no potential for accumulation of wastes leading to any detectable long-term impact.

Due to the distance offshore, it is only pelagic fish, birds, turtles and cetaceans that may be affected by the discharges, and these are unlikely to respond to the minor changes in water quality resulting from vessel discharges. The most likely animal to be attracted to the survey vessels will be large pelagic fish species, such as the highly migratory tuna and billfish, as well as sharks and odontocetes (toothed whales). Pelagic seabirds that feed primarily by scavenging would also be attracted.

Other types of wastes generated during the seismic survey activities will be segregated, duly identified transported to shore for ultimate valorisation and/or disposal at a licensed waste management facility. The disposal of all waste onshore will be fully traceable.

Based on the relatively small discharge volumes and compliance with MARPOL 73/78 standards, offshore location and high energy sea conditions, the potential impact of normal discharges from the survey / support vessels will be of very low intensity, immediate duration and regional in extent (although localised at any one time around the project vessels). The impact consequence is therefore considered very low.

This potential impact cannot be eliminated because the seismic / support vessels are needed to undertake the survey and will generate routine discharges during operations. With the implementation of the project controls and mitigation measures, the residual impact will remain of very low significance.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Routine vessel discharges	Operation	Low	Low	Low
Mitigation Measures				
• Implement leak detection and repair programmes for valves, flanges, fittings, seals, etc. • Use a low-toxicity biodegradable detergent for the cleaning of all deck spillages.				

9.3.1.3 UNPLANNED EVENTS

9.3.1.3.1 VESSEL STRIKES AND ENTANGLEMENT

The potential effects of vessel presence and towed equipment on turtles and cetaceans include physiological injury or mortality. The leatherback and loggerhead turtles that occur in offshore waters around southern Africa, and likely to be encountered in the proposed survey area are considered regionally 'Critically Endangered' and 'Near Threatened', respectively. However, due to their extensive distributions and feeding ranges, the numbers of individuals encountered during the survey are likely to be low. Consequently, the sensitivity of turtles is considered to be medium.

Thirty-three species or sub species/populations of cetaceans (whales and dolphins) are known or likely to occur off the West Coast. The majority of migratory cetaceans in South African waters are baleen whales (mysticetes), while toothed whales (odontocetes) may be resident or migratory. Of the 33 species, the blue whale is listed as 'Critically Endangered', the fin and sei whales are 'Endangered' and the sperm, Bryde's (offshore) and humpback whales are considered 'Vulnerable' (South African Red Data list Categories). Although the survey area is far removed from the coast, overlap with Child's Bank and the proximity to Tripp Seamount, where a greater number of individuals can be expected, the sensitivity of cetaceans to strikes is considered to be high.

The potential for collision between adult turtles and the seismic vessel, or entanglement of turtles in the towed seismic equipment and surface floats, is highly dependent on the abundance and behaviour of turtles in the survey area at the time of the survey. Due to their extensive distributions and feeding ranges, and the extended distance from their nesting sites, the number of turtles encountered during the proposed seismic surveys is expected to be low. Should collisions or entanglements occur, the impacts would be of high intensity for individuals but of low intensity for the population as a whole. Furthermore, as the duration of the impact would be limited to the immediate-term (4 months) and be restricted to the survey area, the potential for collision and entanglement in seismic equipment is therefore considered to be of very low consequence.

The potential for strikes and entanglement of cetaceans in the towed seismic equipment, is similarly highly dependent on the abundance and behaviour of cetaceans in the survey area at the time of the survey. Due to their extensive distributions and feeding ranges, the number of cetaceans encountered during the proposed seismic surveys is expected to be low. Should entanglements occur, the impacts would be of high intensity for individuals but of low intensity for the population as a whole. Furthermore, as the duration of the impact would be limited to the immediate-term (4 months) and be restricted to the survey area the potential for entanglement in seismic equipment is therefore considered to be of very low consequence.

The potential for collision with or entanglement by turtles and cetaceans during the seismic survey or the transit of the vessel to or from the survey area is deemed to be of low significance, due to the high sensitivity of the receptors, but very low likelihood of the impact occurring and the low consequence.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Vessel strikes and entanglement	Operation	Low	Low	Low
Mitigation Measures				
• The vessel operators should keep a constant watch for marine mammals and turtles in the path of the vessel. • Keep watch for marine mammals behind the vessel when tension is lost on the towed equipment and either retrieve or regain tension on towed gear as rapidly as possible. • Ensure that 'turtle-friendly' tail buoys are used by the survey contractor or that existing tail buoys are fitted with either exclusion or deflector 'turtle guards'. • Ensure vessel transit speed between the survey area and port is a maximum of 12 knots (22 km/hr), except in MPAs where it is reduced further to 10 knots (18 km/hr). • Should a cetacean become entangled in towed gear, contact the South African Whale Disentanglement Network (SAWDN) formed under the auspices of DEA to provide verbal specialist assistance in releasing entangled animals where necessary. • Report any collisions with large whales to the International Whaling Commission (IWC) database, which has been shown to be a valuable tool for identifying the species most affected, vessels involved in collisions, and correlations between vessel speed and collision risk.				

9.3.1.3.2 LOSS OF EQUIPMENT

During seismic acquisition, the survey vessel tows a substantial amount of equipment; the deflectors or paravanes, which keep the streamers equally spread are towed by heavy-duty rope, and the streamers themselves are towed by lead-in cables. Each streamer is fitted with a dilt float at the head of the streamer, numerous streamer mounts (birds and fins) to control streamer depth and lateral positioning, and a tail buoy to mark the end of the streamer. Streamers are neutrally buoyant at the required depth (5-10 m) but have buoyancy bags embedded within them that inflate at a depth of 40 m. If streamers are accidentally lost they would therefore float in the water column for some time before sinking. Dilt floats and tail buoys would ultimately be dragged down under the weight of the streamer.

Loss of equipment would likely take place during seismic acquisition within the survey area, which is located in the offshore marine environment, more than 40 km offshore at its closest point, far removed from any sensitive coastal receptors (e.g. key faunal breeding/feeding areas, bird or seal colonies and nursery areas for commercial fish stocks) The survey area lies well offshore where the pelagic and benthic ecosystem threat status is mainly considered as 'Least threatened', and where the deep-water habitat types are comparatively uniform and cover large areas. The benthic fauna beyond ~450 m depth are very poorly known and there are no species of commercial value occurring that far offshore. Sensitive deep-water coral communities would be expected with topographic features such as Tripp Seamount and Child's Bank. The sensitivity of benthic fauna is considered to be low.

Lost equipment could also pose an entanglement risk to migratory turtles and cetaceans transiting through the survey area. The taxa most vulnerable to entanglement in lost equipment are turtles and marine mammals. Some of the species potentially occurring in the survey area, are considered regionally or globally 'Critically Endangered' (e.g. leatherback turtles and blue whales), 'Endangered' (e.g. whale shark, fin and sei whales), or 'Vulnerable' (e.g. loggerhead turtles and sperm, Bryde's and humpback whales). Although species listed as

‘Critically Endangered’ or ‘Endangered’ may potentially occur in the survey area, entanglement is highly unlikely. In addition, due to their extensive distributions their numbers are expected to be low. Based on the low numbers of listed species, the sensitivity is considered to be medium.

The loss of equipment onto the seafloor would provide a localised area of hard substrate in an area of otherwise unconsolidated sediments. The availability of hard substrata on the seabed provides opportunity for colonisation by sessile benthic organisms and could provide shelter for demersal fish and mobile invertebrates thereby potentially increasing the benthic biodiversity and biomass in the continental slope and abyssal regions. The benthic fauna inhabiting islands of hard substrata in otherwise unconsolidated sediments of the outer shelf and continental slope are, however, very poorly known but would likely be different from those of the surrounding unconsolidated sediments. In the unlikely event of equipment loss, associated impacts would be of low intensity and be highly localised and limited to the site over the immediate-term(any lost object, depending on its size, will likely sink into the sediments and be buried over time). The impact consequence for equipment lost to the seabed is therefore considered very low.

The loss of streamers and floats would result in entanglement hazards in the water column before the streamers sink under their own weight. In the unlikely event of streamer loss, associated impacts would similarly be of low intensity and be highly localised and limited to the site (although would potentially float around regionally) over the immediate-term. The impact consequence for equipment lost to the water column is therefore considered very low.

With the implementation of the project controls and mitigation measures, the residual impact will remain of very low significance

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Release of diesel	Operation	Low	Low	Low
Mitigation Measures				
• Ensuring that loads are lifted using the correct lifting procedure and within the maximum lifting capacity of crane system. • Minimise the lifting path between vessels. • Undertake frequent checks to ensure items and equipment are stored and secured safely on board each vessel. • In the event that equipment is lost during the operational stage, assess safety and metocean conditions before performing any retrieval operations. Establishing a hazards database listing the type of gear left on the seabed and/or in the Reconnaissance Permit area with the dates of abandonment/loss and locations, and where applicable, the dates of retrieval				

9.3.1.3.3 RELEASE OF DIESEL

Marine diesel spilled in the marine environment would have an immediate detrimental effect on water quality, with the toxic effects potentially resulting in mortality (e.g. suffocation and poisoning) of marine fauna or affecting faunal health (e.g. respiratory damage). If the spill reaches the coast, it can result in the smothering of sensitive coastal habitats.

Accidental spills and loss of marine diesel during bunkering or in the event of a vessel collision could take place in the survey area and along the route taken by the survey and support vessels between the survey area and the logistics base at Saldanha Bay or Cape Town. The survey area is located in the offshore marine environment, more than 200 km offshore at its closest point, far removed from coastal MPAs and any sensitive coastal receptors (e.g. key faunal breeding/feeding areas, bird or seal colonies and nursery areas for commercial fish stocks); however, discharges could still directly affect migratory pelagic species transiting through the survey area. Diesel spills or accidents en route to the onshore supply base could result in fuel loss closer to shore, thereby potentially having Oil or diesel spilled in the marine environment will have an immediate detrimental effect on water quality. Being highly toxic, marine diesel released during an operational spill would negatively affect any marine fauna it comes into contact with. The taxa most vulnerable to hydrocarbon spills are coastal and pelagic seabirds. Some of the species potentially occurring in the survey area, are considered regionally or globally 'Critically Endangered' (e.g. Tristan Albatross, Cape Gannet) or 'Endangered' (e.g. Black-Browed and Yellow-Nosed Albatross, African Penguin, Bank and Cape Cormorant) or 'Vulnerable' (e.g. Hartlaub's Gull, Swift Tern). As Tripp Seamount is located ~50 km to the north of the proposed 3D the survey area, the sensitivity of marine fauna to diesel spill is considered to be high.

In the unlikely event of an operational spill or vessel collision, the magnitude of the impact would depend on whether the spill occurred in offshore waters where encounters with pelagic seabirds, turtles and marine mammals would be low due to their extensive distribution ranges, or whether the spill occurred closer to the shore where encounters with sensitive receptors will be higher. Based on the results of the oil spill modelling undertaken in the Orange Basin a diesel slick in the survey area would be blown in a north-westerly direction due to the dominant winds and currents in the survey area. The diesel would most likely remain at the surface for <36 hours with no probability of reaching sensitive coastal habitats. In offshore environments, impacts associated with a spill or vessel collision would thus be of low intensity, regional (depending on the nature of the spill) over the immediate-term (<5 days). The impact consequence for a marine diesel spill is therefore considered very low.

However, in the case of a spill or vessel collision en route to the survey area, the spill may extend into coastal MPAs and reach the shore affecting intertidal and shallow subtidal benthos and sensitive coastal bird species, in which case the intensity would be considered high, but still remaining regional over the immediate-term. The magnitude would however remain medium.

With the implementation of the project controls and mitigation measures, the residual impact will reduce to low significance for nearshore spills, and remain low for offshore spills.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Release of diesel	Operation	Medium	Low	Low
Mitigation Measures				

- Use low toxicity dispersants cautiously and only with the permission of DFFE.
- As far as possible, and whenever the sea state permits, attempt to control and contain the spill at sea with suitable recovery techniques to reduce the spatial and temporal impact of the spill
- Ensure adequate resources are provided to collect and transport oiled birds to a cleaning station.
- Ensure offshore bunkering is not undertake in the following circumstances:
  - Wind force and sea state conditions of ≥6 on the Beaufort Wind Scale;
  - During any workboat or mobilisation boat operations;
  - During helicopter operations;
  - During the transfer of in-sea equipment; and
  - At night or times of low visibility.

9.3.1.4 CONFOUNDING EFFECTS AND CUMULATIVE IMPACTS

The assessments of impacts of seismic sounds provided in the scientific literature usually consider short-term responses at the level of individual animals only, as our understanding of how such short-term effects relate to adverse residual effects at the population level are limited. Data on behavioural reactions to seismic noise acquired over the short-term could, however, easily be misinterpreted as being less significant than the cumulative effects over the long-term, i.e. what is initially interpreted as an impact not having a detrimental effect and thus being of low significance, may turn out to result in a long-term decline in the population, particularly when combined with other stressors (e.g. temperature, competition for food, shipping noise). Confounding effects are, however, difficult to separate from those due to seismic surveys.

Similarly, potential cumulative impacts on individuals and populations as a result of other seismic surveys undertaken either previously, concurrently or subsequently are difficult to assess. A significant adverse residual environmental effect is considered one that affects marine biota by causing a decline in abundance or change in distribution of a population(s) over more than one generation within an area. Natural recruitment may not re-establish the population(s) to its original level within several generations or avoidance of the area becomes permanent. Historic survey data for the West Coast is illustrated in **Figure 84**, which shows the 2D survey lines acquired between 2001 and 2018 and indicates 3D survey areas on the West Coast. Despite the density of seismic survey coverage over the past 17 years, the southern right whale population is reported to be increasing by 6.5% per year, and the humpback whale by at least 5% per annum over a time when seismic surveying frequency has increased, suggesting that, for these populations at least, there is no evidence of long-term negative change to population size as a direct result of seismic survey activities.

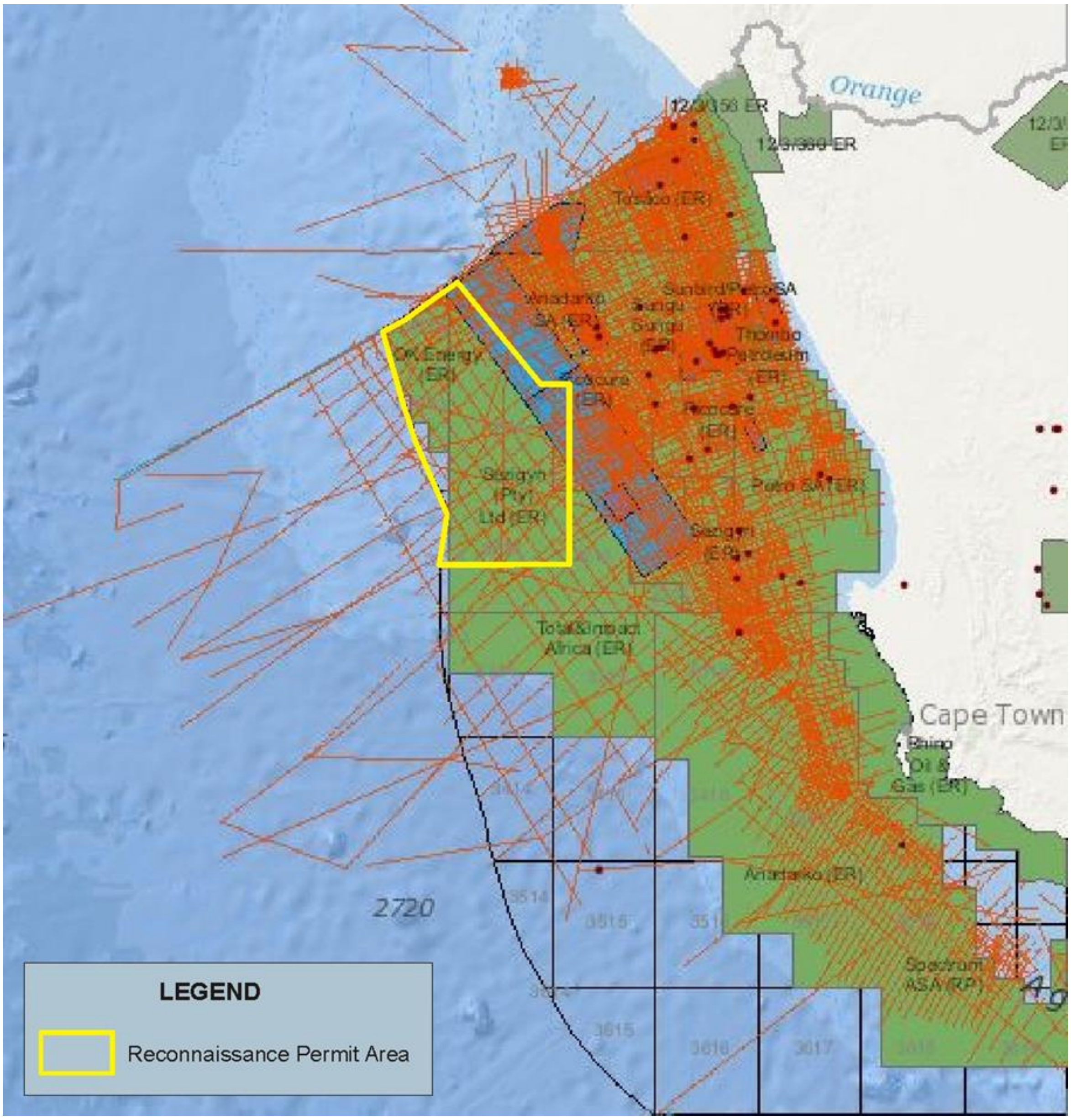

Figure 84: Proposed 3D survey area in relation to historical 2D (red lines) and 3D (blue and purple polygons) surveys conducted on the West Coast between 2001 and 2018 (Source: PASA).

Reactions to sound by marine fauna depend on a multitude of factors including species, state of maturity, experience, current activity, reproductive state, time of day. If a marine animal does react briefly to an underwater sound by changing its behaviour or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the population as a whole. However, if a sound source displaces a species from an important feeding or breeding area for a prolonged period, impacts at the population level could be significant. The increasing numbers of southern right and humpback whales around the Southern African coast, and their lingering on West Coast feeding grounds long into the summer, suggest that those surveys conducted over the past 17 years have not negatively influenced the distribution patterns of these two migratory species at least. Information on the population trends of resident species of baleen and toothed whales is unfortunately lacking, and the potential effects of seismic surveys on such populations remains unknown.

Consequently, suitable mitigation measures must be implemented during seismic data acquisition to ensure the least possible disturbance of marine fauna in an environment where the cumulative impact of increased background anthropogenic noise levels has been recognised as an ongoing and widespread issue of concern.

Should other concurrent seismic survey activities be undertaken in the Orange Basin, cumulative impacts can be expected.

Despite the difficultly in undertaking a reliable assessment of the potential cumulative environmental impacts of future seismic acquisition in the Deep Water Orange Basin due to likely variation in the scope, extent and duration of proposed surveys, the cumulative impacts of three potential surveys occurring concurrently needs to be considered.

The cumulative assessment table below assumes the worst case scenario of three surveys (Searcher, TGS and GX Technologies) occurring simultaneously during the summer survey window in 2022/23. In the unlikely event that multiple surveys would be undertaken concurrently within the Deep Water Orange Basin Area, associated impacts to marine fauna would be of high intensity and extend regionally, over the short-term (assuming they take place over the same summer survey window. The impact consequence for cumulative surveys is therefore considered medium.

9.3.2 IMPACTS ON FISHERIES

This section provides a description of the Fisheries Impacts identified by in the Fisheries Study. For a more detailed description of the impacts, please refer to the Fisheries Study undertaken by Capricorn Marine Environmental (Pty) Ltd included in **Appendix C**.

9.3.2.1 EXCLUSION FROM FISHING GROUND DUE TO TEMPORARY SAFETY ZONE AROUND SURVEY VESSEL

The acquisition of high-quality seismic data requires that the position of the survey vessel and the array be accurately known. Seismic surveys consequently require accurate navigation of the sound source over pre-determined survey transects. This, and the fact that the seismic source array and the hydrophone streamer need to be towed in a set configuration behind the tow-ship, means that the survey operation has little manoeuvrability whilst operating. For this reason, the vessel is considered as a fixed marine feature that is to be avoided by other vessels.

The safety zones aim to ensure the safety of navigation, avoiding or reducing the probability of damage to the towed streamer cables. The temporary exclusion of vessels from entering the safety zone around a seismic survey vessel poses a direct impact to fishing operations in the form of loss of exclusion from fishing grounds. A safety zone would be enforced around the seismic vessel for the duration of the project, resulting in the temporary exclusion of fishing operations in the vicinity of this zone around the vessel and towed array. The dimensions of the exclusion would be approximately 6 Nm ahead and astern and 2 Nm to either side of the survey vessel, resulting in a safety zone of approximately 165 km^2 around the survey vessel.

Based on the location of the proposed seismic survey area, there is no impact of exclusion from fishing grounds expected on the demersal trawl, midwater trawl, demersal longline, small pelagic purse-seine, tuna pole-line, line fish, west coast rock lobster or small-scale fisheries sectors.

Only one sector, namely the large pelagic longline sector, operates within the proposed seismic survey area. In the case of the large pelagic longline and tuna pole-line sectors, the targeted fish stock may only be available in a specific area for a specific period of time. Relocation to an alternative area may not be viable as the preferred area is predicated on the resource being available at a specific time and place. Based on the potential degree of disruption of exclusion from fishing grounds, the sensitivity of the large pelagic longline sector is considered to be high. Sensitivity herein refers to the ability of the fishing industry to operate as expected considering a project-induced change to their normal fishing operations. The sensitivity of a particular fishing sector to the impact of an exclusion zone would differ according to the degree of disruption to fishing operations. The current assessment considers this to be related to the type of gear used and the probability that the fishing operation can be relocated away from the affected area (the exclusion zone) into alternative fishing areas. For instance, the longline sector deploys sets unanchored, baited lines which drift with the surface water currents. These are set for an extended period before being recovered by the vessel. Such operations are particularly susceptible to exclusion than those more mobile operations (i.e. trawl nets are towed directly behind the vessel). Pelagic longline vessels set a drifting mainline, which may be up to 100 km in length, and while setting or hauling a longline the vessel's manoeuvrability is restricted. Thus, a vessel cannot easily manoeuvre out of the way of an approaching survey vessel.

The impact of short-term (temporary) loss of access to fishing ground is likely for the longline sector which targets large pelagic species (tuna, swordfish and shark). Based on the proportion of catch and effort across the proposed survey area, the impact of exclusion is assessed to be of medium intensity to the sector. The extent of the impact is considered to be regional in scale. Based on the combination of intensity, extent and duration of the impact, the magnitude of the impact is assessed to be medium for the large pelagic longline sector. Taking into consideration the impact magnitude and sensitivity of the sector, the overall impact significance is considered to be medium. The probability of the impact occurring is considered likely for large pelagic longline and tuna pole-line sector.

This potential impact cannot be eliminated because the seismic vessels are needed to undertake the survey and a safety zone will be enforced around the vessel during routine operations. With the implementation of the project controls and mitigation measures, the impact will remain of low significance for large pelagic longline sector.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Fisheries Exclusion: Large Pelagic Longline	Operation	Medium	Low	Low

Mitigation Measures

- At least three weeks prior to the commencement of seismic survey activities the following key stakeholders should be consulted and informed of the proposed seismic survey programme (including navigational co-ordinates of location, timing and duration of proposed activities) and the likely implications thereof (specifically the exclusion and safety zone around the seismic vessel):
  - Fishing industry associations: SA Tuna Association; SA Tuna Longline Association, Fresh Tuna Exporters Association, South African Deepsea Trawling Industry Association (SADSTIA), South African Hake Longline Association (SAHLLA).
  - Other key stakeholders: South African Navy Hydrographic Office (SANHO), South African Maritime Safety Association, Ports Authority and the DFFE Vessel Monitoring, Control and Surveillance Unit in Cape Town.
  - These stakeholders should again be notified at the completion of the project when the survey and support vessels are off location.
- Request, in writing, the SANHO to broadcast a navigational warning via Navigational Telex (Navtext) and Cape Town radio for the duration of the seismic survey activity.
- Distribute a Notice to Mariners prior to the commencement of the seismic survey operations. The Notice to Mariners should give notice of (1) the co-ordinates of the survey area, (2) an indication of the proposed survey timeframes, (3) the dimensions of the towed gear array and dimensions of the safety zone around the seismic vessel, and (4) provide details on the movements of support vessels servicing the project. This Notice to Mariners should be distributed timeously to fishing companies and directly onto vessels where possible.
- An experienced Fisheries Liaison Officer (FLO) should be placed on board the seismic or escort vessel to facilitate communications with fishing vessels in the vicinity of the seismic survey area.
- The lighting on the seismic and support vessels should be managed to ensure that they are sufficiently illuminated to be visible to fishing vessels, as well as ensure that it is reduced to a minimum compatible with safe operations.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
• Ensure project vessels fly standard flags and lights to indicate that they are engaged in towing surveys and are restricted in manoeuvrability. • Notify any fishing vessels at a radar range of 12 nm from the seismic vessel via radio regarding the safety requirements around the seismic vessel. • Implement a grievance mechanism in case of disruption to fishing or navigation.				

9.3.2.2 IMPACT OF SOUND ON CATCH RATES

In addition to the potential impacts of exclusion to fishing areas, international research has shown that the noise energy generated during seismic surveys may cause mortality, physiological damage, masking effects and/or behavioural responses in fish and invertebrates. As such, the possible effects of seismic sound on species relevant South African fisheries are considered. Differences in morphology and behaviour between species means that species vary in their vulnerability to seismic noise, and generalisations across groups are not easily made. The potential impact of elevated underwater sound on fish can be grouped into four types of effects:

- **Mortality or lethal effects**: life-threatening physical injuries, including death and severe physical injury. Fish mortality is associated with very high source noise levels and fish in close proximity to the noise source (for example, underwater explosions). Susceptibility to mortality at a particular sound level can vary between fish species, for example shellfish and fish without swim bladders can typically survive higher noise levels.
- **Physical (or physiological) effects**: non-life-threatening physical injuries, such as temporary or permanent auditory damage. The type and severity of physiological effects at different noise levels can differ between species. Some fish detect and respond to sound predominantly by detecting particle motion in the surrounding fluid while others are capable of detecting sound pressure via the gas bladder.
- **Masking effects**: the reduction in the detectability of a sound as a result of the simultaneous occurrence of another noise. Masking noise interferes with the ability of the animal to detect and respond to biologically important sounds.
- **Behavioural effects**: include perceptual, stress and indirect effects, of which the most common are startle responses or avoidance of an area. Behavioural responses can vary between species and sometimes extend over large distances, until the noise decreases below the background sound level.

Summarised below are some of the main findings relevant to the assessment of effects on fisheries:

- Generally, fish species with specialisations for sound pressure detection (e.g. swim bladder) have lower sound pressure thresholds and respond at higher frequencies than fishes lacking these morphological adaptations.
- Evidence suggests that pelagic species have more sensitive hearing (thresholds at lower frequencies) than demersal species.
- Cartilaginous fishes (e.g. sharks) have the highest sensitivity to low frequency sound (~20 Hz to ~1500 Hz) (Myrberg, 2001). Since this group lacks a swim bladder, their detection capabilities are restricted to the particle motion component of sound (Myrberg, 2001; Casper et al., 2012).
- A range of damaging physical effects due to airgun noise have been described for fish, including swim-bladder damage, transient stunning, short-term stress responses, temporary hearing loss, haemorrhaging, eye damage and blindness. However, studies have shown that physical damage to fish caused from seismic sources occurs only in the immediate vicinity of the airguns, in distances of less than a few meters (Gausland, 2003).

- Adult and juvenile fish have been shown to display several behavioural responses to seismic sound. These include leaving the area of the sound source by swimming away and changing depth distribution, changing schooling behaviour and startle responses to short range start up. Behavioural responses to seismic sound could lead to decreased catch rates if fish move out of important fishing grounds (Hirst and Rodhouse 2000).
- Studies indicate that offshore seismic survey activity had no effect on catch rates of crustaceans in the surrounding area (Andriguetto-Filho et al., 2005; Parry & Gason 2006), and little effect on reef invertebrates (crustaceans, echinoderms and molluscs) exposed to commercial seismic airgun noise (Wardle et al. 2001).
- The abundance and spatial distribution of fish and invertebrate larvae and eggs is highly variable and dependent on factors such as fecundity, seasonality in production, tolerances to temperature, length of time spent in the water column, hydrodynamic processes and natural mortality. Due to their importance in commercial fisheries, numerous studies have been undertaken experimentally exposing the eggs and larvae of various species to airgun sources (reviewed in McCauley, 1994). Physiological effects on eggs and larvae of a seismic array have been demonstrated to a distance of 5 m from the acoustic source (Kostyuchenko, 1971). When compared with total population sizes and natural daily mortality rates, the impact of seismic sound sources on fish eggs and larvae could be considered insignificant (McCauley, 1994; Dalen and Mæsted, 2008). The wash from ships propellers and bow waves can be expected to have a similar, if not greater, volumetric effect on plankton than the sounds generated by airgun arrays.
- For squid and other cephalopods a 2 - 5 km zone of acoustic influence is assumed around the acoustic source point.

Threshold levels for underwater noise impacts on fish have been the subject of research over many years, however much of that research has focused on the potential for physiological effects (injury or mortality) rather than on quantifying and relating noise levels with behavioural effects. A review of the literature and guidance on appropriate thresholds for assessment of underwater noise impacts is provided in the 2014 Acoustical Society of America (ASA) Technical Report *Sound Exposure Guidelines for Fishes and Sea Turtles* (Popper et al., 2014)[m].

The ASA Technical Report includes thresholds for mortality (or potentially mortal injury) as well as degrees of impairment such as temporary or permanent threshold shifts (TTS or PTS, indicators of hearing damage). Separate thresholds are defined for peak noise and cumulative impacts (due to continuous or repeated noise events) and for different noise sources (e.g. explosives, pile driving, and continuous vessel noise, drilling or dredging). In relation to fish behavioural impacts, the ASA Technical Report includes a largely qualitative discussion, focusing on long term changes in behaviour and distribution rather than startle responses or minor movements. The ASA qualitative approach to responses to seismic airguns includes definitions of effects at three distances from the source defined in relative terms: Near (N): this distance typically refers to fish within tens of meters from the noise source; Intermediate (I): distances within hundreds of meters from the noise source; and Far (F): fish within thousands of meters (kilometres) from the noise source. The risk is described qualitatively as low, moderate or high.

Sensitivity and hearing range is highly variable amongst fish species. Fish species which may be affected by underwater disturbances may broadly be grouped into three categories; cartilaginous fish without gas-filled chambers or swim bladders, fish with swim bladders where hearing is independent of gas-filled chambers or swim bladders, and lastly fish which are most sensitive to sound pressure through otophysic connections between pressure receptive organs and the inner ear data indicates that fish possessing a swim bladder are more sensitive to impulsive sounds, such as those generated by seismic sources, than fish without swim bladders. Based on the noise exposure criteria, relatively high to moderate behavioural risks to fish without a swim bladder are expected at near to intermediate distances (tens to hundreds of meters) from the source

[m] See also: Hawkins, A.D., Pembroke, A.E. and A.N. Popper. 2014. Information gaps in understanding the effects of noise on fishes and invertebrates. Rev Fish Biol Fisheries (2015) 25:39-64

location. Relatively low behavioural risks are expected at far field distances (thousands of meters) from the source location. For fish species with a swim bladder that is involved in hearing, relatively high behavioural risk is expected at near to intermediate distances, and moderate behavioural risk at far field distances from the source.

Studies have shown that physical damage to fish caused from acoustic sources occurs only in their immediate vicinity, in distances of less than a few meters. Whilst adult fish can flee from this noise, eggs and larvae are unable to do so and therefore may be affected by an acoustic pulse.

A number of studies have reported reductions in catch rates of fish during and after seismic surveys. The observed declines in catch rates differed considerably from study to study as did the distance from the seismic sound source at which reductions in catch rates were measured. Hirst and Rodhouse (2000) compiled the results of a number of results from experiments, which indicated a range from 1 km to greater than 33 km. The observed duration of impacts ranged from approximately 12 hours to up to 10 days. Variability in findings is related to the sensitivity of different fish species to noise, the gear-type used across different fisheries, and abiotic factors e.g. water depth, which affects the transmission of sound in water.

Avoidance effects or behavioural alterations from seismic surveys involving many fish species do not automatically imply risk factors and thus do not necessarily cause a disturbance to the fishery (McCauley et al., 2000). A recent large-scale experiment conducted by Meekan et al. (2021) in Australia showed no short-term or long-term effects on the abundance or behaviour of demersal fish assemblages in response to a commercial seismic source. This suggests that seismic surveys have little impact on demersal fishes. Other studies that found no evidence of significant changes in catch rates or fish abundance include Hassel et al. 2004, Picket et al. 1994, Miler and Cripps 2013 and Thomson et al. 2014.

The greatest risk of physiological injury from seismic sound sources is for species with swim-bladders (e.g. hake and other demersal species targeted by demersal longline and demersal trawl fisheries). In many of the large pelagic species, swim-bladders are either underdeveloped or absent and the risk of physiological injury through damage of this organ is therefore lower. However, two of the four tuna species targeted in South African fisheries, *Thunnus albacares* (yellowfin) and *T. obesus* (bigeye), do have swim bladders and so may be physically vulnerable.

In the case of the large pelagic longline and tuna pole-line sectors, the targeted fish stock may only be available in a specific area for a specific period of time. Relocation to an alternative area may not be viable as the preferred area is predicated on the resource being available at a specific time and place. Noise would be expected to attenuate to below threshold levels for behavioural disturbance before reaching inshore recruitment and/or nursery areas. Due to the location of the Reconnaissance Permit area in the deepwater environment, sound generated during the survey is not expected to influence the spawning behaviour or migration route of snoek (a species of key importance to the line fish and small-scale fisheries sectors). The proposed survey area is situated well offshore of the shelf break which is where snoek are known to spawn during winter-spring.

The sensitivity of the large pelagic longline sector is considered to be high. Noise levels are expected to drop to below threshold levels for behavioural disturbance before reaching areas fished by the remaining sectors viz. demersal trawl, midwater trawl, demersal longline, small pelagic purse-seine, tuna pole-line, traditional line fish, west coast rock lobster, small-scale fisheries and netfish sectors (beach-seine and gillnet).

The magnitude of the impact of sound on catch rates for these sectors is assessed to be medium for the large pelagic longline sector and of overall medium significance. There is no impact expected on the demersal trawl, midwater trawl, demersal longline, small pelagic purse-seine, tuna pole-line, traditional line fish, west coast rock lobster, small-scale fisheries and netfish sectors.

The residual impact of sound produced during the proposed survey is assessed to be of low overall significance to the large pelagic longline sector. There is no impact expected on the demersal trawl, midwater trawl, demersal longline, small pelagic purse-seine, tuna pole-line, traditional line fish, west coast rock lobster, small-scale and netfish sectors.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Impact of Seismic Source Sound on Fishing Operations: Large Pelagic Longline Sector	Operation	Medium	Low	Low
Impact of Seismic Source Sound on Fishing Operations: Demersal Trawl, Midwater Trawl, Demersal Longline, Small Pelagic Purse-Seine, Tuna Pole-Line, Line fish, West Coast Rock Lobster, Small-Scale Fisheries, Netfish	Operation	No Impact	No Impact	No Impact

Mitigation Measures

- At least three weeks prior to the commencement of seismic survey activities the following key stakeholders should be consulted and informed of the proposed seismic survey programme (including navigational co-ordinates of location, timing and duration of proposed activities) and the likely implications thereof (specifically the exclusion and safety zone around the seismic vessel):
  - Fishing industry associations: SA Tuna Association; SA Tuna Longline Association and Fresh Tuna Exporters Association.
  - Other key stakeholders: SANHO, SAMSA, National Ports Authority and the DFFE Vessel Monitoring, Control and Surveillance Unit in Cape Town.
  - These stakeholders should again be notified at the completion of the project when the survey and support vessels are off location.
- Request, in writing, the broadcast by SANHO of a navigational warning via Navigational Telex (Navtext) and Cape Town radio for the duration of the seismic survey activity.
- Distribute a Notice to Mariners prior to the commencement of the seismic survey operations. The Notice to Mariners should give notice of (1) the co-ordinates of the survey area, (2) an indication of the proposed survey timeframes, (3) the dimensions of the towed gear array and dimensions of the safety zone around the seismic vessel, and (4) provide details on the movements of support vessels servicing the project. This Notice to Mariners should be distributed timeously to fishing companies and directly onto vessels where possible.
- An experienced FLO should be placed on board the seismic or escort vessel to facilitate communications with fishing vessels in the vicinity of the seismic survey areas.
- Implement a “soft-start” procedure of a minimum of 20 minutes’ duration on initiation of the seismic source if during daylight hours it is confirmed visually by the MMO during the pre-acquisition watch (60 minutes) that there are no slow swimming large pelagic fish within 500 m of the seismic source.
- In the case of slow swimming large pelagic fish being observed within the mitigation zone, delay the “soft-start’ until animals are outside the 500 m mitigation zone.
- Terminate seismic source on
  - Observation of slow swimming large pelagic fish (including whale sharks, basking sharks, and manta rays) within the 500 m mitigation zone.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance

- Observation of any obvious mass mortalities of fish (specifically large shoals of tuna or surface shoaling small pelagic species such as sardine, anchovy and mackerel) when estimated by the MMO to be as a direct result of the survey.
- For slow swimming large pelagic fish, terminate source until such time as the animals are outside of the 500 m mitigation zone (seismic "pause", no soft-start required). If visual confirmation is not possible implement a seismic pause of 4 minutes.

- For the duration of the survey, circulate a daily survey schedule (look-ahead), via email, to key fishing associations.
- Establish a functional grievance mechanism that allows stakeholders to register specific grievances related to operations, by ensuring they are informed about the process and that resources are mobilized to manage the resolution of all grievances, in accordance with the Grievance Management procedure.

9.3.2.3 UNPLANNED EVENTS

9.3.2.3.1 ACCIDENTAL RELEASE OF OIL AT SEA

Small instantaneous spills of marine diesel at the surface of the sea can potentially occur during operation during bunkering and such spills are usually of a low volume. Larger volume spills of marine diesel could occur in the event of a vessel collision or vessel accident.

Oil spilled in the marine environment would have an immediate detrimental effect on water quality, with toxic effects potentially resulting in mortality (e.g. suffocation and poisoning) or sub-lethal (e.g. respiratory damage) effects on marine fauna. An oil spill can also result in several indirect impacts on fishing. These include:

- Exclusion of fisheries from polluted areas and displacement of targeted species from normal feeding / fishing areas, both of which could potentially result in a loss of catch and / or increased fishing effort;
- Mortality of animals (including eggs and larvae) leading to reduced recruitment and loss of stock (e.g. mariculture); and
- Gear damage due to oil contamination.

Oil contamination could potentially have the greatest impact on commercial fisheries for rock lobster and sessile filter feeders (e.g. mussels) and grazers (e.g. abalone). Mortality is expected to be high on filter feeders and, to a lesser extent, grazers. These species have low mobility and no means to escape contamination and ultimately mortality. Thus, mariculture facilities could be impacted if a spill extended into these areas. For a large oil spill, fishing / mariculture activities and revenues could be affected over a wide area until such time as the oil has either been dispersed or broken down naturally.

The sensitivity of the various fishing sectors that operate in the survey areas is considered to be medium, as a diesel slick would be blown in a north-westerly direction due to the dominant winds and currents off the West Coast, remaining at the surface for less than 36 hours. Both Saldanha Bay and St Helena Bay support near shore mariculture activities. These activities are far removed from the survey area and proposed operation activities (e.g. bunkering) and as such the sensitivity for mariculture is considered to be medium.

The potential impact on the offshore fishing sectors is considered to be of local extent for small instantaneous spills and regional for larger volume spills and of low intensity in the short-term. Thus, in offshore waters, the magnitude of a small spill on all fisheries is considered to be very low. Based on the medium sensitivity of receptors and the very low magnitude, the potential impact on commercial fishing are of very low significance without mitigation.

The effects of an oil spill would, however, potentially have the greatest impact on sessile filter feeding (e.g. mussels and oysters) and grazing species (e.g. abalone) resulting in mortality through physical clogging and or direct absorption. In the case of a spill en route to the survey area (during a vessel accident), the spill may reach the shore affecting mariculture operations, abalone and mussel harvests and small-scale sectors. In this case the intensity would be considered high, but of local extent over the short-term. In nearshore waters, the magnitude of a small accidental spill is expected to be low. Based on the medium sensitivity of receptors and the low magnitude, the potential impact on a nearshore spill of low significance without mitigation.

With the implementation of the above-mentioned intrinsic mitigation measures the residual impact would be of very low significance for offshore spills and low for nearshore spills

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Impact of Accidental Release of Oil at Sea on Fisheries Sectors (Offshore)	Operation	Low	Low	Low
Impact of Accidental Release of Oil at Sea on Fisheries Sectors (Nearshore)	Operation	Low	Low	Low
Mitigation Measures				

• Ensure personnel are adequately trained in both accident prevention and immediate response, and resources are available on each vessel.
• Use low toxicity dispersants.
• Ensure adequate resources are provided to collect and transport oiled birds to a cleaning station.
• Ensure offshore bunkering is not undertake in the following circumstances:
  ○ Wind force and sea state conditions of ≥6 on the Beaufort Wind Scale;
  ○ During any workboat or mobilisation boat operations;
  ○ During helicopter operations;
  ○ During the transfer of in-sea equipment; and
  ○ At night or times of low visibility.
• Ensure that solid streamers rather than fluid-filled streamers are used. Alternatively, low toxicity fluid-fill streamers could be used.				

9.3.2.3.2 LOSS OF EQUIPMENT AT SEA

During seismic acquisition, the survey vessel tows a substantial amount of equipment; the deflectors or paravanes, which keep the streamers equally spread are towed by heavy-duty rope, and the streamers themselves are towed by lead-in cables. Each streamer is fitted with a dilt float at the head of the streamer, numerous streamer mounts (birds and fins) to control streamer depth and lateral positioning, and a tail buoy to mark the end of the streamer. Streamers are neutrally buoyant at the required depth but have buoyancy bags embedded within them that inflate at depth. If streamers are accidentally lost, they would float in the water column for some time before sinking. Dilt floats and tail buoys would ultimately be dragged down under the weight of the streamer.

Seismic sources are suspended under floats by a network of ropes, cables, and chains, with each float configuration towed by an umbilical. Should both the float and umbilical fail, the seismic source would sink to the seabed.

The potential impacts (direct) associated with lost equipment include potential snagging of demersal gear with regards to equipment that sinks to the seabed and potential entanglement hazards with regards to lost streamers, arrays and tail buoys drifting on the surface or in the water column.

The accidental loss of equipment onto the seafloor would provide a localised area of hard substrate in an area of otherwise unconsolidated sediments. The survey area does not coincide with fishing grounds of any demersal fishing sectors thus snagging of demersal gear is considered to be unlikely.

The loss of streamers and floats could result in entanglement hazards in the water column before the streamers sink under their own weight. In the unlikely event of streamer loss, associated impact could be highly localised and limited to the site (although would potentially float around regionally) over the short-term. The impact magnitude for equipment lost to the water column is, therefore, considered small and of very low overall significance to the large pelagic longline fishery. The implementation of the mitigation measures will reduce the impact; however, the residual impact will remain of small magnitude and of very low significance.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Impact on Fisheries Sectors of Loss of Equipment at Sea.	Operation	Low	Low	Low
Mitigation Measures				
• Ensuring that loads are lifted using the correct lifting procedure and within the maximum lifting capacity of the crane system. • Minimise the lifting path between vessels. • Undertake frequent checks to ensure items and equipment are stored and secured safely on board each vessel. • Retrieval of lost objects / equipment, where practicable, after assessing the safety and metocean conditions. Establish a hazards database listing the type of gear left on the seabed and / or in the survey area with the dates of abandonment / loss and locations and, where applicable, the dates of retrieval. • Notify SANHO of any hazards left on the seabed or floating in the water column, and request that they send out a Notice to Mariners with this information. • Ensure at a minimum, one FLO person should be present on board the seismic or escort vessel to facilitate communication with the fishing vessels that are in the area.				

9.3.2.4 CUMULATIVE IMPACTS

The impacts on each of the above fishing sectors could be increased due to the combination of impacts from other projects that may take place during the same period. Cumulative impacts include past, present and future planned activities which result in change that is larger than the sum of all the impacts. Cumulative effects can occur when impacts are 1. Additive (incremental); 2. Interactive; 3. Sequential or 4. Synergistic and would include anthropogenic impacts (including fishing and hydrocarbon industries) as well as non-anthropogenic effects such as environmental variability and climate change.

In the Benguela region, it has been suggested that the seasonal movement of Longfin Tuna northwards from the west coast of South Africa into southern Namibia may be disrupted by the noise associated with an increasing number of seismic surveys. While the potential exists to disrupt the movement of Longfin Tuna in the Benguela, this disruption, if it occurs, would be localised spatially and temporarily and would be compounded by environmental variability. In Australia, no direct cause and effect in changes in movement or availability of Bluefin Tuna could be attributed to seismic surveys, with observed changes being attributed to inter-annual variability. Due to the dearth of information on the impacts of seismic noise on truly pelagic species links between changes in migration patterns and subsequent catches thus remains speculative.

This said, there is the possible chance of an increase in disturbance and disruption to fisheries active in the area and pressure on local services and facilities should additional exploration activities commence (by other applicants or existing exploration right holders) in a relatively short period. It is, however, unlikely that concurrent seismic surveys will be undertaken in the same area during the same survey window.

Concurrent activities such as other planned speculative or proprietary seismic surveys in the Orange Basin could add to the cumulative impact on fisheries, especially if the activities are concurrent. Although it is unlikely that concurrent seismic surveys would be undertaken in the same area during the same survey window, the current report includes an assessment of the cumulative impact on fisheries during simultaneous operations of three regional seismic surveys off the west coast. Simultaneous survey operations would result in an increase in the extent and magnitude of the impact on the large pelagic longline sector. The impact duration would remain unchanged. Three seismic surveys of regional extent, undertaken simultaneously, could be expected to result in an impact of medium negative significance on the large pelagic longline sector, both with and without the application of mitigation measures. Once completed there is not expected to be any residual impact.

9.3.3 IMPACTS ON HERITAGE

This section provides a description of the Heritage Impacts identified by in the HIA. For a more detailed description of the impacts, please refer to the HIA undertaken by PGS Heritage (Pty) Ltd included in **Appendix C**.

9.3.3.1 IMPACTS ON CULTURAL HERITAGE

It must be noted that a large section of the affected communities not only view themselves as small-scale fishers but also as indigenous people and, as such, are intrinsically linked to the ocean and the land they have lived on for centuries. The resurgence movement through which Khoi and San descendants are reclaiming their identity has in recent decades afforded these communities the ability to re-establish their cultural roots and grounding in an ancient landscape. This sentiment is echoed in the founding affidavit submitted (5 February 2022) during the appeal submitted to the first Searcher application by CJ Adams. It notes that the ocean is not only important for fishing but also has spiritual meaning and is a place of healing and holds healing powers for the indigenous communities. It further expanded that the ocean and its resources play an important part in their community's history and heritage.

Community identity and culture are thus strongly linked to the ocean and what it can provide, physically and spiritually. Communities have coexisted with the ocean for generations. This existence has created a culture and heritage that defines their way of living, community, and kinship unique to the West Coast of South Africa. Cook (2001) describes this as maritimity, a process whereby the sum of cultural adaptations made by coastal populations becomes imbued with meaning and culture. This is evident in community structures, cultural events, and seasonal activities.

The public meetings and focused discussions with communities and their constituents have shown that these communities and groupings are struggling economically due to decades of turmoil in the fishing industry. An industry plagued by the closing of fish processing plants, fishing licence and quota issues, and diminishing catches due to environmental and industrial impacts, to name a few. This economic downturn leads to social issues within the communities. Foremost are poverty, loss of social fabric, substance abuse, teenage pregnancies, and violence. In all the interviews, the above issues were raised as central to their social existence and community experience.

Considering the Article 8(j) and 10I Convention on Biological Diversity (29 December 1993), of which South Africa has been a signatory since 1995, the need to "…respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices'" must be considered within the available South African legislation. As such, section 3 (2) of the National Heritage Resources Act 25 of 1999 (NHRA) considers heritage resources that are part of the national estate to include:

- Places to which oral traditions are attached or which are associated with living heritage:
- Or as per subsection 3, has cultural significance or other special values because of –
    - its importance in the community or pattern of South Africa's history;
    - its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
    - its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
    - its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
    - its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
    - its importance in demonstrating a high degree of creative or technical achievement at a particular period;
    - its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons; and
    - its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.

Culture is more than just the tangible but is also shared beliefs, values, language, traditions, functionality, meaning and community connections. Considering the various values and heritage significance as listed in section 3(3) of the NHRA, the cultural and living heritage associated with the communities and indigenous people along the southwestern and west coast of South Africa holds heritage significance. It is part of the national estate and holds importance as a way of life for small-scale fishers and Khoisan descendants alike. The physical and spiritual interaction with the ocean and the shorelines through millennia resulted in a maritimity that developed into the cultural fabric as they experience it today.

The significance of such intangible and living cultural heritage features can potentially have a combined heritage grading of Grade II or even Grade I through further research. However, grading inevitably implies the investigation into and consideration of a Provincial or Heritage declaration of significance for a largely intangible cultural heritage. This is problematic as the NHRA provides for the proclamation/declaration of place, objects, or structures as Provincial or National Heritage Sites and only refers to intangible/living heritage relating to such place, objects, or structures.

The cultural heritage and living heritage related to the communities linked to fisheries and ocean subsistence and further identifying as indigenous communities can potentially be impacted by the proposed project. This impact is indirect and is in the community perceived to be primarily linked to their economic existence as a result in the loss of fishing yield. Investigation and discussion have shown that the historic economic decline of fisheries has resulted in the loss of social cohesion, activities, and traditions.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Impact on Cultural Heritage	Operation	Medium	Low	Low
Mitigation Measures				

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
• Implement recommended mitigation measures as listed in the other specialist reports for the project. • Re-assess post-project the potential effects on the identified communities and their intangible cultural heritage. This will require consideration of the socio-economic baseline developed during the previous survey and this environmental impact process. Based on the outcomes, provide resources and support to enhance the mitigation capacity of communities' intangible cultural heritage by fostering dialogue, mutual understanding and reconciliation between and within communities. • Based on the outcomes, provide resources and support for communities to develop and undertake safeguarding measures or plans to enhance the mitigation capacity of their intangible cultural heritage by fostering dialogue, mutual understanding and reconciliation between and within communities.				

9.3.3.2 CUMULATIVE HERITAGE IMPACTS

The heritage specialist is aware of at least one other current application and the potential of another application soon occurring in the Orange Basin. Communities have expressed a definite concern about the multiple applications occurring in their fishing waters and the potential long-term effect of these surveys resulting in Oil and Gas companies starting applications for production rights based on the findings of these reconnaissance surveys. It is foreseeable that continued seismic surveys could add to the overall load of impacts on fish population that indirectly could impact community livelihoods and thus their way of living and cultural heritage. At this stage, cumulative impacts are purely speculative. Still, the potential for the future increase in cumulative impacts due to current and future seismic surveys and the potential for future Oil and Gas production cannot be excluded but needs to be quantifiable at this stage for cultural heritage.

9.3.4 SOCIAL IMPACTS

Social impacts are the result of social change, and to fully understand the potential impacts it is important to know the impact pathways. A social change process is a discreet, observable and describable process that changes the characteristics of a society, taking place regardless of the societal context (that is, independent of specific groups, religions etc.). Social change processes can be measured objectively. The way in which social change processes are perceived, given meaning or valued, depend on the social context in which various societal groups act. Some groups in society are able to adapt quickly and exploit the opportunities of a new situation. Others (e.g. vulnerable groups) are less able to adapt and will bear most of the negative consequences of change. These social change processes may, in certain circumstances and depending on the context, lead to the experience of social impacts. Social impacts are therefore completely context-dependent.

9.3.4.1 UNCERTAINTY

The fishing communities continue to be uncertain about the impact that the seismic survey will have on their livelihoods. Any event that impacts marine life are seen as suspicious and attributed to seismic surveys (whether the surveys were taking place or not.) Although the marine fauna and fisheries reports indicate that low to negligible impacts on marine life and that all the impacts are reversible, many fishing communities feel that there is still not enough information available to them to determine whether the surveys had an impact on their activities. They want to have some definitive answers about the potential impacts from specialists and research that Searcher has conducted with DFFE in 2024. There is a high level of uncertainty about the future of the ocean, which causes great concern and distress amongst the fishing communities, especially because the uncertainty is related to their livelihoods, and they are already struggling to make ends meet. Uncertainty also takes its toll on people psychologically and may result in mental health issues for some people in the long run.

The marine fauna report indicates that low to negligible impacts on marine life and that all the impacts are reversible. However, even a temporary change in the patterns of the fish can cause great hardship in these communities. According to them, the fish can either go deeper in the sea to get away of the source of noise, which would be a tragedy for them, or they can go closer to the shore, which would be beneficial for them. No-one can predict with certainty how the fish would respond to the noise, just that they would try to move away from the source.

The impact of seismic surveys on the catchability of marine fish is a contentious issue for communities, with some claims that seismic surveys may negatively affect catch rates. However, little empirical evidence exists to quantify the impact or identify the mechanisms of such impact. The communities feel that there is simply not sufficient data available to negate or substantiate these claims and much more research on the topic is needed, especially from a local perspective. The consensus seems to be that there is a great knowledge gap in this regard. Community members feel that companies doing seismic surveys or those who have an interest in the data obtained through seismic surveys can make a great contribution to scientific knowledge of this field by collaborating and/or funding independent research on the topic in South African waters.

People's livelihoods are already impacted by external factors such as fishing quotas, climate change, commercial over-fishing, mining in the sea and the recent Covid pandemic. They fear that the seismic surveys will contribute to an already dire situation and be a tipping point that will render them helpless and without their last source of income. They see seismic surveys as a gateway to oil and gas exploration and are concerned about the potential impacts that the results of the seismic surveys can unlock. There is a high level of uncertainty about the future of the ocean, which causes great concern and distress amongst the fishing communities, especially because the uncertainty is related to their livelihoods, and they are already struggling to make ends meet. Uncertainty also takes its toll on people psychologically and may result in mental health issues for some people in the long run.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
Uncertainty	Operation	High	Medium	Medium
Mitigation Measures				
• Searcher should continue to implement the community engagement protocol that they developed in 2023. This protocol aims to address the impact on vulnerable groups and uncertainty, and also have an educational component. • There should be a grievance mechanism available for the duration of the seismic surveys. • Searcher should contribute to assisting with collaboration on independent research on how fish species on the West Coast such as snoek respond to seismic surveying. Searcher will further contact relevant scientific research institutions to offer the potential of collaborating in independent on-water research during the survey. • Consult with communities on potential ways in which to make a positive contribution to the communities.				

9.3.4.2 FURTHER MARGINALISATION OF VULNERABLE GROUPS

Many of the people on the West Coast belong to the Khoe or the San people. Most of the Khoe people were traditionally cattle or sheep herders, while the San people were traditionally hunters and gatherers (www.san.org). They were the first inhabitants of southern Africa and one of the earliest distinct groups of homo sapiens. They have endured centuries of gradual dispossession at the hands of waves of new settlers, including the Bantu, whose descendants make up most of the black population of South Africa. The process of land distribution instituted by the Government since 1994 has largely excluded the Khoe and the San people, as the government has not acknowledged them as the country's first peoples and their land was mostly taken before the apartheid era. There is a growing movement of indigenous activists that believe it is time to rightfully claim their traditional land.

One of the Khoe and San's biggest challenges is the racial classification system used in South Africa. They are being classified as 'Coloured' - a label that was used during Apartheid for citizens that did not fit the binary race model and included mixed-race children and Afrikaans-speaking non-whites. This categorisation condemned much of the Khoe and San's history to oblivion and facilitated the appropriation of their land. It excluded them from land restitution as it was conceived to be a benefit to black South Africans, and they were not considered to be black. As such the Khoe and San are considered to be very vulnerable and marginalised groups. Being marginalised means that they may easily be overlooked by corporate groups or businesses unfamiliar with the local history. Their needs, their views and even themselves as a stakeholder group can easily be omitted – both intentionally and unintentionally. In Searcher's previous application for a seismic survey in the area the Khoe and San felt that they were not consulted with. Therefore, they are sceptic about Searcher's intentions. They felt that they were discriminated against by not being consulted during the previous application, deepening their status as marginalised groups, and causing distraught to them as groups. Many of the fishers are of Khoe and San descendance, and they feel that they simply cannot win in any situation – whether it is fishing rights, land rights or culture identity.

With increasing interest in the West Coast area by seismic surveyors, which is viewed as the precursor for oil and gas companies to start developing the area, these communities risk increased marginalisation and an increase in vulnerability with every application where their voices are not being heard. They feel that currently they need to fight to make their voices heard. They have been using legal avenues, as they feel that just speaking up is not effective and has failed to give them the desired outcomes. Communities feel that their cultural heritage is threatened.

The San has published the San Code of Research Ethics that provides a guideline for researchers and companies that want to work in their sphere of influence on how to conduct themselves and how to interact with the San. An EA application is also viewed as a form of research. This guideline can be applied to the Khoe and other people in the fishing communities as well. The San Code of Research Ethics is based on:

- Respect for individuals, community and culture;
- Honesty;
- Justice and fairness;
- Care; and
- Process (following San research protocol).

A lack of care can be demonstrated by talking down to communities, confusing them with complicated scientific language, or treating communities as ignorant. A lack of care is also represented by failing to ensure that something is left behind that improves the live of the San.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
Further marginalization	Operation	High	Medium	Medium
Mitigation Measures				
• Searcher should continue to implement the community engagement protocol that they developed in 2023. This protocol aims to address the impact on vulnerable groups and uncertainty, and also have an educational component. • There should be a grievance mechanism available for the duration of the seismic surveys. • Searcher should contribute to assisting with collaboration on independent research on how fish species on the West Coast such as snoek respond to seismic surveying. Searcher will further contact				

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
relevant scientific research institutions to offer the potential of collaborating in independent on-water research during the survey. • Consult with communities on potential ways in which to make a positive contribution to the communities. • Searcher should initiate discussions in their industry. The seismic survey industry should reassess their position and social licence to operate as an industry in a South African context and conduct a strategic environmental assessment of the impact of the industry and embark on an awareness raising and education campaign. Having meetings will not be sufficient. Participatory processes and workshops where communities can engage in experiential learning should be considered. If the seismic survey industry fails to address the community's need for education and cooperation it will result in significant delays and increase the risk for social unrest.				

9.3.4.3 IMPACT ON LIVELIHOODS

A livelihood refers to the way of life of a person or household and how they make a living, in particular, how they secure the basic necessities of life, e.g., their food, water, shelter and clothing, and live in the community. The coastal communities in the area of interest are mostly fishing communities that make their livelihoods from the sea and have been doing so for generations. They rely on the ocean for food and economic security, as well as their identity and heritage. They know how to make a living from the sea. If it is no longer possible for them to make a living from the sea, or if their ability to make a living from the sea is reduced it will result in a great increase in poverty in the area as there are very limited alternative options for them to make a livelihood. This makes these communities extremely vulnerable. Furthermore, an increase in poverty in the area will place an additional burden on taxpayers.

The small-scale fishers can go approximately 75 km offshore with their boats. Some of them have indicated that they already sometimes need to go further to be able to make a catch, which is not only more expensive for them in terms of the diesel required for their boats, but it is also more dangerous. In the mining areas around Port Nolloth they are struggling to get access to the sea and the areas where they are allowed to fish are getting smaller. Livelihoods are already compromised due to the fishing quota system, over-fishing, lack of employment opportunities, pollution, effects of climate change and the recent Covid 19 pandemic.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
Impact on livelihoods	Operation	Medium	Medium	Medium
Mitigation Measures				
• Searcher should continue to implement the community engagement protocol that they developed in 2023. This protocol aims to address the impact on vulnerable groups and uncertainty, and also have an educational component. • There should be a grievance mechanism available for the duration of the seismic surveys. • Searcher should contribute to assisting with collaboration on independent research on how fish species on the West Coast such as snoek respond to seismic surveying. Searcher will further contact relevant scientific research institutions to offer the potential of collaborating in independent on-water research during the survey. • Consult with communities on potential ways in which to make a positive contribution to the communities.				

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
• Searcher should initiate discussions in their industry. The seismic survey industry should reassess their position and social licence to operate as an industry in a South African context and conduct a strategic environmental assessment of the impact of the industry and embark on an awareness raising and education campaign. Having meetings will not be sufficient. Participatory processes and workshops where communities can engage in experiential learning should be considered. If the seismic survey industry fails to address the community's need for education and cooperation it will result in significant delays and increase the risk for social unrest.				

9.3.4.4 IMPACTS ON SENSE AND SPIRIT OF PLACE

Sense of place refers to an individual's personal relationship with his/her local environment, both social and natural, which the individual experiences in his/her everyday daily life (Vanclay et al., 2015). It is highly personal, and once it is affected, it cannot be restored. It is also difficult to quantify. The environmental philosopher Glenn Albrecht noted a consistent theme of distress caused by coal mining in Australia by the assault on the people's sense of identity, place, belonging, control, and good health. He identified a melancholia from the loss of solace and comfort connected with their home which he termed 'solastalgia' – a form of homesickness that one gets when one is still at 'home' associated with the major project impacts they experienced (Albrecht et al., 2007). Social impacts can therefore range from significant health impacts to the loss of a cherished landscape and associated loss of a sense of place.

Spirit of place refers to the unique, distinctive, and cherished aspects of a place. Whereas 'sense of place' is the personal feelings an individual has about a place, spirit of place refers the inherent characteristics of the place (Vanclay et al., 2015). In this case the spirit of place includes the ocean and the properties assigned to it.

Many things can impact on a person's perception of sense of place. For the fishing communities the ocean is an integral part of their being, therefore anything that is perceived to potentially harm the ocean would also cause harm to them. The ocean provides them with food and thus keeping them from starvation. For many the sea is a sacred place. Its water has healing powers that take care of the sick. Many loved ones have given their lives to the ocean while they were out trying to make a livelihood, and their remains have never been found. The sea kept their bones, making the ocean the graveyard where their loved ones rest. For some people the thought of disturbance in the sea causes great distress. The heritage aspects relating to this are discussed in the heritage impact assessment report in **Appendix C**.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
Impact on sense of spirit and place	Operation	Medium	Medium	Medium
Mitigation Measures				
• Searcher should continue to implement the community engagement protocol that they developed in 2023. This protocol aims to address the impact on vulnerable groups and uncertainty, and also have an educational component. • There should be a grievance mechanism available for the duration of the seismic surveys. • Consult with communities on potential ways in which to make a positive contribution to the communities.				

9.3.4.5 IMPACTS ON THE SOCIAL LICENCE TO OPERATE

Social licence to operate (SLO) is a popular expression to imply that the acceptance of the community is also necessary for a project to be successful. Searcher does not have social licence to operate in the fishing communities. Based on the events surrounding Searcher's previous application, the communities do not trust Searcher. In their view Searcher is up to no good. For some seismic surveys are opening the door for oil and gas exploration, which is a great concern for them, mostly due to the anticipated impacts on their livelihoods. The social fabric in the communities have been damaged through previous experiences with businesses in the area. A number of factories in the greater area have closed or moved away and in the process of doing so created great hardship for the communities remaining behind. Very little severance was paid, and this left a bitter taste for the communities. In some areas access to the areas where they make their livelihoods are becoming increasingly restricted through the activities of mining companies. This has reached a point where the communities have realised that they need to fight for the protection of their livelihoods as the companies involved to date have in most cases not treated them fairly or with respect. It is unlikely that any company that would like to undertake any activity in the ocean will have social licence to operated.

Another aspect that affects Searcher's social license to operate negatively, is that they did not establish meaningful consultation with the small-scale fishers in the past. The communities feel disrespected and marginalised. Engaging with the communities in a meaningful way, following the appropriate structures and protocols, will go a long way in improving Searcher's social license to operate. It does not guarantee however that the communities will accept Searcher's activities. It must be kept in mind that improving social license to operate takes time and effort.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
Impacts on the social license to operate	Operation	High	Medium	Medium
Mitigation Measures				
• Searcher should continue to implement the community engagement protocol that they developed in 2023. This protocol aims to address the impact on vulnerable groups and uncertainty, and also have an educational component. • There should be a grievance mechanism available for the duration of the seismic surveys. • Consult with communities on potential ways in which to make a positive contribution to the communities. • Searcher should initiate discussions in their industry. The seismic survey industry should reassess their position and social licence to operate as an industry in a South African context and conduct a strategic environmental assessment of the impact of the industry and embark on an awareness raising and education campaign. Having meetings will not be sufficient. Participatory processes and workshops where communities can engage in experiential learning should be considered. If the seismic survey industry fails to address the community's need for education and cooperation it will result in significant delays and increase the risk for social unrest.				

9.3.4.6 COMMUNITY EXPECTATIONS

Not everyone in the fishing communities is opposed to the project or to oil and gas exploration. Their perceptions are that the ability to make a living from the sea is already declining. It is a hard live and they want a better life for their children. There are very limited alternative opportunities for making a livelihood and very limited job opportunities. They will support industrial development in the area if it brings opportunities for their children for employment and skills development. They know they will not be direct beneficiaries from the extraction of oil and gas, but that they will be the ones that pay the price. Their expectations are that the oil and gas companies will invest in these communities and assist them with making alternative livelihoods and obtaining the necessary skills and experience in that regard. Although Searcher will be doing a survey to gather data that will be utilised by oil and gas companies, and Searcher's activities will be of a temporary nature, the communities do not distinguish between data collection and exploration or extraction. For them these companies are one and the same, and they have similar expectations of Searcher.

The proposed project collects data that would be of great value for the companies interested in extracting oil and gas in the area in future. Should this happen, it would have a positive impact on the economy of South Africa, seen together with the Government's plans for the development of a new industrial port at Boegoebaai. In a country with very high unemployment levels and suffering from a recession and an energy crisis, this is seen as a positive future development by many role players. As such, the communities feel that the government supports the application, and that community consultation is simply a matter of ticking the boxes. The question of who pays the price and who gets the benefit is relevant in this context. The price that the fishing communities will pay eventually, will be high if it has an extremely negative impact on their livelihoods with little or no benefit to them, unless measures are put in place to protect their livelihoods. It must be considered that community livelihoods are broader than just catch rates and fishing, but includes the capabilities, assets (including both material and social resources) and activities required for a means of living.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
Community Expectations	Operation	Medium	Medium	Medium
Mitigation Measures				
• Searcher should continue to implement the community engagement protocol that they developed in 2023. This protocol aims to address the impact on vulnerable groups and uncertainty, and also have an educational component. • There should be a grievance mechanism available for the duration of the seismic surveys. • Consult with communities on potential ways in which to make a positive contribution to the communities.				

9.3.4.7 SOCIAL UNREST

Some of the communities are adamant that they would not allow gas or oil extraction in the area, and that includes collecting the required data from the ocean. There have already been court cases in this regard, and there are also court cases that are ongoing. Some community members have threatened with violence against Searcher's vessel. Others have threatened that they will take action to fight seismic surveys, in any way that they deem appropriate. This is a very emotional issue for many people and that could erupt into social unrest. Related to this is potential for conflict between community members who support the project and those that are against the project.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
Social Unrest	Operation	Medium	Low	Medium
Mitigation Measures				
• Searcher should continue to implement the community engagement protocol that they developed in 2023. This protocol aims to address the impact on vulnerable groups and uncertainty, and also have an educational component. • There should be a grievance mechanism available for the duration of the seismic surveys.				

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance

- Consult with communities on potential ways in which to make a positive contribution to the communities.
- Searcher should initiate discussions in their industry. The seismic survey industry should reassess their position and social licence to operate as an industry in a South African context and conduct a strategic environmental assessment of the impact of the industry and embark on an awareness raising and education campaign. Having meetings will not be sufficient. Participatory processes and workshops where communities can engage in experiential learning should be considered. If the seismic survey industry fails to address the community's need for education and cooperation it will result in significant delays and increase the risk for social unrest.

9.3.4.8 STAKEHOLDER FATIGUE

Signs of stakeholder fatigue are visible in the communities. There are a number of applications for seismic surveying, exploration, and mining in the area that the stakeholders continue to be invited to. The most obvious way to deal with this would be to avoid working with communities, suffering from stakeholder fatigue (Durham et al., 2014), but this is not always possible and infringe on their rights. The EIA process requires public participation and information sharing. The volume of consultation and information shared are confusing to the communities. Stakeholders start to feel overloaded, which negatively affects their willingness to participate and lessens the quality of their input. Over time only those who are deeply interested, that is strongly supportive of strongly opposing may still participate. This can hinder potential projects and can particularly occur when the stakeholders consulted are not actively involved in decision-making. To be effective and to reduce stakeholder fatigue, engagements need to be targeted, with clear aims and results. Stakeholders need to be clear on what the goal or end benefits to themselves would be for participating. It must be kept in mind that the more stakeholders contribute their time and knowledge, the more they will expect in return from the project, so one always need to ensure that the relationship remains balanced.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
Uncertainty	Operation	High	Medium	Medium
Mitigation Measures				

- Undertake fewer, but more informative / effective stakeholder consultations.
- Where possible, avoid prolonged engagements with communities suffering from stakeholder fatigue.
- To be effective and to reduce stakeholder fatigue, engagements need to be targeted, with clear aims and results.
- Searcher should approach the authorities and enter into conversation regarding a strategic impact assessment for the area that would undertake regional public participation which would identify key I&APs, educate communities about the oil and gas industry, advantages and disadvantages to local communities and the country as a whole and have databases for sharing of information. This would help reduce stakeholder fatigue as the communities would be more informed, address key concerns at a local and regional level and remove some uncertainties.

9.3.4.9 CUMULATIVE SOCIAL IMPACTS

A great source of concern for the fishing communities is the effect of cumulative impacts on their livelihoods and sense and spirit of place. There are a number of applications in process as well as approved applications relating to seismic surveys, mining, and oil and gas exploration in the West Coast area. The concern is that at some stage a tipping point will be reach where the marine life no longer recovers from the activities in the ocean or take a long time to recover to the extent that it would no longer be viable to make a living from the sea in those areas. In Norway small-scale fishing successfully co-exists with oil extraction in the ocean, but for the small-scale fishers on the West Coast, it remains uncertain to what extent it will be the case for them as well. The competent authorities have a legal and moral duty to consider the cumulative impacts of the activities taking place and are planned to take place on the livelihoods and heritage of the vulnerable communities in the area. There must be a balance between the contribution these activities can make to South Africa and sustaining the livelihoods of the vulnerable communities on the West Coast. The communities are clear that they do not want to stop development, they want to make sure that their livelihoods and heritage are protected. Once these have been affected negatively, it may not be possible to easily undo the damage.

<table>
<tr><th>Impact</th><th>Phase</th><th>Pre-mitigation ER</th><th>Post-mitigation ER</th><th>Final Significance</th></tr>
<tr><td>Cumulative social impact concerns</td><td>Operation</td><td>High</td><td>Medium</td><td>Medium</td></tr>
<tr><td colspan="5">Mitigation Measures</td></tr>
<tr><td colspan="5">• Searcher should approach the authorities and enter into conversation regarding a strategic impact assessment for the area that should be contributed to by all the exploration companies involved.</td></tr>
</table>

9.3.5 CUMULATIVE NOISE IMPACTS ASSOCIATED WITH MULTIPLE SURVEYS

Should other seismic survey campaigns be undertaken concurrently with Searcher's proposed survey programme (although highly unlikely to be undertaken in the same area during the same survey window due to impacts on operation and data acquisition), cumulative impacts may be likely and there would need for alignment in planning of such concurrent operations in order to reduce cumulative impacts to an acceptable significance in terms of concurrent noise impacts. During the 2022 application, there were two pending applications at PASA namely, the TGS Geophysical Company survey application (PASA ref 12/1/040) as well as the GX Technology Corporation survey application (ref 12/1/042) which both overlap the area proposed for the Searcher 3D survey. There is currently only one multi-client application in the area i.e. TGS 12/1/040 as indicated in the PASA Petroleum Exploration and Production Activities Map (**Figure 85**). The high-resolution Petroleum Exploration and Production Activities Map is attached as **Appendix G**. The TGS 12/1/040 EA was granted on 17 April 2023 and was appealed. All appeals were dismissed by the Minister (DFFE) on 22 May 2024. To date, the reconnaissance permit has not been issued. The survey window for the TGS 12/1/040 is January-May. For purposes of this this study, the worst-case scenario will be implemented where the two overlapping applications (TGS 12/1/040 and Searcher 12/1/048) are approved and occur concurrently.

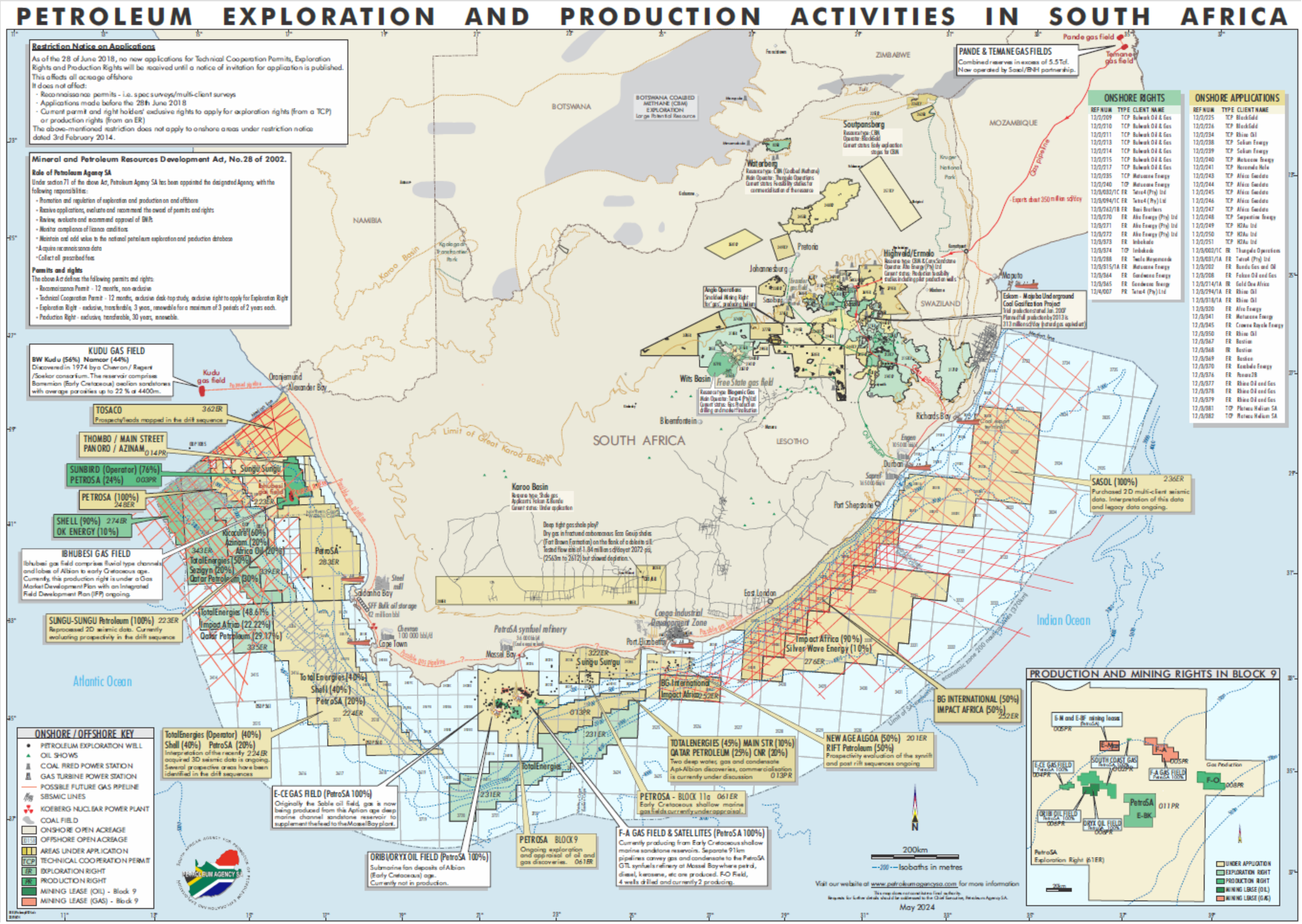

Figure 85: PASA Petroleum Exploration and Production Activities Map.

Despite the difficultly in undertaking a reliable assessment of the potential cumulative environmental impacts of future seismic acquisition in the Deep Water Orange Basin due to likely variation in the scope, extent and duration of proposed surveys, the cumulative impacts of three potential surveys occurring concurrently needs to be considered. The cumulative assessment assumes the worst-case scenario of two surveys (Searcher and TGS) occurring simultaneously during the summer survey window.

In the unlikely event that multiple surveys would be undertaken concurrently within the Deep Water Orange Basin Area, associated impacts to marine fauna would be of high intensity and extend regionally, over the short-term (assuming they take place over the same summer survey window). The impact consequence for cumulative surveys is therefore considered medium.

Concurrent activities such as other planned speculative or proprietary seismic surveys in the southern Benguela region could add to the cumulative impact on fisheries. Simultaneous survey operations would result in an increase in the extent and magnitude of the impact on the large pelagic longline sector. The impact duration would remain unchanged. Three seismic surveys of regional extent, undertaken simultaneously, could be expected to result in an impact of medium negative significance on the large pelagic longline sector, both with and without the application of mitigation measures. Once completed there is not expected to be any residual impact.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
Cumulative impacts on marine fauna and fisheries	Operation	Medium	Low	Low
Mitigation Measures				
In the unlikely event that multiple surveys would take place at the same time within the same survey area, the risk of cumulative noise impact must be considered and is suggested to be managed as follows: • Should surveys be run simultaneously, ensure that a distance of at least 40 km is maintained between survey vessels until sufficient objective evidence is obtained that a reduced buffer distance is acceptable. • Each of the additional activities to those described in the technical noise report would be modelled or otherwise considered in terms of the cumulative noise level and with reference to the criteria described in the report. This modelling is only considered required in the case where a 40 km buffer distance between active survey ships cannot be maintained.				

9.3.6 NO-GO ALTERNATIVE

The no go alternative would imply that no survey activities are undertaken and, as such, the negative impacts as stated above, would not materialise. However, conversely, this will negate the potential positive impacts associated with the proposed survey activities, including:

- The opportunity to identify potential oil and gas resources within the proposed 3D survey area including potential future contribution to the economy of South Africa;
- The opportunity to conduct independent research on how fish species on the West Coast such as snoek respond to seismic surveying; and
- Provision of job or training opportunities (very limited during the survey phase).

Since there are no mitigation measures, the impact significance will be low pre- and post-mitigation and final significance will be the same.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
No-Go Alternative	Operation	Low	Low	Low
Mitigation Measures				
• N/A				

10 CLOSURE AND REHABILITATION

It is anticipated that the activities will have a limited impact on the receiving environment. The impacts will be limited to the planning and operational phases, and it is not anticipated that there will be any need for closure or rehabilitation once the 3D surveys have been concluded. As such, closure of the project will be limited to the conclusion of the physical 3D surveys to be undertaken in the target area. This will mainly relate to:

- Waste generation and disposal; and
- Water contamination and pollution.

Residual impacts post completion of the seismic activities are limited (if any) and therefore there will be no requirements for closure, decommissioning and rehabilitation actions. The overall closure objective will be to ensure that the post closure environment aligns with the pre-development. Therefore, no financial provisions apply to this application. A Rehabilitation, Decommissioning and Closure Plan is included as **Appendix F**.

11 CONCLUSIONS AND RECOMMENDATIONS

The BA process identified potential issues and impacts associated with the proposed project. The BA addresses those identified potential environmental impacts and benefits (direct, indirect and cumulative impacts) associated with applicable phases of the project and recommends appropriate mitigation measures for potentially significant environmental impacts. The BA report provides sufficient information regarding the potential impacts and the acceptability of these impacts in order for the Competent Authority to make an informed decision regarding the proposed project. The release of a draft BA Report for public review and comment will provide stakeholders with an opportunity to verify that the issues they have raised throughout the process to date has been captured and adequately considered. It is anticipated that more issues will be raised during the public review and comment period of the Draft BAR. All issues raised throughout the public participation process will be accurately captured and adequately responded to as far as possible.

The BA report aims to achieve the following:

- Provide an overall assessment of the social and biophysical environments affected by the proposed project.
- Assess potentially significant impacts (direct, indirect and cumulative, where required) associated with the proposed project.
- Identify and recommend appropriate mitigation measures for potentially significant environmental impacts; and
- Undertake a fully inclusive public involvement process to ensure that I&APs are afforded the opportunity to participate, and that their issues and concerns are recorded.

11.1 CONCLUSIONS FROM SPECIALIST STUDIES

The conclusions and recommendations of this BA are the result of the assessment of identified impacts by specialists, and the parallel process of public participation. The public consultation process will be extensive, and every effort will be made to include representatives of all stakeholders in the study area. The main conclusions from each of the specialist studies are presented below.

11.1.1 NOISE / ACOUSTICS

The zones of potential injuries for fish species with a swim bladder, turtles and fish eggs and fish larvae are predicted to be within 160 m from the array source. However, fish species without swim bladders have higher injury impact thresholds, and therefore have smaller zones of potential injuries within 80 m from the array source.

The zones of potential mortal injuries for fish species with and without a swim bladder, fish eggs, and fish larvae are predicted to be within 60 m from the adjacent survey lines for all the 24-hour survey operation scenarios considered. For recoverable injury, the zones of impact are predicted to be within 20 m from the adjacent survey lines for fish without a swim bladder, and within 200 m for fish with a swim bladder for all the operation scenarios considered. The zones of TTS effect for fish species with and without swim bladders are predicted to be within 3 500 m from the adjacent survey lines for the relevant 24-hour survey operation scenarios considered. Existing experimental data regarding recoverable injury and TTS impacts for fish eggs and larvae is sparse and no guideline recommendations have been provided. However, based on a subjective approach, noise impacts are expected to be moderate for fish eggs and larvae. Impact is expected to be low for all of them at intermediate and far field from the source location.

Two long range modelling source locations are proposed for the 3D seismic survey (L1 Adjacent to Childs Bank and Shelf Edge) and L2 (Adjacent to Cape Canyon and Associated Islands, Bays and Lagoons). **Figure 86** and **Figure 87** show the horizontal contour image of the predicted maximum SELs received at locations up to 200 km from source locations L1 and L2 respectively, overlaying the local bathymetry contours. As can be seen from the horizontal and vertical contour figures, the received noise levels at far-field locations vary at different angles and distances from the source locations. This directivity of received levels is due to a combination of the directivity of the source array, and propagation effects caused by bathymetry and sound speed profile variations.

In general, the bathymetry profiles with significant upslope section across the continental slope region have the sound propagations experiencing significant attenuation due to the strong interaction between the sound signal and the seabed. The bathymetry profiles with downslope section have much less sound attenuation. These effects are evident for both locations for propagation paths towards shoreline directions. For both source locations, the seabed depth variations are not significant along the propagation paths within the deep-water region. Therefore, the directivity of received noise is dominated by the directionality of the source array.

The maximum zones of PTS effect for sea turtles are predicted to be within 15 m from the source location. On the other hand, the maximum zones of TTS effect for sea turtles are predicted to be within 30 m of the source array. The behavioural disturbance for sea turtles caused by the immediate exposure to individual pulses are predicted to be within 1.14 km of the source array. Noise impacts related to recoverable injury and TTS on sea turtles are expected to be high at the near field from the source location. The maximum zones of PTS impact are predicted to range within 10 m of the source array. The maximum zones of TTS effect for sea turtles are predicted to be within 50 m of the source array.

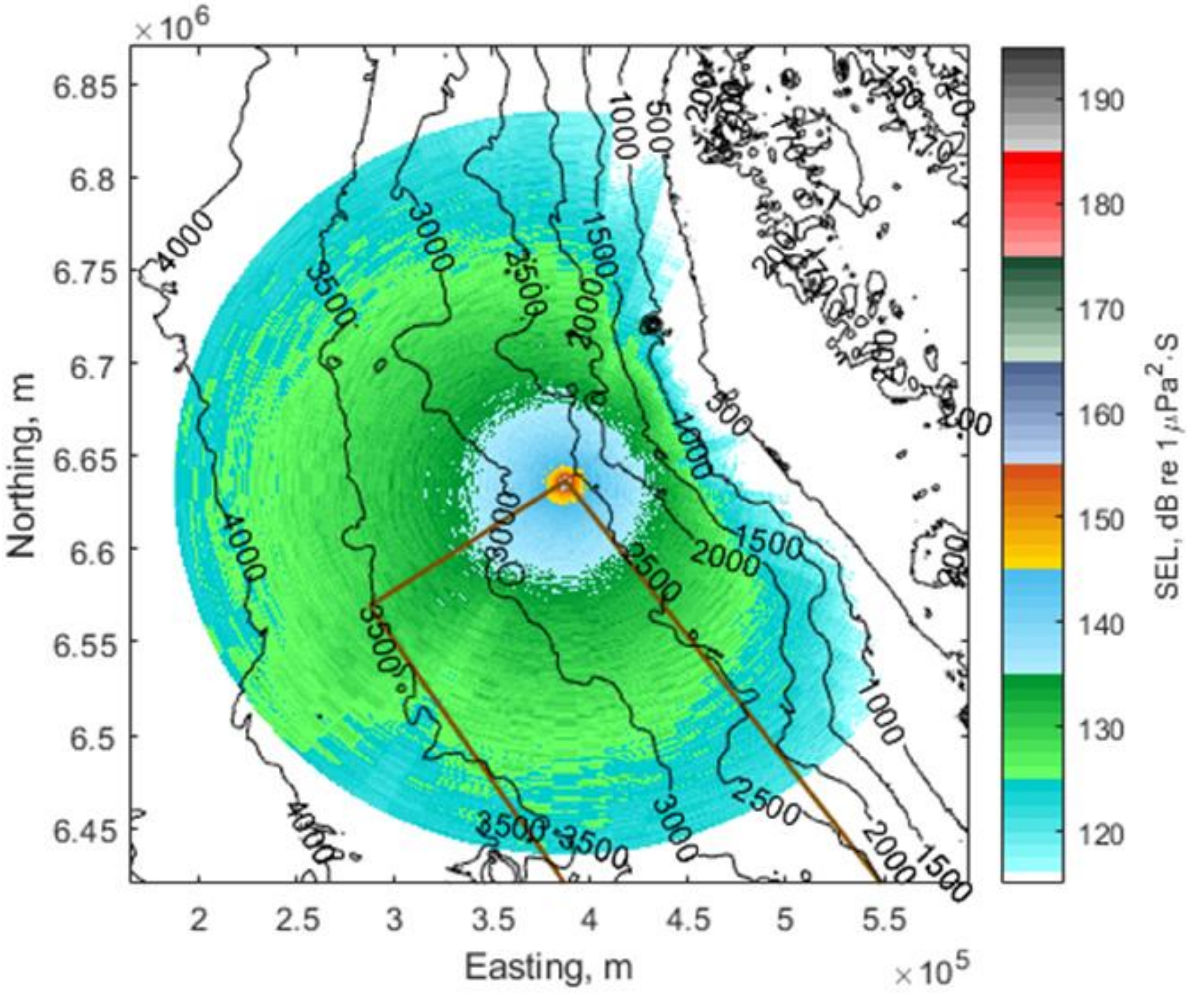

Figure 86: Modelled maximum SEL (maximum level across water column) contours for source location L1 to a maximum range of 200 km, overlayed with bathymetry contour lines. Coordinates in WGS 84/UTM Zone 33S.

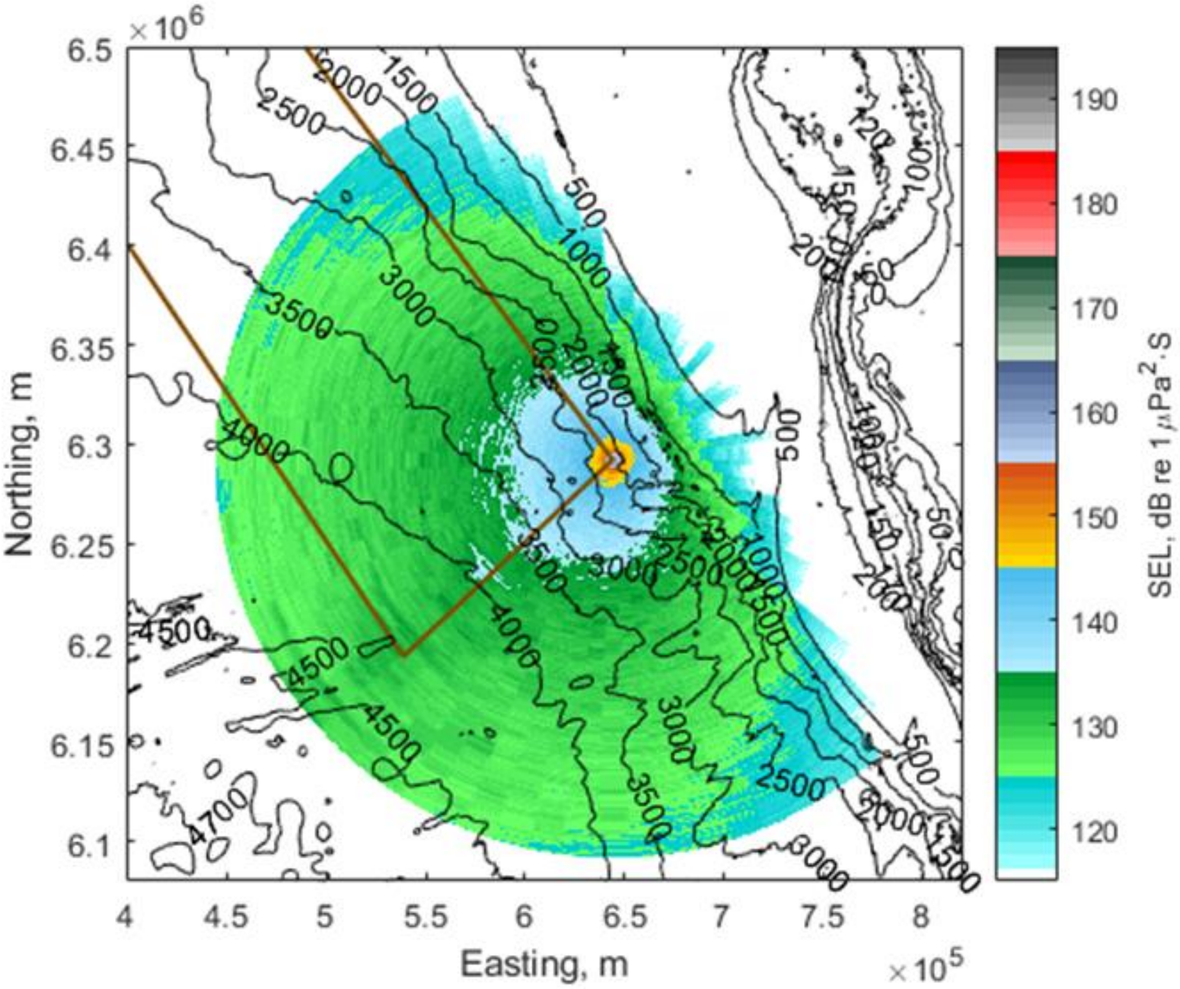

Figure 87: Modelled maximum SEL (maximum level across water column) contours for source location L2 to a maximum range of 200 km, overlayed with bathymetry contour lines. Coordinates in WGS 84/UTM Zone 33S.

Relevant mitigation measures are recommended to minimise the seismic impact on assessed marine fauna species. Recommended safety zones are based on the maximum threshold distances modelled for PTS (marine mammals and sea turtles) and potential mortal injury (fish) due to immediate exposure from single pulses and cumulative exposure from multiple pulses. Implement a soft-start procedure if testing multiple seismic sources. Delay soft-starts if slow swimming large pelagic fish, turtles, seals, or cetaceans are observed within the zone of impact.

In the unlikely event that multiple surveys would take place at the same time within the same survey area, the risk of cumulative noise impact must be considered and is suggested to be managed as follows:

- During seismic pulse releases, maintain a distance of at least 40 kilometres from any other survey vessel until sufficient objective evidence is obtained that a reduced buffer distance is acceptable; and
- Each of the additional activities to that described in the technical noise report would be modelled or otherwise considered in terms of the cumulative noise level and with reference to the criteria described in this report (the modelling is only considered required in the case where a 40 km buffer distance between active survey ships cannot be maintained).

This 40 km buffer maintained by any other survey vessels is considered sufficient on the basis that it provides a corridor between vessels where seismic source noise approaches ambient levels such that animals may pass between, and/or the potential cumulative effect beyond this distance is considered to be negligible.

11.1.2 MARINE ECOLOGY

The proposed survey activities to be undertaken by Searcher are expected to result in impacts on marine invertebrate fauna in the Orange Basin, ranging from negligible to very low significance. Only in the case of potential impacts to turtles and marine mammals are impacts of low significance expected.

If all environmental guidelines, and appropriate mitigation measures recommended in the report are implemented, there is no reason why the proposed seismic survey programme should not proceed. It should also be kept in mind that some of the migratory species are now present year-round off the West Coast, and that certain baleen and toothed whales are resident and/or show seasonality opposite to the majority of the baleen whales. Data collected by independent onboard observers should form part of a survey close–out report to be forwarded to the necessary authorities, and any incidence data and seismic source output data arising from surveys should be made available for analyses of survey impacts in Southern African waters.

11.1.3 FISHERIES ASSESSMENT

The potential impacts of the seismic survey programme on fisheries relate to 1) exclusion of fishing vessels from accessing fishing ground, 2) the impact on catch rates as a result of increased noise levels associated with the seismic survey operation, 3) accidental loss of equipment from the survey array and 4) accidental release of marine diesel at sea.

Under the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972, Part A, Rule 10) a seismic survey vessel that is engaged in surveying is defined as a "vessel restricted in its ability to manoeuvre" which requires that power-driven and sailing vessels give way to a vessel restricted in her ability to manoeuvre. Furthermore, under the Marine Traffic Act, 1981 (No. 2 of 1981), a vessel used for the purpose of exploiting the seabed falls under the definition of an "offshore installation" and as such it is protected by a 500 m safety zone. It is an offence for an unauthorised vessel to enter the safety zone. In addition to a statutory 500 m safety zone, a seismic contractor would request a safe operational limit (that is greater than the 500 m safety zone) that it would like other vessels to stay beyond. Safety clearances for seismic surveys are usually 6 Nm ahead and astern and 2 Nm to either side of the survey vessel, resulting in an exclusion area of approximately 165 km^2 around the survey vessel. The temporary exclusion of fisheries from the safety zone may reduce access to fishing grounds, which in turn could potentially result in a loss of catch and/or displacement of fishing effort (direct negative impact). The safety zone would be implemented around the seismic vessel for the duration of the project, resulting in a temporary (short-term) impact.

The impact of exclusion from fishing ground was assessed on each fishing sector based on the type of gear used and the proximity of fishing areas relative to the affected area. The impact on catch rates due to sound elevation levels was assessed and sensitivity/vulnerability differences amongst the targeted fish species identified for each sector. With the implementation of the project controls and mitigation measures, the residual impact of the proposed survey is considered to be of low significance for large pelagic longline sector. There is no impact expected on the demersal trawl, midwater trawl, demersal longline, small pelagic purse-seine, tuna pole-line, line fish, west coast rock lobster, netfish and small-scale fishing sectors.

Sound generated during the proposed seismic survey is expected to be in the order of 255 dB re 1 µPa at 1 m at an operating frequency range of 5 – 300 Hz. This falls within the hearing range of most fish species. The potential impacts on fish of sound produced by seismic sources may include, amongst other effects, physiological injury/mortality, behavioural avoidance and reduced reproductive success. The results of the Sound Transmission Loss Modelling study were analysed to identify zones of impact for fish species (amongst other marine fauna species of concern) based on relevant noise impact assessment criteria. The noise effects assessed included physiological effects (physical injury/permanent threshold shift (PTS) and temporary threshold shift (TTS)) and behavioural disturbance due to either immediate impact from single seismic source pulses or cumulative effects of exposure to multiple seismic source pulses over a period of 24 hours. The results were used to inform the assessment of potential effects of reduced catch rates as a result of behavioural avoidance of fish in response to elevated sound levels. Based on the current project description, sound levels for the seismic survey can notionally be expected to attenuate below 160 dB less than 4 km from the source array. The current assessment is that behavioural disturbance to fish could be expected within this range and that catch rates could therefore also be affected. The spatial extent of the impact of seismic source noise emissions on catch rates is expected to be regional, although localised at any one time. The impact is considered to be fully reversible – any disturbance of behaviour that may occur as a result of survey noise would be temporary. The impact of increased noise generated during the survey could affect any fishing sector that operates within 4 km of the proposed seismic survey area. Based on the distance of fishing grounds from the proposed survey area, only the large pelagic longline sector would be susceptible to impacts of elevated sound. With the implementation of the project controls and mitigation measures, the residual impact due to seismic noise is considered to be of low significance for large pelagic longline sector.

In order to mitigate the impacts on the large pelagic longline sector, it is recommended that the survey be timed to take place between December and April (periods of relatively low fishing activity in the Reconnaissance Permit area). Prior to the commencement of survey activities, affected parties should be informed of the navigational co-ordinates of the proposed survey acquisition area, timing and duration of proposed activities and any implications relating to the safety zone that would be requested, as well as the movements of support vessels related to the project. The relevant fishing associations include FishSA, SA Tuna Association, SA Tuna Longline Association and Fresh Tuna Exporters Association.

Other key stakeholders should be notified prior to commencement and on completion of the project. These include; DFFE, the South African Navy Hydrographic Office (SANHO), South African Maritime Safety Association (SAMSA) and Ports Authorities. For the duration of the survey, a navigational warning should be broadcast to all vessels via Navigational Telex (Navtext) and Cape Town radio. In addition, it is recommended that updates of the scheduled weekly survey plan should be circulated to the operators of affected fishing vessels on a daily basis. A FLO should be present on board the seismic vessel or escort vessel for the duration of the survey in order to facilitate communications between the seismic and fishing vessels in the project area.

It is the reasoned opinion of the specialist that the reconnaissance activities may be authorised, subject to the implementation of the mitigation measures proposed.

11.1.4 HERITAGE ASSESSMENT

The affected communities not only view them as small-scale fishers but also as indigenous people and, as such, are intrinsically linked to the ocean and the land they have lived on centuries. The resurgence movement through which Khoi and San descendants are reclaiming their identity has in recent decades afforded these communities the ability to re-establish their cultural roots and grounding in an ancient landscape. This sentiment is echoed in the founding affidavit submitted (5 February 2022) during the appeal submitted to the first Searcher application by CJ Adams. It notes that the ocean is not only important for fishing but also has spiritual meaning and is a place of healing and holds healing powers for the indigenous communities. It further expanded that the ocean and its resources play an important part in their community's history and heritage.

The scientific studies conducted for this project identified impacts on the fishing stock as low for all types except for large pelagic longline species. A medium negative residual impact is projected for these species. By inference, a potential impact on fishing yield could be expected and thus potential economic impact on communities due to reduced caught fish volumes. The recommended mitigation measures as listed in the specialist reports for the project focus on the reduction of impacts on fish species and the projected reduction of the impact on the commercial and small-scale fishery catch yield. These mitigation measures should then indirectly have a positive impact on the on the cultural heritage of the communities to be impacted.

A pre-mitigation negative impact is projected on a regional scale over the long term with a moderate intensity due to the potential indirect impact on the communities and, ultimately, their heritage, with a high probability of this impact occurring. The pre-mitigation impact is rated as medium. The potential residual impact with mitigation measures from the scientific studies is projected as low with a medium confidence factor.

Considering the assessment based on the findings of the fieldwork as well as the scientific studies relating to the impact on fisheries, the specialist is of the opinion that the impact of the proposed project on the cultural heritage resources can be mitigated through the implementation of the recommendations in this report.

11.1.5 SOCIAL ASSESSMENT

Searcher's activities for this application would be of short duration if approved, and if viewed in isolation considering only technical risks as discussed in various specialist reports conducted as part of the BA process, the impacts will be negligible. However, communities feel that there are significant gaps in the available data and from a social perspective the non-technical or social risks can potentially cause significant impacts. Although the marine fauna and fisheries specialists have indicated that the impacts on the marine fauna would be negligible, the communities, with generations of experience in the ocean, fear that the behaviour of the fish will change and that this would affect their catch rates and consequently their livelihoods. What is seen as a minor impact in a large eco-system may be experienced as a major impact by an individual. The marine fauna might not be affected greatly, but the fishing community fear that marine fauna might change its behaviour in response and that is a main concern from a social perspective.

Another concern is the cumulative impact of activities in the ocean where these communities earn their livelihoods. Their fears about the tipping point where their source of livelihood does not recover from all the activities in the ocean, and they are no longer able to make their livelihood as fishing communities must be considered. Currently these communities are able to sustain themselves, although it is difficult. The communities are not against development, but they want to see it happen in a sustainable way that does not jeopardise their source of livelihood. They have already seen how their livelihoods are being affected by mining that is taking place in the sea, pollution, climate change, over-fishing and businesses such as factories that come and go and often and do not leave in a socially responsible way.

Searcher, as well as other companies that want to do surveys or exploration in the area, currently do not have social license to operate. A large part of this is due to a lack of meaningful consultation from a community perspective. If Searcher or any other seismic survey company wants to proceed with the project, they will need to engage in meaningful conversation with the communities and try to restore relationships. From a community and social risk perspective this is not negotiable.

Seismic reconnaissance projects are controversial in South Africa and has been in the news frequently in the last year. For many stakeholders it is an emotional matter, for others the potential of impacting their livelihoods is the biggest fear. There are also stakeholders that feel that the exploration for fossil fuels is not in line with sustainable development and the fight against climate change. Other stakeholders feel that it is imperative for the growth and development of the South African economy to engage in these investigations.

From a social perspective it is clear that the communities and local people are divided about the oil and gas industry. If the project is considered in isolation, the impacts are negligible. However, the project does not happen in a vacuum, and the social environment is much wider than the footprint of the project. If the social risks and potential damage to cultural and indigenous rights are considered the impact on the social fabric of already vulnerable communities may be significant. Potential future benefits and the economic development of the country should the surveys find any significant resources are not disputed. From a social perspective it is recommended that the project proceed subject to the mitigation measures being implemented.

11.2 PREFERRED ALTERNATIVES

The preferred alternatives are discussed below. The final Sensitivity Map is provided in **Figure 88** which shows all identified sensitive areas including the MPA 5km buffer zones. No no-go areas were identified within the survey area itself. No layout or location alternatives are applicable so only technology alternatives are discussed below.

The activities proposed in this application require specialised technology and skills. The available technology alternatives are limited by most suitable technology for conducting seismic surveys. To this end, it was concluded by Weilgart (2010) that seismic source design can be optimized to reduce unwanted energy. Imaging deep geological targets requires an acoustic source outputting relatively low frequency content (200Hz) and in directions (both inline and horizontal to the plane of interest) that are not of use. During collection of seismic data for deep imaging purposes one should strive to reduce unnecessary acoustic energy (noise) through array, source, and receiver design optimization. Weilgart (2010) further concluded that that regardless of the imaging target, anyone collecting seismic data should strive to reduce unwanted energy or noise. It should be noted that even if unwanted frequencies (> 200 Hz) are removed, there will still be frequency overlap with several marine animals (including most baleen whales) that can and should be minimized. It was further concluded that, lower source levels could be achieved through better system optimization, i.e. a better pairing of source and receiver characteristics, and better system gain(s). For example, new receiver technologies, such as fibre optic receivers, may allow the use of lower amplitude sources through a higher receiver density and/or a lower system noise floor. Some evidence exists which indicates that re-engineered seismic sources with "mufflers" can be used to attenuate unwanted high frequency energy without affecting frequencies of interest.

The above optimisation techniques should be implemented including better seismic source design and system optimisation with the selected survey contractor. In addition, kerosene free hydro-streamers should be used. It is also important to ensure that ‘turtle-friendly’ tail buoys are used or that existing tail buoys are fitted with either exclusion or deflector 'turtle guards'.

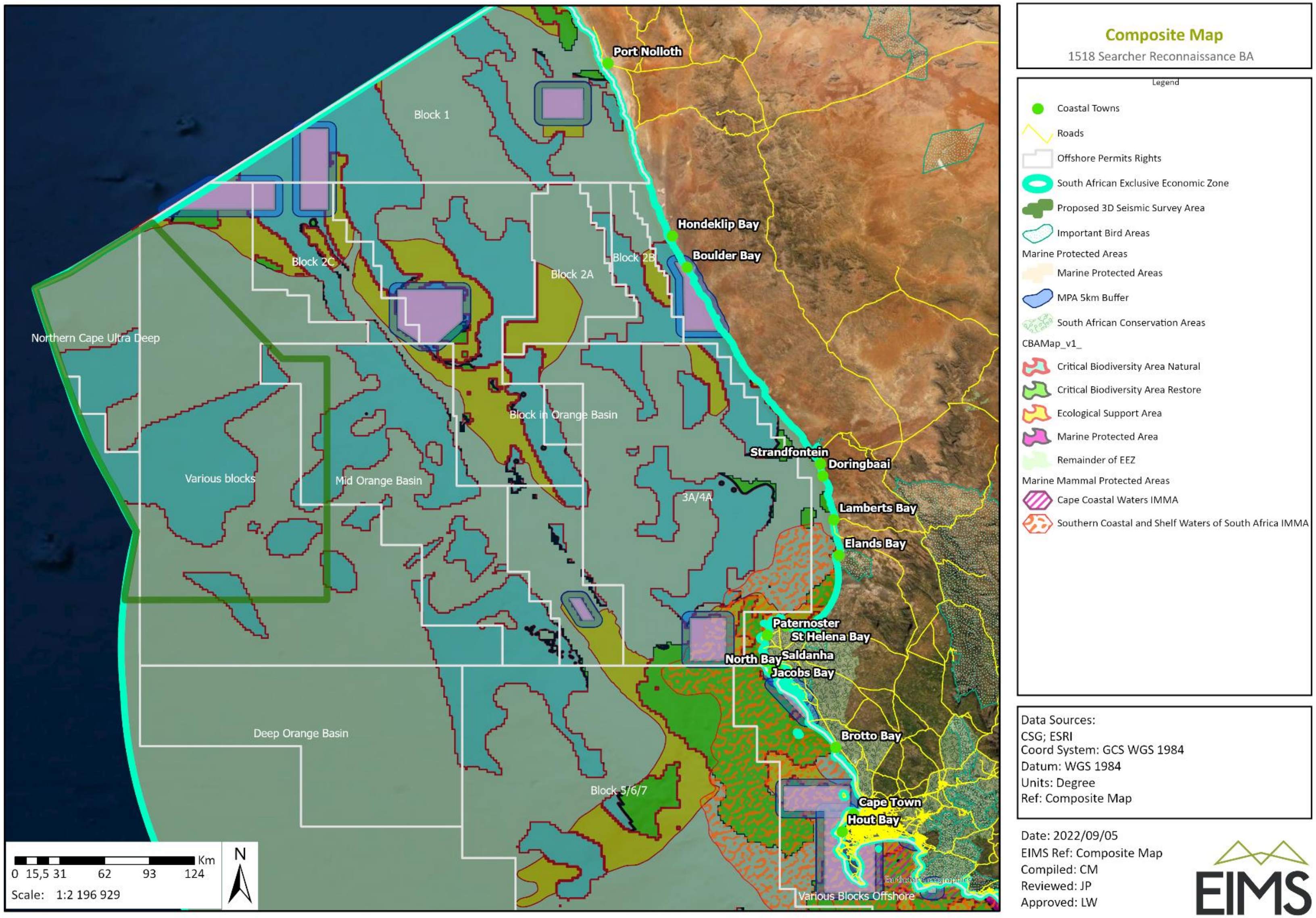

Figure 88: Final Composite Sensitivity Map

11.3 ENVIRONMENTAL IMPACT STATEMENT

The findings of the specialist studies conclude that there are no environmental fatal flaws that should prevent the proposed project from proceeding, provided that the recommended mitigation and management measures are implemented. Based on the nature and extent of the proposed project, the local level of disturbance predicted as a result of the reconnaissance activities, the findings of the specialist studies, and the understanding of the significance level of potential environmental impacts, it is the opinion of the BA project team and the EAP that the significance levels of the majority of identified negative impacts can generally be reduced to an acceptable level by implementing the recommended mitigation measures and the project should be authorized. A sensitivity map is provided in **Figure 88** and table of the impact assessment matrix is provided in **Appendix D.**

The following impacts were determined to have a potentially moderate negative final significance after mitigation:

- Impacts on livelihoods;
- Impacts on sense and spirit of place;
- Impacts on social licence to operate;
- Community expectations;
- Social unrest;
- Uncertainty from a social perspective;
- Stakeholder fatigue;
- Concerns about cumulative social impacts; and
- Further marginalization of vulnerable groups.

11.4 RECOMMENDATIONS FOR INCLUSION IN ENVIRONMENTAL AUTHORIZATION

This section contains recommendations from the various specialist studies for inclusion in the EA.

11.4.1 MARINE ECOLOGY

This section includes marine ecology recommendations for inclusion in the EA.

11.4.1.1 APPLICATION OF THE MITIGATION HIERARCHY

A key component of this BA process is to explore practical ways of avoiding and where not possible to reducing potentially significant impacts of the proposed seismic acquisition activities. The mitigation measures put forward are aimed at preventing, minimising, or managing significant negative impacts to as low as reasonably practicable (ALARP). The mitigation measures are established through the consideration of legal requirements, project standards, best practice industry standards and specialist inputs.

The mitigation hierarchy, as specified in International Finance Corporation (IFC) Performance Standard 1, is based on a hierarchy of decisions and measures aimed at ensuring that wherever possible potential impacts are mitigated at source rather than mitigated through restoration after the impact has occurred. Any remaining significant residual impacts are then highlighted, and additional actions are proposed. With few exceptions, however, identified impacts were of low significance with very low or zero potential for further mitigation. In such cases the appropriate project Standards will be used and additional best management practices are proposed.

The operator will ensure that the proposed seismic survey is undertaken in a manner consistent with good international industry practice and in compliance with the applicable requirements in MARPOL 73/78, as summarised below.

- The discharge of biodegradable wastes from vessels is regulated by MARPOL 73/78 Annex V, which stipulates that:
    - No disposal to occur within 3 nautical miles (± 5.5 km) of the coast.
    - Disposal between 3 nautical miles (± 5.5 km) and 12 nautical miles (± 22 km) needs to be comminated to particle sizes smaller than 25 mm.
    - Disposal overboard without macerating can occur greater than 12 nautical miles from the coast when the vessel is sailing.
- Discharges of oily water (deck drainage, bilge and mud pit wash residue) to the marine environment are regulated by MARPOL 73/78 Annex I, which stipulates that vessels must have:
    - A Shipboard Oil Pollution Emergency Plan (SOPEP).
    - A valid International Oil Pollution Prevention Certificate, as required by vessel class.
    - Equipment for the control of oil discharge from machinery space bilges and oil fuel tanks, e.g. oil separating/filtering equipment and oil content meter. Oil in water concentration must be less than 15 ppm prior to discharge overboard.
    - Oil residue holding tanks.
    - Oil discharge monitoring and control system.
- Sewage and grey water discharges from vessels are regulated by MARPOL 73/78 Annex IV, which specifies the following:
    - Vessels must have a valid International Sewage Pollution Prevention Certificate.
    - Vessels must have an onboard sewage treatment plant providing primary settling, chlorination and dichlorination before discharge of treated effluent.
    - The discharge depth is variable, depending upon the draught of the seismic vessel / support vessel at the time, but will be in accordance with MARPOL 73/78 Annex IV.
    - Discharge of sewage beyond 12 nm requires no treatment. However, sewage effluent must not produce visible floating solids in, nor cause the discolouration of, the surrounding water.
    - Sewage must be comminuted and disinfected for discharges between 3 nautical miles (± 6 km) and 12 nautical miles (± 22 km) from the coast. This will require an onboard sewage treatment plant or a sewage comminuting and disinfecting system.
    - Disposal of sewage originating from holding tanks must be discharged at a moderate rate while the ship is proceeding on route at a speed not less than 4 knots.
- Sewage will be treated using a marine sanitation device to produce an effluent with:
    - A biological oxygen demand (BOD) of <25 mg/l (if the treatment plant was installed after 1/1/2010) or <50 mg/l (if installed before this date).
    - Minimal residual chlorine concentration of 1.0 mg/l.
    - No visible floating solids or oil and grease.

The project will also comply with industry best practices regarding waste management, including:

- Waste management will follow key principles: Avoidance of Waste Generation, adopting the Waste Management Hierarchy (reduce, reuse, recycle, recover, residue disposal), and use of Best Available Technology (BAT).

- An inventory will be established of all the potential waste generated, clarifying its classification (hazardous, non-hazardous or inert) and quantity, as well as identifying the adequate treatment and disposal methods.
- Waste collection and temporary storage shall be designed to minimise the risk of escape to the environment (for example by particulates, infiltration, runoff or odours).
- On-site waste storage should be limited in time and volume.
- Dedicated, clearly labelled, containers (bins, skips, etc.) will be provided in quantities adapted to anticipated waste streams and removal frequency.

Detailed mitigation measures for seismic surveys in other parts of the world are provided by Weir et al., (2006), Compton et al., (2007) and US Department of Interior (2007). Many of the international guidelines presented in these documents are extremely conservative as they are designed for areas experiencing repeated, high intensity surveys and harbouring particularly sensitive species, or species with high conservation status. A number of countries have more recently updated their guidelines, most of which are based on the Joint Nature Conservation Committee - JNCC (2010, 2017) recommendations but adapted for specific areas of operation. The guidelines currently applied to seismic surveying in South African waters are those proposed in the Generic EMPr and by Purdon (2018). Purdon highlights the importance of developing mitigation guidelines both locally and regionally and points out that if South Africa is to maintain environmental integrity, mitigation guidelines for seismic surveys specific to the country, and based on the most recent scientific data, need to be implemented.

The mitigation measures proposed for seismic surveys are as provided below for each phase of a seismic survey operation:

11.4.1.2 MOBILISATION PHASE

11.4.1.2.1 PRE-SURVEY PLANNING

- Plan seismic surveys to avoid most sensitive periods within the survey area for some marine fauna from early June to early December, notably:
    - Movement of migratory cetaceans (particularly baleen whales) from their southern feeding grounds into low latitude waters
    - Aggregation of migratory cetaceans on the summer feeding grounds between St Helena Bay and Dassen Island from late October to late December.
- Plan survey, as far as possible, so that the first commencement of seismic acquisition in a new area (including seismic source tests) are undertaken during daylight hours.
- Prohibit seismic source use (including tests) outside of the area of operation (acoustic sources (seismic sources) must not be operational outside the licence area).
- Although a seismic vessel and its gear may pass through a declared Marine Protected Area, acoustic sources (seismic sources) must not be operational during this transit.
- A 5 km buffer zone where no seismic source operation is permitted is recommended around all MPAs.

11.4.1.2.2 KEY EQUIPMENT

Passive Acoustic Monitoring

- Ensure the seismic vessel is fitted with PAM technology, which detects some animals through their vocalisations. The PAM technology must have enough bandwidth to be sensitive to the whole frequency range of sensitive marine life expected in the area.
- As the survey area would largely be in waters deeper than 1 000 m where sperm whales and other deep-diving odontocetes are likely to be encountered, implement the use of PAM 24-hr a day when the seismic source is in operation.

- Ensure that the PAM hydrophone streamer is towed in such a way that the interference of vessel noise is minimised.

- Ensure the PAM streamer is fitted with at least four hydrophones, of which two are HF and two LF, to allow directional detection of cetaceans.

- Ensure spare PAM hydrophone streamers (e.g. 4 heavy tow cables and 6 hydrophone cables) are readily available in the event that PAM breaks down, in order to ensure timeous redeployment.

Seismic Source

- Define and enforce the use of the lowest practicable seismic source volume for production. Design arrays to maximise downward propagation, minimise horizontal propagation and minimise high frequencies in seismic source pulses.

- Ensure a display screen for the seismic source operations is provided to the marine observers. All information relating to the activation of the acoustic source and the power output levels must be readily available to support the observers in real time via the display screen and to ensure that operational capacity is not exceeded.

- Ensure the ramp-up noise volumes do not exceed the production volume.

- Limit horizontal sound propagation by adopting suitable array configurations and pulse synchronization and eliminating unnecessary high frequencies.

Streamers

- Ensure that 'turtle-friendly' tail buoys are used by the survey contractor or that existing tail buoys are fitted with either exclusion or deflector 'turtle guards'.

- Ensure that solid streamers rather than fluid-filled streamers are used to avoid leaks.

11.4.1.2.3 KEY PERSONELL

- Make provision for the placing of at least two qualified MMOs on board the seismic vessel. As a minimum, one must be on watch during daylight hours for the pre-acquisition observations and when the acoustic source is active.

- The duties of the MMO would be to:

  - Provide effective regular briefings to crew members, and establish clear lines of communication and procedures for onboard operations;

  - Record seismic source activities, including sound levels, "soft-start" procedures and pre-start regimes;

  - Observe and record responses of marine fauna to seismic source from optimum vantage points, including seabird, large pelagic fish (e.g. shoaling tuna, sunfish, sharks), turtle, seal and cetacean incidence and behaviour and any mortality or injuries of marine fauna as a result of the seismic survey. Data captured should include species identification, position (latitude/longitude), distance/bearing from the vessel, swimming speed and direction (if applicable) and any obvious changes in behaviour (e.g. startle responses or changes in surfacing/diving frequencies, breathing patterns) as a result of the seismic activities. Both the identification and the behaviour of the animals must be recorded accurately along with current seismic sound levels. Any attraction of predatory seabirds, large pelagic fish or cetaceans (by mass disorientation or stunning of fish as a result of seismic survey activities) and incidents of feeding behaviour among the hydrophone streamers should also be recorded;

- Sightings of any injured or dead protected species (marine mammals, large pelagic fish (e.g. sharks), seabirds and sea turtles) should be recorded regardless of whether the injury or death was caused by the seismic vessel itself. If the injury or death was caused by a collision with the seismic vessel, the date and location (latitude/longitude) of the strike, and the species identification or a description of the animal should be recorded and included as part of the daily report;
    - Record meteorological conditions at the beginning and end of the observation period, and whenever the weather conditions change significantly;
    - Request the delay of start-up or temporary termination of the seismic survey or adjusting of seismic source, as appropriate. It is important that MMO decisions on the termination of seismic source is made confidently and expediently, following dialogue between the observers on duty at the time. A log of all termination decisions must be kept (for inclusion in both daily and "close-out" reports);
    - Use a recording spreadsheet in order to record all the above observations and decisions; and
    - Prepare daily reports of all observations, to be forwarded to the necessary authorities as required, in order to ensure compliance with the mitigation measures.
- Make provision for placing at least one qualified PAM operator on board the seismic vessel. As a minimum, one must be on "watch" during the pre-acquisition observations and when the acoustic source is active.
- Ensure MMOs and PAM operators are briefed on the area-specific sensitivities and on the seismic survey planning (including roles and responsibilities, and lines of communication).
- Seabird, turtle and marine mammal incidence data and seismic source output data arising from surveys should be made available on request to the Marine Mammal Institute, DFFE, and the Petroleum Agency South Africa for analyses of survey impacts in local waters.
- The duties of the PAM operator would be to:
    - Provide effective regular briefings to crew members, and establish clear lines of communication and procedures for onboard operations;
    - Ensure that the hydrophone cable is optimally placed, deployed and tested for acoustic detections of marine mammals;
    - Confirm that there is no marine mammal activity within 500 m of the seismic source array prior to commencing with the "soft-start" procedures;
    - Record species identification, position (latitude/longitude), distance and bearing from the vessel and acoustic source, where possible;
    - Record general environmental conditions;
    - Record seismic source activities, including sound levels, "soft-start" procedures and pre-start regimes; and
    - Request the delay of start-up and temporary termination of the seismic survey, as appropriate.

11.4.1.3 OPERATIONAL PHASE

11.4.1.3.1 SEISMIC SOURCE TESTING

- Maintain a pre-acquisition watch of 60-minutes before any instances of seismic source testing. If only a single lowest power seismic source is tested, the pre- acquisition watch period can be reduced to 30 minutes.
- Implement a "soft-start" procedure if testing multiple seismic sources.

- The “soft-start” should be carried out over a time period proportional to the number of seismic sources being tested and not exceed 20 minutes; seismic sources should be tested in order of increasing volume;
- If testing all seismic sources at the same time, a 20 minute “soft-start” is required;
- If testing a single lowest power seismic source a “soft-start” is not required..

11.4.1.3.2 PRE-START PROTOCOLS

- Implement a dedicated MMO and PAM pre-acquisition watch of at least 60 minutes (to accommodate deep-diving species in water depths greater than 200 m).
- Implement a “soft-start” procedure of a minimum of 20 minutes’ duration on initiation of the seismic source if:
- during daylight hours it is confirmed:

  a) visually by the MMO during the pre- acquisition watch (60 minutes) that there are no penguins or feeding aggregations of diving seabirds, slow swimming large pelagic fish, turtles, seals or cetaceans within 500 m of the seismic source, and

  b) by PAM technology that there are no vocalising cetaceans detected in the 500 m mitigation zone.

- During times of poor visibility or darkness it is confirmed by PAM technology that no vocalising cetaceans are present in the 500 m mitigation zone during the pre- acquisition watch (60 minutes).
- Delay “soft-starts” if penguins or feeding aggregations of diving seabirds, slow swimming large pelagic fish, turtles, seals or cetaceans are observed within the mitigation zone.
  - A “soft-start” should not begin until 30 minutes after cetaceans depart the 500 m mitigation zone or 30 minutes after they are last seen or acoustically detected by PAM in the mitigation zone.
  - In the case of penguins, diving seabirds, slow swimming large pelagic fish and turtles, delay the “soft-start” until animals are outside the 500 m mitigation zone.
  - In the case of fur seals, which may occur commonly around the vessel, delay “soft-starts” for at least 10 minutes until it has been confirmed that the mitigation zone is clear of all seal activity. However, if after a period of 10 mins seals are still observed within 500 m of the seismic source, the normal “soft-start” procedure should be allowed to commence for at least a 20-minute duration. Seal activity should be carefully monitored during “soft-starts” to determine if they display any obvious negative responses to the seismic source and gear or if there are any signs of injury or mortality as a direct result of the seismic activities.
- As noted above for planning, when arriving at the survey area for the first time, survey activities should, as far as possible, only commence during daylight hours with good visibility and wind speeds below Beaufort 3. However, if this is not possible due to prolonged periods of high wind speeds, poor visibility (e.g. thick fog) or unforeseen technical issue which results in a night-time start, the initial acoustic source activation (including gun tests) may only be undertaken if the normal 60-minute PAM pre-watch and ‘soft-start’ procedures have been followed.
- Schedule "soft-starts" so as to minimise, as far as possible, the interval between reaching full power operation and commencing a survey line. The period between the end of the soft start and commencing with a survey line must not exceed 20 minutes. If it does exceed 20 minutes, refer to breaks in acquisition below.

11.4.1.3.3 LINE TURNS

- If line changes are expected to take longer than 40 minutes :

- Terminate seismic source at the end of the survey line and implement a pre- acquisition search (60 minutes) and “soft-start” procedure (20 minutes) when approaching the next survey line.
    - If line turn is shorter than 80 minutes (i.e. shorter than a 60-minute pre- acquisition watch and 20-minute “soft-start” combined), the pre- acquisition watch can commence before the end of the previous survey line.
- If line changes are expected to take less than 40 minutes, seismic acquisition can continue during the line change if:
    - The power is reduced to 180 cubic inches (or as close as is practically feasible) at standard pressure. Seismic source volumes of less than 180 cubic inches can continue to discharge at their operational volume and pressure;
    - The Seismic Pulse Interval (SPI) is increased to provide a longer duration between pulses, with the SPI not to exceed 5 minutes; and
    - The power is increased and the SPI is decreased in uniform stages during the final 10 minutes of the line change (or geophone repositioning), prior to data collection re-commencing (i.e. a form of mini soft start).
    - Normal MMO and PAM observations continue during this period when reduced power seismic source is active.

11.4.1.3.4 SHUT-DOWNS

- Terminate seismic source on observation and/or detection of penguins or feeding aggregations of diving seabirds, turtles, slow swimming large pelagic fish (including whale sharks, basking sharks, manta rays [and devil rays-Namibia only]) or cetaceans within the 500 m mitigation zone.
- Terminate seismic source on observation of any obvious mortality or injuries to cetaceans, turtles, seals or mass mortalities of squid and fish (specifically large shoals of tuna or surface shoaling small pelagic species such as sardine, anchovy and mackerel) when estimated by the MMO to be as a direct result of the survey.
- Depending the species, specific mitigation will be implemented to continue the survey operations, as specified below:
    - For specific species such as turtles, penguins, diving seabirds and slow swimming large pelagic fish (including whale sharks, basking sharks, manta rays [and devil rays-Namibia only]), terminate source until such time as the animals are outside of the 500 m mitigation zone (seismic "pause", no soft-start required). If visual confirmation is not possible implement a seismic pause of 4 minutes.
    - For cetaceans, terminate source until such time as there has been a 30-minute delay from the time the animal was last sighted within the mitigation zone before the commencement of the normal soft start procedure.

11.4.1.3.5 BREAKS IN SEISMIC SOURCE

- If after breaks in seismic acquisition, the seismic source can be restarted within 5 minutes, no soft-start is required and acquisition can recommence at the same power level provided no marine mammals have been observed or detected in the mitigation zone during the break-down period.
- For all breaks in seismic source of longer than 5 minutes, but less than 20 minutes, implement a “soft-start” of similar duration, assuming there is continuous observation by the MMO and PAM operator during the break.

- For all breaks in seismic source of 20 minutes or longer, implement a 60-minute pre- acquisition watch and 20-minute “soft-start” procedure prior to the survey operation continuing.
- For planned breaks, ensure that there is good communication between the seismic contractor and MMOs and PAM operators in order for all parties to be aware of these breaks and that early commencement of pre-watch periods can be implemented to limit delays.

11.4.1.3.6 PAM MALFUNCTIONS

- If the PAM system malfunctions or becomes damaged **during night-time operations or periods of low visibility**, continue operations for 30 minutes without PAM if no marine mammals were detected by PAM in the mitigation zones in the previous 2 hours, while the PAM operator diagnoses the issue. If after 30 minutes the diagnosis indicates that the PAM gear must be repaired to solve the problem, reduce power to 180 cubic inches. The reduced seismic source may continue for 30 minutes while PAM is being repaired, the last 10-minute of which is a 10-minute ramp up to full power (mini “soft-start”). If the PAM repair will take longer than 60 minutes, stop surveying until such time as a functional PAM system can be redeployed and tested.
- If the PAM system breaks down **during daylight hours**, continue operations for 20 minutes without PAM, while the PAM operator diagnoses the issue. If the diagnosis indicates that the PAM gear must be repaired to solve the problem, operations may continue for an additional 2 hours without PAM monitoring as long as:
    - No marine mammals were detected by PAM in the mitigation zones in the previous 2 hours;
    - Two MMOs maintain watch at all times during operations when PAM is not operational;
    - The time and location in which operations began and stop without an active PAM system is recorded.

11.4.1.4 VESSEL AND AIRCRAFT OPERATIONS

- Pre-plan flight paths to ensure that no flying occurs over seabird and seal colonies and offshore islands by at least 1 852 m (i.e. 1 nm);
- Avoid extensive low-altitude coastal flights by ensuring that the flight path is perpendicular to the coast, as far as possible;
- Brief all pilots on the ecological risks associated with flying at a low level along the coast or above marine mammals;
- The lighting on the survey and support vessels should be reduced to a minimum compatible with safe operations whenever and wherever possible. Light sources should, if possible and consistent with safe working practices, be positioned in places where emissions to the surrounding environment can be minimised;
- Keep disorientated, but otherwise unharmed, seabirds in dark containers for subsequent release during daylight hours. Ringed/banded birds should be reported to the appropriate ringing/banding scheme (details are provided on the ring);
- Avoid the unnecessary discharge of ballast water;
- Use filtration procedures during loading in order to avoid the uptake of potentially harmful aquatic organisms, pathogens and sediment that may contain such organisms;
- Ensure that routine cleaning of ballast tanks to remove sediments is carried out, where practicable, in mid-ocean or under controlled arrangements in port or dry dock, in accordance with the provisions of the ship's Ballast Water Management Plan;

- Ensure all equipment (e.g. arrays, streamers, tail buoys etc) that has been used in other regions is thoroughly cleaned prior to deployment;
- Implement a waste management system that addresses all wastes generated at the various sites, shore-based and marine. This should include:
  - Separation of wastes at source;
  - Recycling and re-use of wastes where possible;
  - Treatment of wastes at source (maceration of food wastes, compaction, incineration, treatment of sewage and oily water separation).
- Implement leak detection and repair programmes for valves, flanges, fittings, seals, etc.
- Use a low-toxicity biodegradable detergent for the cleaning of all deck spillages.
- The vessel operators should keep a constant watch for marine mammals and turtles in the path of the vessel.
- Keep watch for marine mammals behind the vessel when tension is lost on the towed equipment and either retrieve or regain tension on towed gear as rapidly as possible.
- Ensure that 'turtle-friendly' tail buoys are used by the survey contractor or that existing tail buoys are fitted with either exclusion or deflector 'turtle guards'.
- Ensure vessel transit speed between the survey area and port is a maximum of 12 knots (22 km/hr), except in the MPAs where it is reduced further to 10 knots (18 km/hr) as well as when they are present in the vicinity.
- Ensuring that loads are lifted using the correct lifting procedure and within the maximum lifting capacity of crane system.
- Minimise the lifting path between vessels.
- Undertake frequent checks to ensure items and equipment are stored and secured safely on board each vessel.
- In the event that equipment is lost during the operational stage, assess safety and metocean conditions before performing any retrieval operations. Establishing a hazards database listing the type of gear left on the seabed and/or in the Survey area with the dates of abandonment/loss and locations, and where applicable, the dates of retrieval
- Use low toxicity dispersants cautiously and only with the permission of DFFE.
- As far as possible, and whenever the sea state permits, attempt to control and contain the spill at sea with suitable recovery techniques to reduce the spatial and temporal impact of the spill
- Ensure adequate resources are provided to collect and transport oiled birds to a cleaning station.
- Ensure offshore bunkering is not undertake in the following circumstances:
  - Wind force and sea state conditions of ≥6 on the Beaufort Wind Scale;
  - During any workboat or mobilisation boat operations;
  - During helicopter operations;
  - During the transfer of in-sea equipment; and
  - At night or times of low visibility.

11.4.2 FISHERIES

- Prior to the commencement of seismic survey activities the following key stakeholders should be consulted and informed of the proposed seismic survey programme (including navigational co-ordinates of location, timing and duration of proposed activities) and the likely implications thereof (specifically the exclusion and safety zone around the seismic vessel):
  - Fishing industry associations: SA Tuna Association; SA Tuna Longline Association and Fresh Tuna Exporters Association.
  - Other key stakeholders: SAN Hydrographer, South African Maritime Safety Association, Ports Authority and the DFFE Vessel Monitoring, Control and Surveillance Unit in Cape Town.
- These stakeholders should again be notified at the completion of the project when the survey and support vessels are off location.
- Request, in writing, the SAN Hydrographer to broadcast a navigational warning via Navigational Telex (Navtext) and Cape Town radio for the duration of the seismic survey activity.
- Distribute a Notice to Mariners prior to the commencement of the seismic survey operations. The Notice to Mariners should give notice of (1) the co-ordinates of the survey area, (2) an indication of the proposed survey timeframes, (3) the dimensions of the towed gear array and dimensions of the safety zone around the seismic vessel, and (4) provide details on the movements of support vessels servicing the project. This Notice to Mariners should be distributed timeously to fishing companies and directly onto vessels where possible.
- An experienced Fisheries Liaison Officer should be placed on board the seismic or guard vessel to facilitate communications with fishing vessels in the vicinity of the seismic survey areas.
- The lighting on the seismic and support vessels should be managed to ensure that they are sufficiently illuminated to be visible to fishing vessels, as well as ensure that it is reduced to a minimum compatible with safe operations whenever and wherever possible.
- Notify any fishing vessels at a radar range of 12 nm from the seismic vessel via radio regarding the safety requirements around the seismic vessel.
- Implement a grievance mechanism in case of disruption to fishing or navigation.

11.4.3 HERITAGE

The following recommendations are based on the UNESCO ICHC guidelines and is aimed at safeguarding the cultural heritage of the small-scale fishers and cultural groupings in influence of this project:

- Re-assess post-project the potential effects on the identified communities and their intangible cultural heritage. This will require consideration of the socio-economic baseline developed during the previous survey and this environmental impact process. Based on the outcomes, provide resources and support to enhance the mitigation capacity of communities' intangible cultural heritage by fostering dialogue, mutual understanding and reconciliation between and within communities.
- Based on the outcomes, provide resources and support for communities to develop and undertake safeguarding measures or plans to enhance the mitigation capacity of their intangible cultural heritage by fostering dialogue, mutual understanding and reconciliation between and within communities.

11.4.4 SOCIAL

Based on the findings of the SIA, the following recommendations are made:

- Searcher should continue to implement the community engagement protocol that was developed in 2023/24.

- Continue to consult with communities on potential ways in which to make a positive contribution to the communities.
- Stakeholder fatigue is a serious concern in the area and should be addressed by collectively:
    - Undertaking fewer, but more informative / effective stakeholder consultations;
    - Where possible, avoid prolonged engagements with communities suffering from stakeholder fatigue; and
    - To be effective and to reduce stakeholder fatigue, engagements need to be targeted, with clear aims and results.
- Participatory processes and workshops where communities can engage in experiential learning should be considered. If the oil and gas industry fails to address the community's need for education and cooperation it will result in significant delays and increase the risk for social unrest.
- There should be a grievance mechanism available for the duration of the seismic surveys.

11.4.5 ACOUSTICS

In the unlikely event that multiple surveys would take place at the same time, during seismic pulse releases, maintain a distance of at least 40 kilometres from any other survey vessel until sufficient objective evidence is obtained from modelling that a reduced buffer distance is acceptable.

12 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations relating to this Basic Assessment should be noted:

12.1 FISHERIES

The study is based on a number of assumptions and is subject to certain limitations, which should be noted when considering information presented in this report. The validity of the findings of the study is not expected to be affected by these assumptions and limitations:

- The official governmental record of fisheries data was used to display fishing catch and effort relative to the proposed project area. These data are derived from logbooks that are completed by skippers, and it is assumed that there will be a proportion of erroneous data due to mistakes in the capturing of these data into electronic format. The proportion of erroneous data is estimated to be up to 10% of the total dataset and would be primarily related to the accurate recording or transcription of the fishing position (latitude and longitude). Where obvious errors in the reporting of fishing positions were identified these were excluded from the analysis.
- In assessing the impact of the proposed exclusion zone on fishing operations, catch and effort figures are quoted across the entire extent of the proposed survey areas. In practice, the exclusion area would be a moving exclusion zone of approximately 165 km^2 extending around the vessel (based on the required safety clearances). The approach adopted for this report is likely to be an overestimate of the potential impact on fishing operations which in reality could continue within certain portions of the proposed survey area.
- The acoustic impact is transitory i.e. the sound source moves in space and time as the survey progresses within the target area.
- The effects of seismic sound on the CPUE of fish and invertebrates have been drawn from the findings of international studies. To date there have been no studies focused directly on the species found locally. Although the results from international studies are likely also to be representative for local species, current gaps in knowledge on the topic lead to uncertainty when attempting to accurately quantify the potential loss of catch for each type of fishery. Research into the effects of seismic sound on marine fauna is ongoing.

12.2 GENERAL

In determining the significance of impacts, with mitigation, it is assumed that mitigation measures proposed in the report are correctly and effectively implemented and managed throughout the life of the project.

12.3 NOISE

The assumptions made in the noise technical report are as follows:

- Data obtained was provided to SLR in May 2024. The data was reviewed to check assumptions around the modelled source depth, temperature profile and source emission strengths. The data is considered accurate.
- The in-line survey directions for the 3D survey modelling locations are assumed to be NW-SE.
- Two survey line sections are assumed to be acquired within the 24-hour period for each noise modelling scenario.
- For marine seismic surveys, the cumulative exposure level at certain locations is modelled based on the assumption that the animals are constantly exposed to the survey seismic source noise at a fixed location over the entire 24-hour period.

12.4 MARINE ECOLOGY

As determined by the terms of reference, this study has adopted a 'desktop' approach. Consequently, the description of the natural baseline environment in the study area is based on a review and collation of existing information and data from the scientific literature, internal reports and the MMO Reports. The assumptions made in this specialist assessment are:

- The study is based on the project description made available to the specialist at the time of the commencement of the study.
- Some important conclusions regarding the extent of the zones of impact of seismic sound and associated assessments on marine fauna are based on the results of the Underwater Acoustic Modelling Study (SLR Consulting Australia 2024).
- Potential changes in the marine environment such as sea-level rise and/or increases in the severity and frequency of storms related to climate change are not included in the terms of reference and therefore not dealt with in this report.
- All identified marine impacts are summarised, categorised and ranked in appropriate impact assessment tables, to be incorporated in the overall EIA Report.

Information gaps include:

- details of the benthic macrofaunal communities beyond the shelf break;
- details on demersal fish communities beyond the shelf break;
- information specific to the marine communities of seamounts (Tripp Seamount, Child's Bank) and submarine canyons (Cape Canyon and Cape Point Canyon); and
- current information on the distribution, population sizes and trends of most cetacean species occurring in South African waters and the project area in particular.

Keeping these information gaps in mind, the assessment of impacts has adopted a strongly precautionary approach.

12.5 HERITAGE

Not detracting from the stakeholder engagement completed, it is necessary to realise that the intangible heritage elements identified during engagements only represent some possible intangible cultural heritage elements present in this region. Various factors account for this, including the layered histories (e.g., memory of conflict, dispossession, and disempowerment through time) associated with the West Coast region, specifically in terms of intangible and living heritage resources associated with the ocean landscape. The values attributed to the ocean by the communities do not necessarily align to provide one definitive single significance to the ocean. Instead, the depth and complexity of values assigned to intangible heritage in this landscape depend on people's relationship to the ocean and their feelings about the proposed project.

12.6 SOCIAL

The following assumptions and limitations were relevant:

- Not every individual in the community could be interviewed therefore only key people in the community were approached for discussion. Additional information was obtained using existing data.
- The social environment constantly changes and adapts to change, and external factors outside the scope of the project can offset social changes, for example changes in local political leadership, droughts or economic conditions. It is therefore difficult to predict all impacts to a high level of

accuracy, although care has been taken to identify and address the most likely impacts in the most appropriate way for the current local context within the limitations.

- Given that the survey will be conducted over a short period of time, the the impacts will be short term and from an outsiders perspective may appear as inconsequential. However, the outcomes of the survey will introduce new social impacts, and the potential of these impacts occuring is already causing fear and uncertainty amongst coastal communities. Communities view the survey as the beginning of potentially significant changes in their socio-economic environment.

- Social impacts can be felt on an actual or perceptual level, and therefore it is not always straightforward to measure the impacts in a quantitative manner.

- Social impacts commence when the project enters the public domain. Some of these impacts will occur irrespective of whether the project continues or not, and other impacts have already started. These impacts are difficult to mitigate and some would require immediate action to minimise the risk.

- There are different groups with different interests in the community, and what one group may experience as a positive social impact, another group may experience as a negative impact. This duality will be pointed out in the impact assessment phase of the report.

- Social impacts are not site-specific, but take place in the communities surrounding the proposed development.

13 AFFIRMATION REGARDING CORRECTNESS OF INFORMATION

I **Vukosi Mabunda** herewith undertake that the information provided in the foregoing report is correct to the best of my knowledge, and that the comments and inputs from stakeholders and Interested and Affected Parties has been correctly recorded in the report where applicable as well as inputs and recommendations from the specialist reports completed as part of this assessment.

Signature of the EAP

Date: 19 June 2024

14 REFERENCES

ABGRALL, P., MOULTON, V.D. & W.R. RICHARDSON. 2008. Updated Review of Scientific Information on Impacts of Seismic Survey Sound on Marine Mammals, 2004-present. LGL Rep. SA973-1. Rep. from LGL Limited, St. John's, NL and King City, ON, for Department of Fisheries and Oceans, Habitat Science Branch, Ottawa, ON. 27 p. + appendices.

ACO Associates cc. 2015. Heritage Impact Assessment for the Proposed Ibhubesi Gas Project West Coast. Prepared for CCA Environmental (Pty) Ltd.

AINSLIE, M. A., LAWS, R. M., AND SERTLEK, H. O., International Airgun Modelling Workshop: Validation of source signature and sound propagation models – Dublin (Ireland), 16 July 2016 – problem description, IEEE J. Ocean. Eng., to be published.

ANDERSEN, S. 1970. Auditory sensitivity of the harbour porpoise, Phocoena phocoena. Invest. Cetacea 2: 255-259.

ANDERSON, M. & P. HULLEY, 2000. Functional ecosystems: The Deep Sea. In: Durham B, Pauw J (eds), Marine Biodiversity Status Report for South Africa at the end of the 20th Century. Pretoria: National Research Foundation. pp 20–25.

ANDRÉ, M., SOLÉ, M., LENOIR, M., DURFORT, M., QUERO, C., MAS, A., LOMBARTE, A., VAN DER SCHAAR, M., LÓPEZ-BEJAR, M., MORELL, M., ZAUGG, S. & L. HOUÉGNIGAN, 2011. Low-frequency sounds induce acoustic trauma in cephalopods. Front. Ecol. Environ. 9(9): 489–493.

ANDRIGUETTO-FILHO, J.M., OSTRENSKY, A., PIE, M.R., SILVA, U.A., BOEGER, W.A., 2005. Evaluating the impact of seismic prospecting on artisanal shrimp fisheries. Continental Shelf Research, 25: 1720–1727.

ANTONOV, J. I., SEIDOV, D., BOYER, T. P., LOCARNINI, R. A., MISHONOV, A. V., GARCIA, H. E., BARANOVA, O. K., ZWENG, M. M., AND JOHNSON, D. R., 2010, World Ocean Atlas 2009, Volume 2: Salinity. S. Levitus, Ed. NOAA Atlas NESDIS 69, U.S. Government Printing Office, Washington, D.C., 184 pp.

ASHFORD, O.S., KENNY, A.J., BARRIO FROJÁN, C.R.S., DOWNIE, A-L., HORTON, T. & A.D. ROGERS, 2019. On the Influence of Vulnerable Marine Ecosystem Habitats on Peracarid Crustacean Assemblages in the Northwest Atlantic Fisheries Organisation Regulatory Area. Frontiers in Marine Science 11.

ATEMA, J., FAY, R.R., POPPER, A.N. & W.N. TAVOLGA, 1988. Sensory biology of aquatic animals. Springer-Verlag, New York.

ATKINSON, L.J. & K.J. SINK (eds), 2018. Field Guide to the Offshore Marine Invertebrates of South Africa. Malachite Marketing and Media, Pretoria, pp498.

ATKINSON, L.J., 2009. Effects of demersal trawling on marine infaunal, epifaunal and fish assemblages: studies in the southern Benguela and Oslofjord. PhD Thesis. University of Cape Town, pp 141.

ATKINSON, L.J., FIELD, J.G.and L. HUTCHINGS, 2011. Effects of demersal trawling along the west coast of southern Africa: multivariate analysis of benthic assemblages. Marine Ecology Progress Series 430: 241-255.

AU, W.W.L. 1993. The Sonar of dolphins. Springer-Verlag, New York. 277p.

AU, W.W.L., NACHTIGALL, P.E. & J.L. POlowSKI, 1999. Temporary threshold shift in hearing induced by an octave band of continuous noise in the bottlenose dolphin. J. Acoust. Soc. Am., 106: 2251.

AUGUSTYN C.J., LIPINSKI, M.R. and M.A.C. ROELEVELD, 1995. Distribution and abundance of sepioidea off South Africa. S. Afr. J. Mar. Sci. 16: 69-83.

AUGUSTYN, C. J. 1990. Biological studies on the chokka squid Loligo vulgaris reynaudii (Cephalopoda; Myopsida) on spawning grounds off the south-east coast of South Africa. South African Journal of Marine Science, 9(1), 11-26.

AUGUSTYN, C. J., LLPIŃSKI, M. R., & SAUER, W. H. H. (1992). Can the Loligo squid fishery be managed effectively? A synthesis of research on Loligo vulgaris reynaudii. South African Journal of Marine Science, 12(1), 903-918.

AUGUSTYN, C.J., LIPINSKI, M.R., SAUER, W.H.H., ROBERTS, M.J., MITCHELL-INNES, B.A., 1994. Chokka squid on the Agulhas Bank: life history and ecology. S. Afr. J. Sci., 90: 143-153.

AUSTER, P.J., GJERDE, K., HEUPEL, E., WATLING, L., GREHAN, A. & A.D. ROGERS, 2011. Definition and detection of vulnerable marine ecosystems on the high seas: problems with the “move-on” rule. ICES Journal of Marine Science 68: 254–264.

AUSTIN, M., MCCRODAN, A., WLADICHUK, J., 2013, MARINE MAMMAL MONITORING AND MITIGATION DURING SHELL’S ACTIVITIES IN THE CHUKCHI SEA, JULY–SEPTEMBER 2013: DRAFT 90-DAY REPORT. (CHAPTER 3) IN REIDER, H. J., L. N. BISSON, M. AUSTIN, A. MCCRODAN, J. WLADICHUK, C. M. REISER, K.B. MATTHEWS, J.R. BRANDON, K. LEONARD, ET AL., (eds.). Underwater Sound Measurements. LGL Report P1272D–2. Report from LGL Alaska Research Associates Inc., Anchorage, AK, USA, and JASCO Applied Sciences, Victoria, BC, Canada, for Shell Gulf of Mexico, Houston, TX.

Avery, G. 1975. Discussion of the age and use of tidal fishtraps (visvyers). South African Archaeological Bulletin 30: 105 – 113.

AVILA, I.C., DORMANN, C.F., GARCÍA, C., PAYÁN, L.F. & M.X. ZORRILLA, 2019. Humpback whales extend their stay in a breeding ground in the Tropical Eastern Pacific. ICES J. Mar. Sci., 77: 109–118.

AWBREY, F.T. & B.S. STEWART, 1983. Behavioural responses of wild beluga whales (Delphinapterus leucas) to noise from oil drilling. Journal of the Acoustical Society of America, Suppl. 1, 74: S54.

AWBREY, F.T., THOMAS, J.A., KASTELIN, R.A., 1988. Low frequency underwater hearing sensitivity in belugas, Delphinapterus leucas. J. Acoust. Soc. Am., 84(6): 2273-2275.

AXELSON, E. 1998. Vasco da Gama: The Diary of his Travels Through African Waters. Published by Philips (Pty) Ltd.

BACKUS, R.H. & W.E. SCHEVILL, 1966. "Physter clicks," In: K. S. Norris (Ed.) Whales, dolphins and porpoises, University of California Press, Berkeley and Los Angeles.

BAILEY G.W. and P. CHAPMAN, 1991. Chemical and physical oceanography. In: Short-term variability during an Anchor Station Study in the southern Benguela Upwelling system. Prog. Oceanogr., 28: 9-37.

BAILEY, G.W., 1991. Organic carbon flux and development of oxygen deficiency on the modern Benguela continental shelf south of 22°S: spatial and temporal variability. In: TYSON, R.V., PEARSON, T.H. (Eds.), Modern and Ancient Continental Shelf Anoxia. Geol. Soc. Spec. Publ., 58: 171–183.

BAILEY, G.W., 1999. Severe hypoxia and its effect on marine resources in the southern Benguela upwelling system. Abstract, International Workshop on Monitoring of Anaerobic processes in the Benguela Current Ecosystem off Namibia.

BAILEY, G.W., BEYERS, C.J. DE B. and S.R. LIPSCHITZ, 1985. Seasonal variation of oxygen deficiency in waters off southern South West Africa in 1975 and 1976 and its relation to catchability and distribution of the Cape rock-lobster Jasus lalandii. S. Afr. J. Mar. Sci., 3: 197-214.

BAILLON, S., HAMEL, J-F., WAREHAM, V.E. & A. MERCIER, 2012. Deep cold-water corals as nurseries for fish larvae. Frontiers in Ecology and the Environment 10: 351–356.

BAIN, D.E., KREITE, B. & M.E. DAHLHEIM, 1993. Hearing abilities of killer whales (Orcinus orca). J. Acoust. Soc. Am., 93(3,pt2): 1929.

BALCOMB, K.C. & D.E. CLARIDGE, 2001. A mass stranding of cetaceans caused by naval sonar in the Bahamas. Bahamas J. Sci., 8(2): 1-12.

BANKS, A. BEST, P.B., GULLAN, A., GUISSAMULO, A., COCKCROFT, V. & K. FINDLAY, 2011. Recent sightings of southern right whales in Mozambique. Document SC/S11/RW17 submitted to IWC Southern Right Whale Assessment Workshop, Buenos Aires 13-16 Sept. 2011.

BARENDSE, J., BEST, P.B., THOMTON, M., POMILLA, C. CARVALHO, I. and H.C. ROSENBAUM, 2010. Migration redefined ? Seasonality, movements and group composition of humpback whales Megaptera novaeangliae off the west coast of South Africa. Afr. J. mar. Sci., 32(1): 1-22.

BARENDSE, J., BEST, P.B., THORNTON, M., ELWEN, S.H., ROSENBAUM, H.C., CARVALHO, I., POMILLA, C., COLLINS, T.J.Q. and M.A. MEŸER, 2011. Transit station or destination? Attendance patterns, regional movement, and population estimate of humpback whales Megaptera novaeangliae off West South Africa based on photographic and genotypic matching. African Journal of Marine Science, 33(3): 353-373.

BARGER, J.E. & W.R. HAMBLEN. 1980. "The air gun impulsive underwater transducer". J. Acoust. Soc. Am., 68(4): 1038-1045.

BARNARD, A. 1992. Hunters and Herders of Southern Africa: A Comparative Ethnography of the Khoisan Peoples. Cambridge University Press, Cambridge.

BARNETT, E. & Casper, M. 2001. Research: A definition of "social environment". American Journal of Public Health. 91(3): 465.

BARRIO FROJÁN, C.R.S., MACISAAC, K.G., MCMILLAN, A.K., DEL MAR SACAU CUADRADO, M., LARGE, P.A., KENNY, A.J., KENCHINGTON, E. & E. DE CÁRDENAS GONZÁLEZ, 2012. An evaluation of benthic community structure in and around the Sackville Spur closed area (Northwest Atlantic) in relation to the protection of vulnerable marine ecosystems. ICES Journal of Marine Science 69: 213–222.

BARTOL, S.M. & D.R. KETTEN, 2006. Turtle and tuna hearing. In: SWIMMER, Y., BRILL, R. (Eds.), Sea Turtle and Pelagic Fish Sensory Biology: Developing Techniques to Reduce Sea Turtle Bycatch in Longline FisheriesTechnicalMemorandum NMFS-PIFSC-7. National Ocean and Atmospheric Administration (NOAA), US Department of Commerce, pp. 98–105.

BATTERSHILL, C., CAPPO, M., COLQUHOUN, J., CRIPPS, E., JORGENSEN, D., MCCORRY, D., STOWAR, M. & W. VENABLES, 2007. Environmental Report for Seismic 3-D effects on deep water corals for Woodside Petroleum and EPA. Scott Reef Australian Institute of Marine Science.

BATTERSHILL, C., CAPPO, M., COLQUHOUN, J., CRIPPS, E., JORGENSEN, D., MCCORRY, D., STOWAR, M. & W. VENABLES, 2008. Final Report. Towed Video and Photoquadrat Assessments for Seismic 3-D effects on deep water corals for Woodside Petroleum and EPA. Scott Reef, May 2008.

BAX, N, WILLIAMSON, A., AGUERO, M., GONZALEZ, E. and W. GEEVES, 2003. Marine invasive alien species: a threat to global biodiversity. Marine Policy 27: 313-323.

BEAZLEY, L.I., KENCHINGTON, E.L., MURILLO, F.J. & M DEL M.SACAU, 2013. Deep-sea sponge grounds enhance diversity and abundance of epibenthic megafauna in the Northwest Atlantic. ICES Journal of Marine Science 70: 1471–1490.

BEAZLEY. L., KENCHINGTON, E., YASHAYAEV, I. & F.J. MURILLO, 2015. Drivers of epibenthic megafaunal composition in the sponge grounds of the Sackville Spur, northwest Atlantic. Deep Sea Research Part I: Oceanographic Research Papers 98: 102–114.

BEJDER, L., SAMUELS, A., WHITEHEAD, H. & N. GALES, 2006. Interpreting short-term behavioral responses to disturbance within a longitudinal perspective. Animal Behavior 72: 1149-1158.

BELL, P.A., Fisher, J.D., Baum, A. & Greene, T.C. 1996. Environmental Psychology – Fourth Edition. Florida: Harcourt Brace College Publishers.

BENTHIC SOLUTIONS LTD, 2019. Venus 1X Environmental Baseline Survey. Vol 2: Environmental Baseline Survey and Habitat Assessment Report. Prepared for Total E & P Namibia B.V. May 2019, pp152.

BERG, J.A. and R.I.E. NEWELL, 1986. Temporal and spatial variations in the composition of seston available to the suspension-feeder Crassostrea virginica. Estuar. Coast. Shelf. Sci., 23: 375–386.

BERGEN, M., WEISBERG, S.B., SMITH, R.W., CADIEN, D.B., DALKEY, A., MONTAGNE, D.E., STULL, J.K., VELARDE, R.G. and J. ANANDA RANASINGHE, 2001. Relationship between depth, sediment, latitude and the structure of benthic infaunal assemblages on the mainland shelf of southern California. Marine Biology 138: 637-647.

BERGSTAD, O.A., GIL, M., HØINES, Å.S., SARRALDE, R., MALETZKY, E., MOSTARDA, E., SINGH, L., ANTÓNIO, M.A., RAMIL, F., CLERKIN, P. & G. CAMPANIS, 2019. Megabenthos and benthopelagic fishes on Southeast Atlantic seamounts, African Journal of Marine Science, 41(1): 29-50.

BEST P.B., MEŸER, M.A. & C. LOCKYER, 2010. Killer whales in South African waters – a review of their biology. African Journal of Marine Science. 32: 171–186.

BEST, P.B. and C. ALLISON, 2010. Catch History, seasonal and temporal trends in the migration of humpback whales along the west coast of southern Africa. IWC sc/62/SH5.

BEST, P.B. and C.H. LOCKYER, 2002. Reproduction, growth and migrations of sei whales Balaenoptera borealis off the west coast of South Africa in the 1960s. South African Journal of Marine Science, 24: 111-133.

BEST, P.B., 2001. Distribution and population separation of Bryde's whale Balaenoptera edeni off southern Africa. Mar. Ecol. Prog. Ser., 220: 277 – 289.

BEST, P.B., 2007. Whales and Dolphins of the Southern African Subregion. Cambridge University Press, Cape Town, South Africa.

BEST, P.B., GLASS, J.P., RYAN, P.G. & M.L. DALEBOUT, 2009. Cetacean records from Tristan da Cunha, South Atlantic. J. Mar. Biol. Assoc. UK, 89: 1023–1032.

BEST, P.B., MEŸER, M.A., THORNTON, M., KOTZE, P.G.H., SEAKAMELA, S.M., HOFMEYR, G.J.G., WINTNER, S., WELAND, C.D. and D. STEINKE, 2014. Confirmation of the occurrence of a second killer whale morphotype in South African waters. African Journal of Marine Science 36: 215-224.

BEST, P.B., SEKIGUCHI, K. and K.P. FINDLAY, 1995. A suspended migration of humpback whales Megaptera novaeangliae on the west coast of South Africa. Marine Ecology Progress Series, 118: 1–12.

BETT, B.J. & A.L. RICE, 1992. The influence of hexactinellid sponge (Pheronema carpenteri) spicules on the patchy distribution of macrobenthos in the porcupine seabight (bathyal ne atlantic). Ophelia 36: 217–226.

BIANCHI, G., HAMUKUAYA, H. and O. ALVHEIM, 2001. On the dynamics of demersal fish assemblages off Namibia in the 1990s. South African Journal of Marine Science 23: 419-428.

BICCARD A, GIHWALA K, CLARK BM, HARMER RW, BROWN EA, MOSTERT BP, WRIGHT AG & A MASOSONKE. 2018. De Beers Marine Namibia Environmental Monitoring Programme: Atlantic 1 Mining Licence Area 2016 Benthic Sampling Campaign. Report prepared for De Beers Marine Namibia by Anchor Environmental Consultants (Pty) Ltd. Report no. 1726/1.

BICCARD, A. & B.M. CLARK, 2016. De Beers Marine Namibia Environmental Monitoring Programme in the Atlantic 1 Mining Licence Area: 2013 Benthic Sampling Campaign. Report prepared for De Beers Marine Namibia by Anchor Environmental Consultants (Pty) Ltd. Report no. 1527/3.

BICCARD, A., CLARK, B.M. & E.A. BROWN, 2016. De Beers Marine Namibia Environmental Monitoring Programme in the Atlantic 1 Mining Licence Area: 2014 Benthic Sampling Campaign. Report prepared for De Beers Marine Namibia by Anchor Environmental Consultants (Pty) Ltd. Report no. 1527/4.

BICCARD, A., CLARK, B.M., BROWN, E.A., DUNA, O., MOSTERT, B.P., HARMER, R.W., GIHWALA, K. & A.G. WRIGHT, 2017. De Beers Marine Namibia Environmental Monitoring Programme: Atlantic 1 Mining Licence Area 2015 Benthic Sampling Campaign. Report prepared for De Beers Marine Namibia by Anchor Environmental Consultants (Pty) Ltd. Report no. 1527/4.

BICCARD, A., K. GIHWALA, B.M. CLARK, E.A. BROWN, B.P. MOSTERT, A. MASOSONKE, C. SWART, S. SEDICK, B. TSHINGANA & J. DAWSON, 2019. De Beers Marine Namibia Environmental Monitoring Programme: Atlantic 1 Mining Licence Area 2017 Benthic Sampling Campaign. Report prepared for De Beers Marine Namibia by Anchor Environmental Consultants (Pty) Ltd. Report no. 1775/1.

BIRCH G.F., ROGERS J., BREMNER J.M. and G.J. MOIR, 1976. Sedimentation controls on the continental margin of Southern Africa. First Interdisciplinary Conf. Mar. Freshwater Res. S. Afr., Fiche 20A: C1-D12.

BIRCH, G. & J. ROGERS, 1973. Nature of the seafloor between Lüderitz and Port Elizabeth. South African Shipping News and Fishing Industry Review 39: 56–65.

BIRDLIFE SOUTH AFRICA, 2021. Threatened seabird habitats in the South African Economic Exclusive Zone: biodiversity feature layer submission to the National Coastal and Marine Spatial Biodiversity Plan. BirdLife South Africa SCP Report 2021/1.

BIRDLIFE SOUTH AFRICA, 2022. Threatened seabird habitats in the South African Exclusive Economic Zone: biodiversity feature layer submission to the National Coastal and Marine Spatial Biodiversity Plan. BirdLife South Africa SCP Report 2022/1.

BLACKWELL, S.B., NATIONS, C.S., McDONALD, T.L., GREENE JR, C.R., THODE, A.M., GUERRA, M., et al., 2013. Effects of airgun sounds on bowhead whale calling rates in the Alaskan Beaufort Sea. Mar Mamm Sci.; 29(4): E342–E365.

BLACKWELL, S.B., NATIONS, C.S., McDONALD, T.L., THODE, A.M., MATHIAS, D., KIM, K.H., GREENE JR, C.R. & A.M. MACRANDER, 2015. Effects of airgun sounds on bowhead whale calling rates: evidence for two behavioral thresholds. PloS one 10(6): p.e0125720.

BLESS, C., Higson-Smith, C. & Kagee, A. 2006. Fundamentals of Social Research Methods. An African Perspective. 4th Ed. Cape Town: Juta and Company Ltd.

BLOOM, P. & M. JAGER, 1994. The injury and subsequent healing of a serious propeller strike to a wild bottlenose dolphin (Tursiops truncatus) resident in cold waters off the Northumberland coast of England. Aquatic Mammals, 20(2: 59-64.

BOERTMANN, D., TOUGAARD, J., JOHANSEN, K., MOSBECH, A.,. 2009. Guidelines to environmental impact assessment of seismic activities in Greenland waters. NERI Technical Report no. 723. 44pp.

BOEZAK, W. 2016. Struggle of an Ancient Faith – A Hisotry of the Khoikhoi of Southern Africa. Bidvest Data, 40.

BOHNE, B.A., BOZZAY, D.G. & J.A. THOMAS, 1986. Evaluation of inner ear pathology in Weddell seals. Antarctic Journal of the United States, 21(5): 208.

BOHNE, B.A., THOMAS, J.A. YOHE, E. & S. STONE, 1985. Examination of potential hearing damage in Weddell seals (Leptonychotes weddellii) in McMurdo Sound, Antarctica. Antarctica Journal of the United States, 19(5): 174-176.

BOOMAN, C., DALEN, J., LEIVESTAD, H., LEVSEN, A., VAN DER MEEREN, T. & K. TOKLUM, 1996. Effekter av luftkanonskyting på egg, larver og yngel. Undersøkelser ved Havforskningsinstituttet og Zoologisk Laboratorium, UiB. (Engelsk sammendrag og figurtekster). Havforskningsinstituttet, Bergen. Fisken og Havet, 3 (1996). 83pp.

BOOMAN, C., LEIVESTAD, H. & J. DALEN, 1992. Effects of Air-gun Discharges on the Early Life Stages of Marine Fish. Scandinavian OIL-GAS Magazine, Vol. 20 – No 1/2 1992.

BOOTH, C.G., SINCLAIR, R.R. & J. HARWOOD, 2020. Methods for Monitoring for the Population Consequences of Disturbance in Marine Mammals: A Review. Front. Mar. Sci., 7: 115. doi: 10.3389/fmars.2020.00115

BOWLES, A.E. & S.J. THOMPSON. 1996. A review of nonauditory physiological effects of noise on animals (A). J. Acoust. Soc. Am., 100(4): 2708-2708.

BOWLES, A.E., SMULTEA, M., WURSIG, B., DE MASTER, D.P. & D. PALKA, 1991. Biological survey effort and findings from the Heard Island feasibility test 19 January – 3 February 1991. Report from Hubbs/Sea World Research Institute, San Diego, California. pp102.

BOYD, A..J. and G.P.J. OBERHOLSTER, 1994. Currents off the west and south coasts of South Africa. S. Afr. Shipping News and Fish. Ind. Rev., 49: 26-28.

BRADLEY, D.L. & R. STERN, 2008. Underwater sound and the marine mammal acoustic environment: A guide to fundamental principles. US Marine Mammal Commission. July 2008, pp79

BRANCH, T.A., STAFFORD, K.M., PALACIOS, D.M., ALLISON, C., BANNISTER, J.L., BURTON, C.L.K., CABRERA, E., CARLSON, C.A., GALLETTI VERNAZZANI, B., GILL, P.C., HUCKE-GAETE, R., JENNER, K.C.S., JENNER, M.-N.M., MATSUOKA, K., MIKHALEV, Y.A., MIYASHITA, T., MORRICE, M.G., NISHIWAKI, S., STURROCK, V.J., TORMOSOV, D., ANDERSON, R.C., BAKER, A.N., BEST, P.B., BORSA, P., BROWNELL JR, R.L., CHILDERHOUSE, S., FINDLAY, K.P., GERRODETTE, T., ILANGAKOON, A.D., JOERGENSEN, M., KAHN, B., LJUNGBLAD, D.K., MAUGHAN, B., MCCAULEY, R.D., MCKAY, S., NORRIS, T.F., OMAN WHALE AND DOLPHIN RESEARCH GROUP, RANKIN, S., SAMARAN, F., THIELE, D., VAN WAEREBEEK, K. and R.M. WARNEKE, 2007. Past and present distribution, densities and movements of blue whales in the Southern Hemisphere and northern Indian Ocean. Mammal Review, 37 (2): 116-175.

BRANDÃO, A., VERMEULEN, E., ROSS-GILLESPIE, A., FINDLAY, K. and D.S. BUTTERWORTH, 2017. Updated application of a photo-identification based assessment model to southern right whales in South African waters, focussing on inferences to be drawn from a series of appreciably lower counts of calving females over 2015 to 2017. Paper SC/67b/SH22 to the 67th Meeting of the Scientific Committee of the International Whaling Commission, Bled, Slovenia.

BRANSCOMB, E.S., RITTSCHOF, D., 1984. An investigation of low frequency sound waves as a means of inhibiting barnacle settlement. Journal of Experimental Marine Biology and Ecology, 79: 149–154.

BREDEKAMP, H. C. AND VAN DEN BERG, O. (eds), 1986. A New History Atlas for South Africa. Publishers: Edward Arnold.Brink, G. 2000.

BREEZE, H., DAVIS, D.S. BUTLER, M. and V. KOSTYLEV, 1997. Distrbution and status of deep sea corals off Nova Scotia. Marine Issues Special Committee Special Publication No. 1. Halifax, NS: Ecology Action Centre. 58 pp.

BREMNER, J.M., ROGERS, J. & J.P. WILLIS, 1990. Sedimentological aspects of the 1988 Orange River floods. Trans. Roy. Soc. S. Afr. 47 : 247-294.

BRICELJ, V.M. and R.E. MALOUF, 1984. Influence of algal and suspended sediment concentrations on the feeding physiology of the hard clam Mercenaria mercenaria. Mar. Biol., 84: 155–165.

BRÖKER, K., GAILEY, G.A., MUIR, J. & R. RACCA, 2015. Monitoring and impact mitigation during a 4D seismic survey near a population of gray whales off Sakhalin Island, Russia. Endangered Species Research, 28: 187 208.

BRÖKER, K.C.A., 2019. An Overview of Potential Impacts of Hydrocarbon Exploration and Production on Marine Mammals and Associated Monitoring and Mitigation Measures. Aquatic Mammals, 45(6): 576-611.

BROWN, P.C. and J.L. HENRY, 1985. Phytoplankton production, chlorophyll a and light penetration in the southern Benguela region during the period between 1977 and 1980. In: SHANNON, L.V. (Ed.) South African Ocean Colour and Upwelling Experiment. Cape Town, SFRI : 211-218.

BROWN, P.C., 1984. Primary production at two contrasting nearshore sites in the southern Benguela upwelling region, 1977-1979. S. Afr. J. mar. Sci., 2 : 205-215.

BRUCE, B., BRADFORD, R., FOSTER, S., LEE, K., LANSDELL, M., COOPER, S. & R. PRZESLAWSKI, 2018. Quantifying fish behaviour and commercial catch rates in relation to a marine seismic survey. Marine Environmental Research, 140: 18–30.

BRUCE, B., Bradford, R., Foster, S., Lee, K., Lansdell, M., Cooper, S. and Przeslawski, R. 2018. Quantifying fish behaviour and commercial catch rates in relation to a marine seismic survey. Marine Environmental Research 140: 18–30.

BRUNNSCHWEILER, J.M., BAENSCH, H., PIERCE, S.J. & D.W. SIMS, 2009. Deep-diving behaviour of a whale shark Rhincodon typus during long-distance movement in the western Indian Ocean. Journal of Fish Biology, 74: 706–714.

BUDELMANN, B.U., 1988. Morphological diversity of equilibrium receptor systems in aquatic invertebrates. In: ATEMA, J. et al., (Eds.), Sensory Biology of Aquatic Animals, Springer-Verlag, New York, : 757-782.

BUDELMANN, B.U., 1992. Hearing in crustacea. In: WEBSTER, D.B. et al. (Eds.), Evolutionary Biology of Hearing, Springer-Verlag, New York, : 131-139.

BUHL-MORTENSEN, L. & P.B. MORTENSEN, 2005. Distribution and diversity of species associated with deep-sea gorgonian corals off Atlantic Canada. Cold-water corals and ecosystems. Springer. pp 849–879.

BUHL-MORTENSEN, L., VANREUSEL, A., GOODAY, A.J., LEVIN, L.A., PRIEDE, I.G., BUHL-MORTENSEN, P., GHEERARDYN, H., KING, N.J. & M. RAES, 2010. Biological structures as a source of habitat heterogeneity and biodiversity on the deep ocean margins. Marine Ecology 31: 21–50.

CADE, D.E., SEAKAMELA, S.M., FINDLAY, K.P., FUKUNAGA, J., KAHANE-RAPPORT, S.R., WARREN, J.D., et al., 2021. Predator-scale spatial analysis of intra-patch prey distribution reveals the energetic drivers of rorqual whale super-group formation. Funct. Ecol., 35: 894–908.

CALDWELL, J. & W. DRAGOSET, 2000. A brief overview of seismic air-gun arrays. The Leading Edge, 19: 898-902.

CAMPBELL, K., 2016. Factors influencing the foraging behaviour of African Penguins (Spheniscus demersus) provisioning chicks at Robben Island, South Africa. Unpublished PhD Thesis, University of Cape Town, 258pp.

CAMPHER, C. J., DI PRIMIO, R., KUHLMANN, G., VAN DER SPUY, D. AND DOMONEY, R., 2009, Geological Modelling of the Offshore Orange Basin, West Coast of South Africa (2nd Edition), AAPG International Conference and Exhibition, Rio de Janeiro, Brazil, November 15-18, 2009.

CAPRICORN MARINE ENVIRONMENTAL PTY LTD, 2024. Proposed 3D Seismic Survey In The Orange Basin, Offshore South Africa - Specialist Fisheries Assessment.

CARLTON, J.T., 1987. Patterns of transoceanic marine biological invasions in the Pacific Ocean. Bulletin of Marine Science 41: 452–465.

CARLTON, J.T., 1999. The scale and ecological consequences of biological invasions in the world's oceans. In: SANDLUND, O.T., SCHEI, P.J. & A. VIKEN (eds), Invasive species and biodiversity management. Dordrecht: Kluwer Academic Publishers. pp 195–212.

CARLUCCI, R., MANEA, E., RICCI, P., CIPRIANO, G., FANIZZA, C., MAGLIETTA, R. & E. GISSI, 2021. Managing multiple pressures for cetaceans' conservation with an Ecosystem-Based Marine Spatial Planning approach. Journal of Environmental Management, 287:112240.

CARROLL, A.G., PRZESLAWSKI, R., DUNCAN, A., GUNNING, M., BRUCE, B., 2017. A critical review of the potential impacts of marine seismic surveys on fish and invertebrates. Marine Pollution Bulletin, 114: 9-24.

CATHALOT. C., VAN OEVELEN, D., COX, T.J.S., KUTTI, T., LAVALEYE, M., DUINEVELD, G. & F.J.R. MEYSMAN, 2015. Cold-water coral reefs and adjacent sponge grounds: Hotspots of benthic respiration and organic carbon cycling in the deep sea. Frontiers in Marine Science 2: 37.

CERCHIO, S., STRINDBERG, S., COLLINS, T., BENNETT, C. & H.C. ROSENBAUM, 2014. Seismic surveys negatively affect Humpback Whale singing activity off Northern Angola. PLoS ONE, 9: e86464.

CETUS PROJECTS CC, 2007. Specialist report on the environmental impacts of the proposed Ibhubesi Gas Field on marine flora and fauna. Document prepared for CCA Environmental (Pty) Ltd., 35 Roeland Square, 30 Drury Lane, Cape Town, 8001.

CHAHOURI, A., ELOUAHMANI, N. & H. OUCHENE, 2021. Recent progress in marine noise pollution: A thorough review. Chemosphere, in press.

CHAPMAN, C.J. & A.D. HAWKINS, 1973. A field study of hearing in the cod, Gadus morhua. Journal of Comparative Physiology, 85:147-167.

CHAPMAN, P. and L.V. SHANNON, 1985. The Benguela Ecosystem. Part II. Chemistry and related processes. Oceanogr. Mar. Biol. Ann. Rev., 23: 183-251.

CHILD, M.F., ROXBURGH, L., DO LINH SAN, E., RAIMONDO, D. and DAVIES-MOSTERT, H.T. (editors). 2016. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. (https://www.ewt.org.za/Reddata/Order%20Cetacea.html).

CHILDERHOUSE, S. & DOUGLAS, L., 2016, Information Document: Review of multibeam echosounder surveys and potential impacts on marine mammals, Document Reference Number: BPM-16-MDC-Review of multibeam echosounder surveys and marine mammals v1.2.Collins, M. D., 1993, A split-step Padé solution for the parabolic equation method, J. Acoust. Soc. Am., 93: 1736-1742.

CHOLEWIAK, D., CLARK, C.W., PONIRAKIS, D., FRANKEL, A., HATCH, L.T., RISCH, D., STANISTREET, J.E., THOMPSON, M., VU, E. & S.M. VAN PARIJS, 2018. Communicating amidst the noise: modeling the aggregate influence of ambient and vessel noise on baleen whale communication space in a national marine sanctuary. Endanger. Species Res., 36: 59–75.

CHRISTIAN, J.R., MATHIEU, A., THOMSON, D.H., WHITE, D. & R.A. BUCHANAN, 2003. Effects of Seismic Energy on Snow Crab (Chionoecetes opilio). Report from LGL Ltd. Og Oceans Ltd. for the National Energy Board, File No.: CAL-1-00364, 11 April 2003. 91pp.

CHRISTIE N.D. and A.G. MOLDAN, 1977. Effects of fish factory effluent on the benthic macro-fauna of Saldanha Bay. Marine Pollution Bulletin, 8: 41-45.

CHRISTIE, N.D., 1974. Distribution patterns of the benthic fauna along a transect across the continental shelf off Lamberts Bay, South Africa. Ph.D. Thesis, University of Cape Town, 110 pp & Appendices.

CHRISTIE, N.D., 1976. A numerical analysis of the distribution of a shallow sublittoral sand macrofauna along a transect at Lambert's Bay, South Africa. Transactions of the Royal Society of South Africa, 42: 149-172.

CLARK, B. M., HAUK, M., HARRIS, J. M., SALO, K., & RUSSELL, E. (2010). Identification of subsistence fishers, fishing areas, resource use and activities along the South African coast. South African Journal of Marine Science, 24: 425–437.

CLARK, M.R., O'SHEA, S., TRACEY, D. and B. GLASBY, 1999. New Zealand region seamounts. Aspects of their biology, ecology and fisheries. Report prepared for the Department of Conservation, Wellington, New Zealand, August 1999. 107 pp.

CLARKE, R., 1956. Marking whales from a helicopter. Norsk Hvalfangst-Tidende 45: 311-318.

CLIFF, G., ANDERSON-READE, M.D., AITKEN, A.O., CHARTER, G.E. & V.M. PEDDEMORS, 2007. Aerial census of whale sharks (Rhincodon typus) on the northern KwaZulu-Natal coast, South Africa. Fish Res., 84: 41−46.

COCHRANE, K.L., WILKINSON, S., 2015. Assessment of the Potential Impacts on the Small Pelagic Fishery of the proposed 2D Seismic Survey by Rhino Oil and Gas Exploration South Africa (Pty) Ltd in the inshore area between Saldanha Bay and Cape Agulhas. Unpublished Report as part of the EIA undertaken on behalf of CapMarine (Pty) Ltd for Rhino Oil and Gas Exploration South Africa (Pty) Ltd. December 2015, pp20.

COCKCROFT, A.C, SCHOEMAN, D.S., PITCHER, G.C., BAILEY, G.W.AND D.L. VAN ZYL, 2000. A mass stranding, or 'walk out' of west coast rock lobster, Jasus lalandii, in Elands Bay, South Africa: Causes, results and implications. In: VON VAUPEL KLEIN, J.C.and F.R. SCHRAM (Eds), The Biodiversity Crisis and Crustacea: Proceedings of the Fourth International Crustacean Congress, Published by CRC press.

COCKCROFT, A.C., VAN ZYL, D. AND L. HUTCHINGS, 2008. Large-Scale Changes in the Spatial Distribution of South African West Coast Rock Lobsters: An Overview. African Journal of Marine Science 2008, 30 (1) : 149–159.

COETZEE, J.C., VAN DER LINGEN, C.D., HUTCHINGS, L. and T.P. FAIRWEATHER, 2008. Has the fishery contributed to a major shift in the distribution of South African sardine? ICES Journal of Marine Science 65: 1676–1688.

COETZEE, M. 2002. Summary document on the IDP LA21 relationship. Local pathway to sustainable development in South Africa. Package presented to the World Summit on Sustainable Development, Department of Provincial and Local Government, Johannesburg.

COLEY, N.P. 1994. Environmental impact study: Underwater radiated noise. Institute for Maritime Technology, Simon's Town, South Africa. pp. 30.

COLEY, N.P. 1995. Environmental impact study: Underwater radiated noise II. Institute for Maritime Technology, Simon's Town, South Africa. pp. 31.

COLMAN, J.G., GORDON, D.M., LANE, A.P., FORDE, M.J. and J.J. FITZPATRICK, 2005. Carbonate mounds off Mauritania, Northwest Africa: status of deep-water corals and implications for management of fishing and oil exploration activities. In: Cold-water Corals and Ecosystems, Freiwald, A and Roberts, J. M. (eds). Springer-Verlag Berlin Heidelberg pp 417-441.

COMPAGNO, L.J.V., 2001. Sharks of the World: an annotated and illustrated catalogue of shark species known to date. Bullhead, mackerel and carpet sharks (Heterodontiformes, Lamniformes and Orectolobiformes). FAO Species Catalogue for Fisheries Purposes No. 1, vol. 2. Food and Agriculture Organization of the United Nations, Rome, Italy

COMPAGNO, L.J.V., EBERT, D.A. and P.D. COWLEY, 1991. Distribution of offshore demersal cartilaginous fish (Class Chondrichthyes) off the West Coast of southern Africa, with notes on their systematics. S. Afr. J. Mar. Sci. 11: 43-139.

COMPTON, R, GOODWIN, L., HANDY, R. & V. ABBOTT, 2007. A critical examination of worldwide guidelines for minimising the disturbance to marine mammals during seismic surveys. Marine Policy, doi:10.1016/j.marpol.2007.05.005

CONSTANTINE, R., 2001. Increased avoidance of swimmers by wild bottlenose dolphins (Tursiops truncatus) due to long-term exposure to swim-with-dolphin tourism. Marine Mammal Science 17: 689-702.

Constitution of the Republic of South Africa, 1996

COSTA, D., SCHWARZ, L., ROBINSON, P., SCHICK, R., MORRIS, P.A., CONDIT, R., et al., 2016. A bioenergetics approach to understanding the population consequences of disturbance: Elephant seals as a model system. In: POPPER, A.N. & A. HAWKINS (Eds.), The effects of noise-on aquatic life II: Advances in experimental medicine and biology, 875: 161-169.

COTE, D., MORRIS, C.J., REGULAR, P.M. & M.G. PIERSIAK, 2020. Effects of 2D Seismic on Snow Crab Movement Behavior, Fisheries Research, 20: 105661.COURTENAY, S.C., BOUDREAU, M. & K. LEE, 2009. Potential impacts of seismic energy on snow crab: an update on the September 2004 peer review. Fisheries and Oceans Canada, Moncton.

COURTENAY, S.C., BOUDREAU, M. & K. LEE, 2009. Potential impacts of seismic energy on snow crab: an update on the September 2004 peer review. Fisheries and Oceans Canada, Moncton.

COX, K., BRENNAN, L.P., GERWING, T.G., DUDAS, S.E. & F. JUANES, 2018. Sound the alarm: A meta-analysis on the effect of aquatic noise on fish behavior and physiology. Global Change Biology, 24: 3105–3116.

COX, T.M. and 35 others. 2006. Understanding the impacts of anthropogenic sound on beaked whales. J. Cetacean Res. Manage., 7(3): 177-187.

CRAWFORD R.J.M., RYAN P.G. and A.J. WILLIAMS. 1991. Seabird consumption and production in the Benguela and western Agulhas ecosystems. S. Afr. J. Mar. Sci. 11: 357-375.

CRAWFORD R.J.M., Shannon L.V., Pollock D.E. 1987. The Benguela Ecosystem. Part IV. The major fish and invertebrate resources. Oceanogr. Mar. Biol. Ann. Rev. 25: 353-505.

CRAWFORD, R.J., MAKHADO, A.B., WALLER, L.J. & P.A. WHITTINGTON, 2014. Winners and losers–Responses to recent environmental change by South African seabirds that compete with purse-seine fisheries for food. Ostrich 85: 111–117.

CRAWFORD, R.J., MAKHADO, A.B., WHITTINGTON, P.A., RANDALL, R.M., OOSTHUIZEN, W.H. & L.J. WALLER, 2015. A changing distribution of seabirds in South Africa—The possible impact of climate and its consequences. Frontiers in Ecology and Evolution 3: 1–10.

CRAWFORD, R.J.M. & G. DE VILLIERS, 1985. Snoek and their prey – interrelationships in the Benguela upwelling system. S. Afr. J. Sci., 81(2): 91–97.

CRAWFORD, R.J.M. 1980. Seasonal patterns in South Africa's western Cape purse-seine fishery. J. Fish. Biol., 16 (6): 649-664.

CRAWFORD, R.J.M., DUNDEE, B.L., DYER, B., KLAGES, N.T.W., MEYER, M.A. & L. UPFOLD, 2011. Trends in numbers of Cape gannets (Morus capensis), 1956/1957-2005/2006, with consideration of the influence of food and other factors. ICES Journal of Marine Science, 64: 169-177.

CRAWFORD, R.J.M., SHANNON, L.V. and D.E. POLLOCK, 1987. The Benguela ecosystem. 4. The major fish and invertebrate resources. Oceanogr. Mar. Biol. Ann. Rev., 25: 353 - 505.

CROFT, B. & B. Li, 2017. Shell Namibia Deepwater Exploration Drilling: Underwater Noise Impact Assessment. Prepared by SLR Consulting Australia Pty Ltd. for SLR Consulting (Cape \Town) Pty Ltd. 19pp.

CROWTHER CAMPBELL & ASSOCIATES CC and CENTRE FOR MARINE STUDIES (CCA & CMS). 2001. Generic Environmental Management Programme Reports for Oil and Gas Prospecting off the Coast of South Africa. Prepared for Petroleum Agency SA, October 2001.

CRUIKSHANK, R.A., 1990. Anchovy distribution off Namibiadeduced from acoustic surveys with an interpretation of migration by adults and recruits. S. Afr. J. Mar. Sci., 9: 53-68.

CRUM, L.A. & Y. MAO, 1996. Acoustically induced bubble growth at low frequencies and its implication for human diver and marine mammal safety. J Acoust. Soc. Am., 99(5): 2898-2907.

CSIR & CIME, 2011. Environmental Impact Assessment for Exploration Drilling Operations, Yoyo Mining Concession and Tilapia Exploration Block, Offshore Cameroon. CSIR Report no. CSIR/CAS/EMS/ER/2011/0015/A.

CSIR, 1996. Elizabeth Bay monitoring project: 1995 review. CSIR Report ENV/S-96066.

CSIR, 1998. Environmental Impact Assessment for the Proposed Exploration Drilling in Petroleum Exploration Lease 17/18 on the Continental Shelf of KwaZulu-Natal, South Africa. CSIR Report ENV/S-C 98045.

CSIR, 2006. Environmental Management Programme Report for Exploration/Appraisal Drilling in the Kudu Gas Production Licence No 001 on the Continental Shelf of Namibia. Prepared for: Energy Africa Kudu Limited, CSIR Report: CSIR/NRE/ECO/2006/0085/C.

CUNHA, H.A., DE CASTRO, R.L., SECCHI, E.R., CRESPO, E.A., LAILSON-BRITO, J., AZEVEDO, A.F., LAZOSKI, C. & A.M. SOLÉ-CAVA, 2015. Molecular and morphological differentiation of common dolphins (Delphinus spp.) in the southwestern Atlantic: testing the two species hypothesis in sympatry. PloS One 10:e0140251.

CURRIE JC, ATKINSON LJ, FAIRWEATHER TP & AMOROSO RO. 2021. Mapping the distribution of South African demersal trawl activity, 2005-2018. Draft Technical Report. 18pp.

CURRIE, D.R., SOROKIN, S.J. and T.M. WARD, 2009. Infaunal macroinvertebrate assemblages of the eastern Great Australian Bight: effectiveness of a marine protected area in representing the region's benthic biodiversity. Marine and Freshwater Research 60: 459-474.

DA SILVA, C., KERWATH, S.E., WILKE, C., MEŸER, M. & S.J. LAMBERT, 2010. First documented southern transatlantic migration of blue shark Prionace glauca tagged off South Africa. African Journal of Marine Science, 32(3) : 639-642.

DAFF (Department of Agriculture, Forestry and Fisheries) 2008. Annual report of South Africa: Part 1 (Submitted to ICCAT).

DAFF (Department of Agriculture, Forestry and Fisheries) 2016. Small-Scale Fisheries. A guide to the small-scale fisheries sector. http://small-scalefisheries.co.za/wp-content/downloads/SSF%20Booklet%20English.pdf

DAFF (Department of Agriculture, Forestry and Fisheries) 2016. Status of the South African marine fishery resources 2016. Cape Town: DAFF.

DAFF (Department of Agriculture, Forestry and Fisheries) media release: 09 February 2016. Small-scale fisheries sector – establishing the legal framework and moving towards implementation.

DAFF (Department of Agriculture, Forestry and Fisheries). 2014. Section C. Sector specific conditions: beach seine and gillnet fishery. Fishing season: 2014. Department of Agriculture, Forestry and Fisheries, Cape Town.

DAFF (Department of Agriculture, Forestry and Fisheries). 2015. Policy on the allocation of commercial fishing rights in the seaweed fishery. Government Gazette, 16 November 2015 No. 39417. Department of Agriculture, Forestry and Fisheries, Cape Town.

DAFF (Department of Agriculture, Forestry and Fisheries). 2017. Sector specific conditions: commercial linefishery. Fishing season: 2016/7. Department of Agriculture, Forestry and Fisheries, Cape Town.

DAFF Fishing Industry Handbook: South Africa, Namibia & Mozambique: 2019 47th Edition. George Warman Publications. Cape Town.

DAHLHEIM, M.E. & D.K. LJUNGBLAD, 1990. Preliminary hearing study on gray whales (Eschrichtius robustus) in the field. pp 335-346. In: THOMAS, J.A. and KASTELIN, R.A. (Eds.) Sensory abilities of cetaceans, laboratory and field evidence. NATO ASI Series A: Life Sciences Vol. 196, Plenum Press, New York 710 pp.

DALEN, J. & A. RAKNESS, 1985. Scaring effects on fish from 3D seismic surveys. Rep P.O. 8504. Institute of Marine Research, Bergen Norway.

DALEN, J. & G.M. KNUTSEN, 1986. Scaring effects in fish and harmful effects on eggs. Larvae and fry by offshore seismic explorations. P. 93-102 In: MERKLINGER, H.M. (ed.) Progress in underwater acoustics. Plenum Press, London. 835pp

DALEN, J. & K. MÆSTED, 2008. The impact of seismic surveys. Marine Research News 5.

DALEN, J. 1973. Stimulering av sildestimer. Forsøk i Hopavågen og Imsterfjorden/Verrafjorden 1973. Rapport for NTNF. NTH, nr. 73-143-T, Trondheim. 36 s.

DALEN, J., DRAGSUN, E., NÆSS, A. & O. SAND, 2007. Effects of seismic surveys on fish, fish catches and sea mammals. Report prepared for Cooperation group - Fishery Industry and Petroleum Industry. Report no.: 2007-0512.

DALEN, J., ONA, E., VOLD SOLDAL, A. & R. SÆTRE, 1996. Seismiske undersøkeleser til havs: En vurdering av konsekvenser for fisk og fiskerier. Fisken og Havet, 9: 1-26.

DARLING, J.D. & R. SOUSA-LIMA, 2005. Songs indicate interaction between humpback whale (Megaptera novaeangliae) populations in the Western and Eastern South Atlantic Ocean. Marine Mammal Science, 21(3): 557-566.

DARLING, J.D., ACEBES, J.M.V., FREY, O., URBÁN, R.J. & M. YAMAGUCHI, 2019. Convergence and divergence of songs suggests ongoing, but annually variable, mixing of humpback whale populations throughout the North Pacific. Sci. Rep., 9: 1–14.

DAVID, J. & VAN SITTERT, L. 2006. A Reconstruction of the Cape (South African) fur seal harvest 1653 – 1899 and a comparison with the 20th-century harvest. South African Journal of Science 104. Pp 107 – 110.

DAVID, J.H.M, 1989., Seals. In: Oceans of Life off Southern Africa, Eds. Payne, A.I.L. and Crawford, R.J.M. Vlaeberg Publishers. Halfway House, South Africa.

DAVID, M. & SUTTON, C.D. 2004. Social Research: The Basics. London: Sage Publications.

DAVIDSEN, J.G., DONG, H., LINNE, M., ANDERSSON, M.H., PIPER, A., PRYSTAY, T., HVAM, E.B., THORSTAD, E.B., WHORISKEY, F., COOKE, S.J., SJURSEN, A.D., RONNING, L., NETLAND, T.C. & A.D. HAWKINS. 2019. Effects of sound exposure from a seismic airgun on heart rate, acceleration and depth use in free-swimming Atlantic cod and saithe. Conserv Physiol 7(1): coz020; doi:10.1093/conphys/coz020.

DAVIS, R.W., EVANS, W.E. & B. WÜRSIG, 2000. Cetaceans, sea turtles and seabirds in the Northern Gulf of Mexico: distribution, abundance and habitat associations. OCS Study MMS 2000-03, US Dept of the Interior, Geological Survey, Biological Resources Division and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

DAY, J.H., FIELD, J.G. and M. MONTGOMEREY, 1971. The use of numerical methods to determine the distribution of the benthic fauna across the continental shelf of North Carolina. Journal of Animal Ecology 40:93-126.

DAY, R.D., McCAULEY, R., FITZGIBBON, Q.P., SEMMENS, J.M., 2016a. Assessing the Impact of Marine Seismic Surveys on Southeast Australian Scallop and Lobster Fisheries. (FRDC Report 2012/008) University of Tasmania, Hobart.

DAY, R.D., McCAULEY, R.D., FITZGIBBON, Q.P., SEMMENS, J.M., 2016b. Seismic air gun exposure during early-stage embryonic development does not negatively affect spiny lobster Jasus edwardsii larvae (Decapoda:Palinuridae). Sci Rep 6, 22723.

DAY, R.D., McCAULEY, R.D., FITZGIBBON, Q.P., SEMMENS, J.M., 2017. Seismic air gun exposure during early-stage embryonic development does not negatively affect spiny lobster Jasus edwardsii larvae (Decapoda:Palinuridae). Sci Rep 6, 22723.

DE DECKER, A.H., 1970. Notes on an oxygen-depleted subsurface current off the west coast of South Africa. Invest. Rep. Div. Sea Fish. South Africa, 84, 24 pp.

DE JONG, K., AMORIM, M.C.P, FONSECA, P.J., FOX, C.J. AND HEUBEL, K.U. 2018. Noise can affect acoustic communication and subsequent spawning success in fish. Environmental Pollution 237: 814-823.

DE JONG, K., FORLAND, T.N., AMORIM, M.C.P., RIEUCAU, G., SLABBEKOORN, H. & L.D. SIVLE, 2020. Predicting the effects of anthropogenic noise on fish reproduction. Rev. Fish. Biol. Fish., 30: 245–268.

DE KOCK W.K. (ED.) 1968. Dictionary of South African Biography, vol.1. Cape Town: South African Library.

DE ROCK, P., ELWEN, S.H., ROUX, J-P., LEENEY, R.H., JAMES, B.S., VISSER, V., MARTIN, M.J. and T. GRIDLEY, 2019. Predicting large-scale habitat suitability for cetaceans off Namibia using MinxEnt. Marine Ecology Progress Series, 619: 149-167.

DE WET, W.M., 2013. Bathymetry of the South African Continental Shelf. MSc Thesis, University of Cape Town, South Africa.

DEACON, 1995. Archaeological Heritage in Southern Africa: A South African Perspective. African Cultural heritage and the World Heritage Convention.

DEACON, H. AND SMEETS, R., 2013. Authenticity, value and community involvement in heritage management under the World heritage and intangible heritage conventions. Heritage & Society, 6(2), pp.129-143.

DEACON, H. J., DEACON, J., BROOKER, M., AND WILSON, M. L. 1978. The evidence for herding at Boomplaas Cave in the southern Cape, South Africa. South African Archaeological Bulletin 33: 39-65.

DEACON, J. 1988. The power of a place in understanding southern African rock engravings. World Archaeology 20: 129-140.

DEAT (Department of Environmental Affairs and Tourism). 2004. Cumulative Effects Assessment, Integrated Environmental Management, Information Series 7, Department of Environmental.

DEFF (Department of Environment, Forestry and Fisheries) 2019. Strategic Environmental Assessment for Marine and Freshwater Aquaculture Development in South Africa. ISBN: 978-0-7988-5646-1. CSIR Report Number: CSIR/IU/021MH/ER/2019/0050/A. Stellenbosch, Western Cape.

DEFF (Department of Environment, Forestry and Fisheries) 2020. Marine Living Resources Act, 1998 (Act No. 18 of 1998): Invitation to comment on the proposed resource split between local commercial and small-scale fishing in the traditional linefish, squid and abalone fishing sectors (Notice 1129). Government Gazette, 43835: 58-60 (23 October).

DEFF (Department of Environment, Forestry and Fisheries) 2020. Marine Living Resources Act, 1998 (Act No. 18 of 1998): Invitation to comment on the proposed reclassification of the white mussel, oyster and hake handline fishing sectors as small-scale fishing species (Notice 1130). Government Gazette, 43834: 61-62 (23 October).

DEFF (Department of Environment, Forestry and Fisheries) 2020. Status of the South African marine fishery resources 2020. Cape Town: DEFF.

DEL GROSSO, V. A., 1974, New equation for the speed of sound in natural waters (with comparisons to other equations), J. Acoust. Soc. Am. 56: 1084-1091.

DEPARTMENT OF FISHERIES AND OCEANS CANADA [DFO], 2004. Review of scientific information on impacts of seismic sound on fish, invertebrates, marine turtles and marine mammals. In: DFO Can. Sci. Advis. Sec. Habitat Status Report 2004/002.

DEROUS, D., TEN DOESCHATE, M., BROWNlow, A.C., DAVISON, N.J. & D. LUSSEAU, 2020. Toward New Ecologically Relevant Markers of Health for Cetaceans. Front. Mar. Sci., 7: 367. doi: 10.3389/fmars.2020.00367

DeRUITER, S. & K. LARBI DOUKARA, 2012. Loggerhead turtles dive in response to airgun sound exposure. Endanger. Species Res. 16: 55–63. http://dx.doi.org/10.3354/ esr00396.

DeRUITER, S.L., SOUTHALL, B.L., CALAMBOKIDIS, J., ZIMMER, W.M.X., SADYKOVA, D., FALCONE, E.A., FRIEDLAENDER, A.S., JOSEPH, J.E., MORETTI, D., SCHORR, G.S., THOMAS, L. & P.L. TYACK, 2013. First direct measurements of behavioural responses by Cuvier's beaked whales to mid-frequency active sonar. Biol. Lett., 9: 2013022320130223.

DERVILLE, S., TORRES, L.G., ALBERTSON, R., ANDREWS, O., BAKER, C.S., CARZON, P., et al., 2019. Whales in warming water: assessing breeding habitat diversity and adaptability in Oceania's changing climate. Glob. Change Biol., 25: 1466–1481.

DERVILLE, S., TORRES, L.G., ZERBINI, A.N., OREMUS, M. & C. GARRIGUE, 2020. Horizontal and vertical movements of humpback whales inform the use of critical pelagic habitats in the western South Pacific. Sci. Rep., 10: 4871.

DeSOTO, N.A., DELORME, N., ATKINS, J., HOWARD, S., WILLIAMS, J. & M. JOHNSON, 2013. Anthropogenic noise causes body malformations and delays development in marine larvae. Nature: Scientific Reports, 3: 2831. DOI: 10.1038/srep02831.

DEY, S.P., VICHI, M., FEARON, G. et al., 2021. Oceanographic anomalies coinciding with humpback whale super-group occurrences in the Southern Benguela. Sci Rep., 11, 20896.

DFO, 2004. Potential impacts of seismic energy on snow crab. DFO Can. Sci. Advis. Sec. Habitat Status Report 2004/003.

DI IORIO, L. & C.W. CLARKE, 2010. Exposure to seismic survey alters blue whale acoustic communication, Biol. Lett., 6: 51-54.

DING WANG, KEXIONG WANG, YOUFA XIAO GANG SHENG, 1992. Auditory sensitivity of a Chinese river dolphin, Lipotes vexillifer. In: KASTELEIN, T.R.A and SUPIN, A.Y. (eds.) Marine Mammal Sensory Systems. Plenum, New York. p213-221.

DINGLE, R.V., 1970. Bathymetry. Tech. Rep. Joint Geol. Surv./UCT Marine Geol. Prog. 3: 11 –12.

DINGLE, R.V., 1973. The Geology of the Continental Shelf between Lüderitz (South West Africa) and Cape Town with special reference to Tertiary Strata. J. Geol. Soc. Lond., 129: 337-263.

DINGLE, R.V., 1986. Revised bathymetric map of the Cape Canyon. Technical Report, Joint Geological Survey, University of Cape Town Marine Geoscience Unit 16: 20–25.

DINGLE, R.V., BIRCH, G. F., BREMNER, J. M., DE DECKER, R. H., PLESSIS, A. D., ENGELBRECHT, J. C, FINCHAM, M. J., FITTON, T., FLEMMING, B. W., GENTLE, R. I., GOODLAD, S. W., MARTIN, A. K., MILLS, E. G, MOIR, G. J., PARKER, R. J., ROBSON, S. H., ROGERS, J., SALMON, D. A., SIESSER, W. G., SIMPSON, E. S. W., SUMMERHAYES, C. P., WESTALL, F., WINTER, A. AND WOODBORNE, M. W., 1987, Deep sea sedimentary environments around southern Africa (South-East Atlantic and South- West Indian Oceans), Annals of the South African Museum, 98. 1-27. DOC (Ed), 2016, Report of the Sound Propagation and Cumulative Exposure Models Technical Working Group, Marine Species and Threats, Department of Conservation, Wellington, New Zealand, 59p.

DINGLE, R.V., BIRCH, G.F., BREMNER, J.M., DE DECKER, R.H., DU PLESSIS, A., ENGELBRECHT, J.C., FINCHAM, M.J., FITTON, T, FLEMMING, B.W. GENTLE, R.I., GOODLAD, S.W., MARTIN, A.K., MILLS, E.G., MOIR, G.J., PARKER, R.J., ROBSON, S.H., ROGERS, J. SALMON, D.A., SIESSER, W.G., SIMPSON, E.S.W., SUMMERHAYES, C.P., WESTALL, F., WINTER, A. and M.W. WOODBORNE, 1987. Deep-sea sedimentary environments around Southern Africa (South-east Atlantic and South-west Indian Oceans). Annals of the South African Museum 98(1).

DINGLE, R.V., SIESSER, W.G. & A.R. NEWTON, 1983. Mesozoic and Tertiary Geology of southern Africa. Rotterdam, Netherlands: Balkema.

DOUGLAS, A.B., CALAMBOKIDIS, J., RAVERTY, S., JEFFRIES, S.J., LAMBOURN, D.M.& S.A. NORMA, 2008. Incidence of ship strikes of large whales in Washington State. Journal of the Marine Biological Association of the United Kingdom 88: 1121-1132.

DOWNEY, N. J. 2014. The role of the deep spawning grounds in chokka squid (Loligo reynaudi d'orbigny, 1845) recruitment. PhD thesis, Rhodes University; Faculty of Science, Ichthyology and Fisheries Science

DOW-PINIAK, W., ECKERT, S., HARMS, C. & E. STRINGER, 2012a. Underwater hearing sensitivity of the leatherback sea turtle (Dermochelys coriacea): assessing the potential effect of anthropogenic noise. In: U.S Department of the Interior Bureau of Ocean Energy Management (Ed.), U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Headquarters, Herndon, VA. OCS Study BOEM 2012-01156.

DOW-PINIAK, W., MANN, D.A., ECKERT, S.A. & C.A. HARMS, 2012b. Amphibious hearing in sea turtles. In: POPPER, A.N. & A. HAWKINS (eds). The effect of noise on aquatic life. Springer, New York: 695.

DRAGOSET, W. 2000. Introduction to air guns and air gun arrays. The Leading Edge, May 2000: 892-897.

DRAGOSET, W. H., 1984, A comprehensive method for evaluating the design of airguns and airgun arrays, 16th Annual Proc. Offshore Tech. Conf. 3: 75-84.

DRAKE, D.E., CACCHIONE, D.A. and H.A. KARL, 1985. Bottom currents and sediment transport on San Pedro Shelf, California. J. Sed. Petr., 55: 15-28.

DREWITT, A. 1999. Disturbance effects of aircraft on birds. Birds Network Information Note, pp. 14. English Nature, Peterborough

DU PREEZ, M. & PEROLD, J. 2005. Scoping/feasibility study for the development of a new landfill site for the Northern Areas of the Metropolitan Municipality of Johannesburg. Socio-Economic Assessment. Mawatsan.

DUARTE, C.M., CHAPUIS, L., COLLIN, S.P., COSTA, D.P., DEVASSY, R.P., EGUILUZ, V.M., ERBE, C., GORDON, T.A., HALPERN, B.S., HARDING, H.R., HAVLIK, M.N., et al., 2021. The soundscape of the Anthropocene ocean. Science, 371 (6529).

DUNA, O., CLARK, B.M., BICCARD, A., HUTCHINGS, K., HARMER, R., MOSTERT, B., BROWN, E., MASSIE, V., MAKUNGA, M., DLAKU, Z. & A, MAKHOSONKE, 2016. Assessment of mining-related impacts on macrofaunal benthic communities in the Northern Inshore Area of Mining Licence Area MPT 25-2011 and subsequent recovery. Technical Report. Report prepared for De Beers Marine by Anchor Environmental Consultants (PTY) Ltd. Report no. 1646/1.

DUNCAN, C. and J.M. ROBERTS, 2001. Darwin mounds: deep-sea biodiversity 'hotspots'. Marine Conservation 5: 12.

DUNCAN, P.M. 1985. Seismic sources in a marine environment. pp. 56-88 In : Proceedings of the workshop on the effects of explosives use in the marine environment, Jan 29-31, 1985. Tech. Rep. 5. Can. Oil and Gas Admin. Environ. Protection Branch, Ottawa, Canada. 398 pp.

DUNCOMBE RAE, C.M., F.A. Shillington, J.J. Agenbag, J. Taunton-Clark and Grundlingh, M.L. 1992. An Agulhas ring in the South Atlantic Ocean and its interaction with the Benguela upwelling frontal system. Deep-Sea Research 39: 2009-2027.

DUNDEE, B.L., 2006. The diet and foraging ecology of chick-rearing gannets on the Namibian islands in relation to environmental features: a study using telemetry. MSc thesis, University of Cape Town, South Africa.

DUNLOP, R.A., BRAITHWAITE, J., MORTENSEN, L.O. & C.M. HARRIS, 2021. Assessing Population-Level Effects of Anthropogenic Disturbance on a Marine Mammal Population. Front. Mar. Sci., 8: 1 12.

DUNLOP, R.A., McCAULEY, R.D. & M.J. NOAD, 2020. Ships and air guns reduce social interactions in humpback whales at greater ranges than other behavioral impacts. Marine Pollution Bulletin, 154: 111072.

DUNLOP, R.A., NOAD, M.J., CATO, D.H. & D. STOKES, 2007. The social vocalization repertoire of east Australian migrating humpback whales (Megaptera novaeangliae), Journal of the Acoustical Society of America, 122: 2893-2905.

DUNLOP, R.A., NOAD, M.J., McCAULEY, R.D., KNIEST, E., PATON, D. & D.H. CATO, 2015. The behavioral response of humpback whales (Megaptera novaeangliae) to a 20 cubic inch air gun. Aquat. Mamm., 41 (4): 412–433.

DUNLOP, R.A., NOAD, M.J., McCAULEY, R.D., KNIEST, E., SLADE, R., PATON, D. & D.H. CATO, 2016. Response of humpback whales (Megaptera novaeangliae) to ramp-up of a small experimental air gun array. Mar. Pollut. Bull., 103 (1–2): 72–83.

DUNLOP, R.A., NOAD, M.J., McCAULEY, R.D., KNIEST, E., SLADE, R., PATON, D. & D.H. CATO, 2017a. The behavioural response of migrating humpback whales to a full seismic airgun array. Proceedings of the Royal Society B: Biological Sciences: 284(1869): 20171901.

DUNLOP, R.A., NOAD, M.J., McCAULEY, R.D., KNIEST, E., SLADE, R., PATON, D. & D.H. CATO, 2018. A behavioral dose-response model for migrating humpback whales and seismic air gun noise. Mar. Pollut. Bull., 133: 506–516.

DUNLOP, R.A., NOAD, M.J., McCAULEY, R.D., SCOTT-HAYWARD, L., KNIEST, E., SLADE, R., PATON, D. & D.H CATO, 2017b. Determining the behavioural dose-response relationship of marine mammals to air gun noise and source proximity. J. Exp. Biol., 220 (16): 2878–2886.

DUTKIEWICZ, A., MÜLLER, R. D., O'CALLAGHAN, S. AND JÓNASSON H., Census of seafloor sediments in the world's ocean, 2015, GEOLOGY, September 2015; v. 43; no. 9; p. 795–798, doi:10.1130/G36883.1.

ECKERT, S.A. & B.S. STEWART, 2001. Telemetry and satellite tracking of whale sharks, Rhincodon typus, in the Sea of Cortez, Mexico, and the north Pacific Ocean. Environmental Biology of Fishes, 60: 299–308.

ECKERT, S.A., BOWLES, A. & E. BERG, 1998. The effects of seismic airgun surveys on leatherback sea turtles (Dermochelys coriacea) during the nesting season. Final report submitted to BHP Petroleum. Hubbs-Sea World Research Institute, San Diego, CA. 66pp.

Environmental Impact Management Services, 2022. 1518 Searcher Reconnaissance Permit Basic Assessment Report.

ELLINGSEN, K.E., 2002. Soft-sediment benthic biodiversity on the continental shelf in relation to environmental variability. Marine Ecology Progress Series, 232: 15-27.

ELLIOTT, B.W., READ, A., GODLEY, B.J., NELMS, S.E. & D. NOWACEK, 2019. Critical information gaps remain in understanding impacts of industrial seismic surveys on marine vertebrates. Endanger. Species Res., 39: 247 254.

ELLISON, W.T., RACCA, R., CLARK, C.W., STREEVER, B. et al. 2016. Modeling the aggregated exposure and responses of bowhead whales Balaena mysticetus to multiple sources of anthropogenic underwater sound. Endang. Species Res., 30: 95−108.

ELLISON, W.T., SOUTHALL, B.L., FRANKEL, A.S., VIGNESS-RAPOSA, K. & C.W. CLARK, 2018. An acoustic scene perspective on spatial, temporal, and spectral aspects of marine mammal behaviour responses to noise. Aquat. Mamm., 44: 239−243.

ELPHICK, R. 1977. KRAAL AND CASTLE: Khoikhoi and the Founding of White South Africa. New Haven, London: Yale University Press.

ELPHICK, R. AND MALHERBE, V.C. 1989. "The Khoisan to 1828." In Elphick, R. and Giliomee, H. (editors). The Shaping of South African Society, 1652-1840. Cape Town: Maskew Miller Longman, pp. 3-65.

Elphick, R., and Giliomee, H. B. 1979. "The origins and entrenchment of European dominance at the Cape, 1652-c.1840." In Richard Elphick and Hermann Buhr Giliomee, The Shaping of South African Society, 1652-1820, 521-566. Middletown, CT: Wesleyan University Press.

ELVIN, S.S. & C.T. TAGGART, 2008. Right whales and vessels in Canadian waters. Marine Policy 32 (3): 379-386.

ELWEN S.H., REEB D., THORNTON M. & P.B. BEST, 2009a. A population estimate of Heaviside's dolphins Cephalorhynchus heavisidii in the southern end of their range. Marine Mammal Science 25: 107-124.

ELWEN S.H., SNYMAN L. & R.H. LEENEY, 2010a. Report of the Nambian Dolphin Project 2010: Ecology and conservation of coastal dolphins in Namibia. Submitted to the Ministry of Fisheries and Marine Resources, Namibia. Pp. 1-36.

ELWEN S.H., THORNTON M., REEB D. & P.B. BEST, 2010b. Near-shore distribution of Heaviside's (Cephalorhynchus heavisidii) and dusky dolphins (Lagenorhynchus obscurus) at the southern limit of their range in South Africa. African Journal of Zoology 45: 78-91.

ELWEN, S.H. & R.H. LEENEY, 2010. Injury and Subsequent Healing of a Propeller Strike Injury to a Heaviside's dolphin (Cephalorhynchus heavisidii). Aquatic Mammals 36 (4): 382-387.

ELWEN, S.H. & R.H. LEENEY, 2011. Interactions between leatherback turtles and killer whales in Namibian waters, including predation. South African Journal of Wildlife Research, 41(2): 205-209.

ELWEN, S.H. MEŸER, M.A.M, BEST, P.B., KOTZE, P.G.H, THORNTON, M. & S. SWANSON, 2006. Range and movements of a nearshore delphinid, Heaviside's dolphin Cephalorhynchus heavisidii a determined from satellite telemetry. Journal of Mammalogy, 87(5): 866–877.

ELWEN, S.H., BEST, P.B., REEB, D. & M. THORNTON, 2009b. Near-shore diurnal movements and behaviour of Heaviside’s dolphins (Cephalorhynchus heavisidii), with some comparative data for dusky dolphins (Lagenorhynchus obscurus). South African Journal of Wildlife Research, 39(2): 143-154.

ELWEN, S.H., BEST, P.B., THORNTON, M., & D. REEB, 2010. Near-shore distribution of Heaviside's (Cephalorhynchus heavisidii) and dusky dolphins (Lagenorhynchus obscurus) at the southern limit of their range in South Africa. African Zoology, 45(1).

ELWEN, S.H., FEAREY, J., ROSS-MARCH, E. & T. GRIDLEY, 2019. Cetaceans of the south east Atlantic – sightings from Cape Town to Vema Seamount, 2019. A report to Greenpeace International.

ELWEN, S.H., FEAREY, J., ROSS-MARSH, E.C, THOMPSON, K., MAACK, T., WEBBER, T. & T. GRIDLEY (in prep./Accepted with minor revision). Cetacean diversity of the eastern South Atlantic and Vema Seamount detected during a visual and passive acoustic survey, 2019. – Journal of the Marine Biological Association of the UK

ELWEN, S.H., FINDLAY, K.P., KISZKA, J. & C.R. WEIR, 2011. Cetacean research in the southern African subregion: a review of previous studies and current knowledge. African Journal of Marine Science, 33: 469 -493.

ELWEN, S.H., GRIDLEY, T., ROUX, J.-P., BEST, P.B. & M.J. SMALE, 2013. Records of Kogiid whales in Namibia, including the first record of the dwarf sperm whale (K. sima). Marine Biodiversity Records. 6, e45 doi:10.1017/S1755267213000213.

ELWEN, S.H., TONACHELLA, N., BARENDSE, J,. COLLINS, T.J.Q., BEST, P.B., ROSENBAUM, H.C., LEENEY, R.H. and T. GRIDLEY. 2014. Humpback Whales off Namibia: Occurrence, Seasonality, and a Regional Comparison of Photographic Catalogs and Scarring. Journal of Mammalogy, 95 (5): 1064–76. doi:10.1644/14-MAMM-A-108.

EMANUEL, B.P., BUSTAMANTE, R.H., BRANCH, G.M., EEKHOUT, S. and F.J. ODENDAAL, 1992. A zoogeographic and functional approach to the selection of marine reserves on the west coast of South Africa. S. Afr. J. Mar. Sci., 12: 341-354.

ENGÅS, A. & S. LØKKEBORG, 2002. Effects of seismic shooting and vessel-generated noise on fish behaviour and catch rates. Bioacoustics, 12: 313-315.

ENGÅS, A., LØKKEBORG, S., ONA, E. & A.V. SODAL, 1995. Effects of seismic shooting on local abundance and catch rates of cod (Gadus morhua) and haddock (Melanogrammus aeglefinus). Can J. Fish. Aquat. Sci., 53(10): 2238-2249.

ENGER, P.S. 1981. Frequency discrimination in teleosts - Central or peripheral ? pp 243-255. In : Tavolga, W.N., Popper, A.N. and Fay, R.R. (Eds.) Hearing and sound communication in fishes. Springer-Verlag, New York. 608 pp.

ENO, N.C., 1996. Non-native marine species in British waters: effects and controls. Aquatic Conservation: Marine and Freshwater Ecosystems 6: 215–28.

Equispectives Research & Consulting Services, 2024. Social Impact Assessment - ZA24-010_Orange Basin MC3D MSS Project.

ERBE, C., 2008, Critical ratios of beluga whales (Delphinapterus leucas) and masked signal duration, Journal of the Acoustical Society of America 124(4), 2216-2223.

ERBE, C., DUNLOP, R., JENNER, K.C.S., JENNER, M.N.M., MCCAULEY, R.D., PARNUM, I., PARSONS, M., ROGERS, T. & C. SALGADO-KENT, 2017. Review of Underwater and In-Air Sounds Emitted by Australian and Antarctic Marine Mammals. Acoust Aust 45, 179–241 (2017).

ERBE, C., DUNLOP, R.A. & S.J. DOLMAN, 2018. Effects of Noise on Marine Mammals. In: SLABBEKOORN, H., DOOLING, R. & A.N. POPPER (eds) Effects of Anthropogenic Noise on Animals. Springer, New York, p277 309.

ERBE, C., MARLEY, S.A., SCHOEMAN, R.P., SMITH, J.N., TRIGG, L.E. & C.B. EMBLING, 2019. The effects of ship noise on marine mammals—a review. Front. Mar. Sci., 6: 606.

ERBE, C., WILLIAMS, R., PARSONS, M., PARSONS, S.K., HENDRAWAN, G. & I.M.I. DEWANTAMA, 2018. Underwater noise from airplanes: An overlooked source of ocean noise. Mar. Pollut. Bull., 137: 656–661.

ERLING, K.A., STENEVIK, R.E., VERHEYE, H.M., LIPINSKI, M.R., OSTROWSKI, M. AND T. STRØMME. 2008. Drift routes of Cape hake eggs and larvae in the southern Benguela Current system. Journal of Plankton Research Vol. 30:10. Pp. 1147 – 1156.

ESCARAVAGE, V., HERMAN, P.M.J., MERCKX, B., WŁODARSKA-KOWALCZUK, M., AMOUROUX, J.M., DEGRAER, S., GRÉMARE, A., HEIP, C.H.R., HUMMEL, H., KARAKASSIS, I., LABRUNE, C. and W. WILLEMS, 2009. Distribution patterns of macrofaunal species diversity in subtidal soft sediments: biodiversity-productivity relationships from the MacroBen database. Marine Ecology Progress Series 382: 253-264.

ESTEVES, A.M., FRANKS, D. & VANCLAY, F. 2012. Social impact assessment: The state of the art, Impact Assessment & Project Appraisal 30(1): 35-44

EVANS, D.L. & G.R. ENGLAND, 2001. Joint Interim Report Bahamas Marine Mammal Stranding Event of 15-16 March 2000. U.S. Department of Commerce and U.S. Navy. http://www.nmfs.noaa.gov/prot_res/overview/Interim_Bahamas_Report.pdf.

EVANS, K., McCAULEY, R.D., EVESON, P. & T. PATTERSON, 2018. A summary of oil and gas exploration in the Great Australian Bight with particular reference to southern bluefin tuna. Deep-Sea Research Part II, 157-158: 190-202.

EVANS, P.G.H. & H. NICE, 1996. Review of the effects of underwater sound generated by seismic surveys on cetaceans. Rep. from Sea Watch Foundation for UKOOA. 50 pp.

FALK, M.R. & M.J. LAWRENCE, 1973. Seismic exploration : its nature and effect on fish. Tech. Rep. No. CENT/T-73-9. Resource Management Branch, Fisheries Operations Directorate, central region Winnipeg. 51 pp.

FAO, 2008. International Guidelines for the Management of Deep-Sea Fisheries in the High Seas. SPRFMO-VI-SWG-INF01

FARMER, N.A., BAKER, K., ZEDDIES, D.G., DENES, S.L., NOREN, D.P., GARRISON, L.P. & M. ZYKOV, 2018. Population consequences of disturbance by offshore oil and gas activity for endangered sperm whales (Physeter macrocephalus). Biol. Conserv., 227: 189–204.

FEGLEY, S.R., MACDONALD, B.A. & T.R. JACOBSEN, 1992. Short-term variation in the quantity and quality of seston available to benthic suspension feeders. Estuar. Coast. Shelf Sci., 34: 393–412.

FELTHAM, A., GIRARD, M., JENKERSON, M., NECHAYUK, V., GRISWOLD, S., HENDERSON, N. & G. JOHNSON, 2017. The Marine Vibrator Joint Industry Project: Four years on. Exploration Geophysics, 49(5), 675-687.

FERNANDEZ, A., EDWARDS, J.F., RODRIGUEZ, F., ESPINOSA DE LOS MONEROS, A., HERRAEZ, P., CASTRO, P., JABER, J., et al., 2005. "'Gas and Fat Embolic Syndrome'" Involving a Mass Stranding of Beaked Whales (Family Ziphiidae) Exposed to Anthropogenic Sonar Signals. Veterinary Pathology, 457: 446–457.

FEWTRELL, J.L, McCAULEY R.D., 2012. Impact of air gun noise on the behaviour of marine fish and squid. Marine Pollution Bulletin, 64: 984–993.

FIELD J.G. & C.A. PARKINS, 1998. A Baseline Study of the Benthic Communities of the Unmined Sediments of the De Beers Marine SASA Grid. Marine Biology Research Institute, University of Cape Town. Compiled for De Beers Marine (Pty) Ltd. pp 29.

FIELD, J.G., PARKINS, C.A., WINCKLER, H., SAVAGE, C. & K. VAN DER MERWE, 1996. Specialist study #9: Impact on benthic communities. In: Impacts of Deep Sea Diamond Mining, in the Atlantic 1 Mining Licence Area in Namibia, on the Natural Systems of the Marine Environment. Environmental Evaluation Unit Report No. 11/96/158, University of Cape Town. Prepared for De Beers Marine (Pty) Ltd.: 370 pp.

FIELDS, D.M., HANDEGARD, N.O., DALEN, J., EICHNER, C., MALDE, K., KARLSEN, Ø., SKIFTESVIK, A.B., DURIF, C.M. & H.I. BROWMAN, 2019. Airgun blasts used in marine seismic surveys have limited effects on mortality, and no sublethal effects on behaviour or gene expression, in the copepod Calanus finmarchicus. Journal of Marine Science, 76(7): 2033-2044.

FILANDER, Z., 2018. First impressions of the benthic biodiversity patterns of the Cape Canyon and its surrounding areas. Oral presentation at 2018 Biodiversity Planning Forum (Abstract).

FINDLAY K.P., BEST P.B., ROSS G.J.B. and V.C. COCKROFT. 1992. The distribution of small odontocete cetaceans off the coasts of South Africa and Namibia. S. Afr. J. Mar. Sci. 12: 237-270.

FINDLAY, K.P., SEAKAMELA, S.M., MEŸER, M.A., KIRKMAN, S.P., BARENDSE, J., CADE, HURWITZ, D., KENNEDY, A.S., KOTZE, P.G.H., MCCUE, S.A., THORNTON, M., VARGAS-FONSECA, O.A., & C.G. WILKE, 2017. Humpback whale “super-groups” - A novel low-latitude feeding behaviour of Southern Hemisphere humpback whales (Megaptera novaeangliae) in the Benguela Upwelling System. PLoS ONE 12(3): e0172002. doi:10.1371/journal.pone.0172002

FINNERAN, J. J., 2015, Auditory weighting functions and TTS/PTS exposure functions for cetaceans and marine carnivores, San Diego: SSC Pacific.

FINNERAN, J. J., 2016, Auditory weighting functions and TTS/PTS exposure functions for marine mammals exposure to underwater noise, Technical Report, 49 pp.

FINNERAN, J.J., CARDER, D.A. & S.H. RIDGWAY, 2001. Temporary threshold shift (TTS) in bottlenose dolphins (Tursiops truncatus) exposed to tonal signals, J. Acoust. Soc. Am. 110(5), 2749(A), 142nd Meeting of the Acoustical Society of America, Fort Lauderdale, FL, December 2001.

FINNERAN, J.J., CARDER, D.A. & S.H. RIDGWAY, 2003. Temporary threshold shift (TTS) measurements in bottlenose dolphins (Tursiops truncatus), belugas (Delphinapterus leucas), and California sea lions (Zalophus califomianus), Environmental Consequences of Underwater Sound (ECOUS) Symposium, San Antonio, TX, 12-16 May 2003.

FINNERAN, J.J., SCHLUNDT, C.E., CARDER, D.A., CLARK, J.A., YOUNG, J.A., GASPIN, J.B. & S.H. RIDGWAY, 2000. Auditory and behavioural responses of bottlenose dolphins (Tursiops truncatus) and a beluga whale (Delphinapterus leucas) to impulsive sounds resembling distant signatures of underwater explosions. J. Acoust. Soc. Am., 108(1): 417–431.

FINNERAN, J.J., SCHLUNDT, C.E., DEAR, R., CARDER, D.A. & S.H. RIDGWAY, 2002. Temporary shift in masked hearing thresholds (MTTS) in odontocetes after exposure to single underwater impulses from a seismic watergun, J. Acoust. Soc. Am. 111: 2929-2940.

Fishing Industry Handbook South Africa, Namibia and Moçambique (2019). 47th edition George Warman Publications

FITZBIBBON, Q.P., DAY, R.D., MCCAULEY, R.D., SIMON, C.J. & J.M. SEMMENS, 2017. The impact of seismic air gun exposure on the haemolymph physiology and nutritional condition of spiny lobster, Jasus edwardsii. Mar. Poll. Bull., 125: 146–156.

FishSAFE, 2021. Seismic Surveys. (https://fishsafe.org/en/offshore-structures/seismic-surveys/)

FLEISCHER, G., 1976. Hearing in extinct cetaceans as determined by cochlear structure. J Paleontol., 50 (1): 133-52.

FLEISCHER, G., 1978. Evolutionary principles of the mammalian ear. Advances in anatomy, embryology and cell biology. 55(5): 1-70, Springer-Verlag, Berlin.

FOBES, J.L. & C.C. SMOCK, 1981. Sensory capabilities of marine mammals. Psychol. Bull., 89(2): 288-307.

FORNEY, K.A., SOUTHALL, B.L., SLOOTEN, E., DAWSON, S., READ, A.J., BAIRD, R.W. & R.L. BROWNELL JR., 2017. Nowhere to go: Noise impact assessments for marine mammal populations with high site fidelity. Endanger. Species Res., 32: 391–413.

FOSSATI, C., MUSSI, B., TIZZI, R., PAVAN, G. & D.S. PACE, 2018. Italy introduces pre and post operation monitoring phases for offshore seismic exploration activities. Mar. Pollut. Bull., 120: 376−378.

FOSSING, H., FERDELMAN, T.G. and P. BERG, 2000. Sulfate reduction and methane oxidation in continental margin sediments influenced by irrigation (South-East Atlantic off Namibia). Geochim. Cosmochim. Acta. 64(5): 897–910.

FOULIS, A.J., 2013. A retrospective analysis of shark catches made by pelagic longliners off the east coast of South Africa and biology and life history of shortfin mako shark, Isurus oxyrinchus. MSc. Thesis, University of KwaZulu-Natal, Durban, South Africa. pp. 117.

FRANCIS, C.D., ORTEGA, C.P. & A. CRUZ, 2009. Cumulative consequences of noise pollution: Noise changes avian communities and species interactions. Current Biology, 19: 1415–1419.

FRANKEL, A. & C.W. CLARK, 2000. Behavioural responses of humpback whales (Megaptera novaeangliae) to full-scale ATOC signals. J. Acoust. Soc. Am., 108(4): 1930–1937.

FRANTZIS. A., 1998. Does acoustic testing strand whales? Nature, 392 (6671): 29.

FREITAS, C., CALDEIRA, R. & T. DELLINGER, 2019. Surface behaviour of pelagic juvenile loggerhead sea turtles in the eastern North Atlantic. J. Exp. mar. Biol. Ecol., 510: 73-80.

FREITAS, C., CALDEIRA, R., REIS, J. & T. DELLINGER, 2018. Foraging behavior of juvenile loggerhead sea turtles in the open ocean: from Levy exploration to area-restricted search. Mar. Ecol. Prog. Ser., 595: 203–215.

FRÉON, P., COETZEE, J.C., VAN DER LINGEN, C.D., CONNELL, A.D., O'DONOGHUE, S.H., ROBERTS, M.J., DEMARCQ, H., ATTWOOD, C.G., LAMBERTH, S.J. AND HUTCHINGS, L. 2010. A review and tests of hypotheses about causes of the KwaZulu-Natal sardine run. African Journal of Marine Science, 32(2): 449-479.

FRIEDLAENDER, A.S., HAZEN, E.L., GOLDBOGEN, J.A., STIMPERT, A.K., CALAMBOKIDIS, J. & B.L. SOUTHALL, 2016. Prey-mediated behavioral responses of feeding blue whales in controlled sound exposure experiments. Ecol. Appl., 26 (4): 1075–1085.

FRITTS, T.H., IRVINE, A.B., JENNINGS, R.D., COLLUM, L.A., HOFFMAN, W. & M.A. McGEHEE, 1983. Turtles, birds, and mammals in the northern Gulf of Mexico and nearby Atlantic waters. FWS/OBS-82/65. Technical Report. U.S. Fish and Wildlife Service, Washington, D.C., USA.

FROST, P.G., SHAUGHNESSY, P.D., SEMMELINK, A., SKETCH, M. & W.R. SIEGFRIED, 1975. The response of Jackass Penguins to Killer Whale vocalisations. South African Journal of Science, 71: 157-158.

GABIE, S. 2014. Khoisan ancestry and Coloured identity: A study of the Korana Royal House under Chief Josiah Kats. MA thesis, University of the Witwatersrand.

GALINDO-ROMERO, M., LIPPERT, T. AND GAVRILOV, A., 2015, Empirical prediction of peak pressure levels in anthropogenic impulsive noise. Part I: Airgun arrays signals. J. Acoust. Soc. Am. 138 (6), December: EL540-544.

GAMBELL, R., 1968. Aerial observations of sperm whale behaviour. Norsk Hvalangst-Tidende 57: 126-138.

GARRATT, P.A., 1988. Notes on seasonal abundance and spawning of some important offshore linefish in in Natal and Transkei waters, southern Africa South African Journal of Marine Science 7: 1-8

GAUSLAND, I., 2003. Impact of seismic surveys on marine life. In: SPE International Conference in Health, Safety and the Environment in Oil and Gas Exploration and Production. June 2000, Stavanger, Norway, Society of Petroleum Engineers., pp26–28.

GEBCO Compilation Group (2020) GEBCO 2020 Grid (doi:10.5285/836f016a-33be-6ddc-e053-6c86abc0788e).

GEDAMKE, J., GALES, N. & S. FRYDMAN, 2011. Assessing risk of baleen whale hearing loss from seismic surveys: The effect of uncertainty and individual variation, The Journal of the Acoustical Society of America, 129: 496-506.

GIBBONS, M.J., ABIAHY, B.B., ANGEL, M., ASSUNCAO, C.M.L., BARTSCH, I., BEST, P., BISESWAR, R., BOUILLON, J., BRADFORD-GRIEVE, J.M., BRANCH, W., BURRESON, E., CANNON, L., CASANOVA, J.-P., CHANNING, A., CHILD, C.A., CORNELIUS, P.F.S., DAVID, J.H.M., DELLA CROCE, N., EMSCHERMANN, P., ERSEUS, C., ESNAL, G., GIBSON, R., GRIFFITHS, C.L., HAYWARD, P.J., HEARD, R., HEEMSTRA, P. C., HERBERT, D., HESSLER, R., HIGGINS, R., HILLER, N., HIRANO, Y.M., KENSLEY, B., KILBURN, R., KORNICKER, L., LAMBSHEAD, J., MANNING, R., MARSHALL, D., MIANZAN, H., MONNIOT, C., MONNIOT, F., NEWMAN, W., NIELSEN, C., PATTERSON, G., PUGH, P., ROELEVELD, M., ROSS, A., RYAN, P., RYLAND, J.S., SAMAAI, T., SCHLEYER, M., SCHOCKAERT, E., SEAPY, R., SHIEL, R., SLUYS, R., SOUTHWARD, E.C., SULAIMAN, A., THANDAR, A., VAN DER LAND, J., VAN DER SPOEL, S., VAN SOEST, R., VETTER, E., VINOGRADOV, G., WILLIAMS, G. and WOOLDRIDGE, T., 1999. The taxonomic richness of South Africa's marine fauna: crisis at hand. South African Journal of Science 95: 8-12.

GIHWALA, K., BICCARD, A., CLARK, B.M., BROWN, E.A., MAKHOSONKE, A., SWART, C. & B. TSHINGANA, 2018. De Beers Marine Namibia Environmental Monitoring Programme: Mining-related impacts in mining license area MPT 25-2011 and subsequent recovery. Report prepared for De Beers Marine Namibia by Anchor Environmental Consultants (Pty) Ltd. Report no. 1800/1.

GIHWALA, K., BICCARD, A., CLARK, B.M., BROWN, E.A., MAKHOSONKE, A., SWART, C. & B. TSHINGANA, 2019. Mining-related impacts to soft bottom benthic habitats and associated macrofauna assemblages in mining license area SASA 2C and subsequent recovery. Report prepared for De Beers Group of Companies by Anchor Environmental Consultants (Pty) Ltd. Report no. 1800/1.

GISINER, R.C., 2016. Sound and marine seismic surveys. Acoust. today, 12: 10-18.

GOLDBOGEN, J.A., SOUTHALL, B.L., DERUITER, S.L., CALAMBOKIDIS, J., FRIEDLAENDER, A.S., HAZEN, E.L., FALCONE, E.A., SCHORR, G.S., DOUGLAS, A. & D.J. MORETTI, 2013. Blue whales respond to simulated mid-frequency military sonar. Proc. R. Soc. B Biol. Sci., 280: 20130657.

GOODALL, C., CHAPMAN, C., NEIL, D., TAUTZ, J., REICHERT, H., 1990. The acoustic response threshold of the Norway lobster, Nephrops norvegicus, in a free sound field. In: WIESE, K., W.D., K., MULLONEY, B. (Eds.), Frontiers in Crustacean Neurobiology. Birkhauser, Basel, pp. 106–113.

GOODWIN, A. J. H. 1946. “Prehistoric fishing methods in South Africa.” Antiquity no. 20: 1-8.

GOOLD, J.C. & P.J. FISH, 1998. Broadband spectra of seismic survey air-gun emissions, with reference to dolphin auditory thresholds. J. Acoust. Soc. Am., 103 (4): 2177- 2184.

GOOSEN, A.J.J., GIBBONS, M.J., MCMILLAN, I.K., DALE, D.C. and P.A. WICKENS, 2000. Benthic biological study of the Marshall Fork and Elephant Basin areas off Lüderitz. Prepared by De Beers Marine (Pty) Ltd. for Diamond Fields Namibia, January 2000. 62 pp.

GORDON, J. & A. MOSCROP, 1996. Underwater noise pollution and its significance for whales and dolphins. pp 281-319 In SIMMONDS. M.P. and HUTCHINSON, J.D. (eds.) The conservation of whales and dolphins. John Wiley and Sons, London.

GORDON, J.C., GILLESPIE, D., POTTER, J.R., FRANTZIS, A., SIMMONDS, M.P., SWIFT, R. & D. THOMPSON, 2004. A review of the Effects of Seismic Surveys on Marine Mammals. Marine Technology Society Journal, 37: 16-34.

GRAY, J. S. 1981. The ecology of marine sediments: an introduction to the structure and function of benthic communities. Cambridge University Press, Cambridge.

GRAY, J.S. 1974. Animal-sediment relationships. Oceanography and Marine Biology Annual Reviews 12: 223-261.

GRAY, M.D., ROGERS, P.H., POPPER, A.N., HAWKINS, A.D. & R.R. FAY, 2016. Large Tank Acoustics: How Big is Big Enough? The Effects of Noise on Aquatic Life II. Springer + Business Media, New York, pp. 363–370.

GREEN, G.A., BRUEGGEMAN, J.J., GROTEFENDT, R.A., C.E. BOWLBY, C.E., M.L. BONNELL, M.L. & K.C. BALCOMB III., 1992. Cetacean distribution and abundance off Oregon and Washington, 1989-1990. In: J.J. BRUEGGEMAN, ed. Oregon and Washington Marine Mammal and Seabird Surveys. OCS Study MMS 91-0093. Minerals Management Service, Pacific OCS Region, Los Angeles, CA, USA, p. 1-100.

GREENLAW, C.F., 1987. Psychoacoustics and pinnipeds. In MATE, B.R. and HARVEY, J.T. (Eds.) Acoustic deterrents in marine mammal conflicts with fisheries. US National Technical Information Service, Springfield VA. 116 pp NTIS PB-178439.

GRÉMILLET, D., LEWIS, S., DRAPEAU, L., VAN DER LINGEN, C.D., et al. 2008. Spatial match-mismatch in the Benguela upwelling zone:should we expect chlorophyll and seasurface temperature to predict marine predator distributions? J Appl. Ecol., 45: 610−621

GRIBBLE, J. 2006. Pre-Colonial Fish Traps On the South Western Cape Coast, South Africa, in Grenier, R., Nutley, D. and Cochran, I. (eds) Underwater Cultural Heritage at Risk: Managing Natural and Human Impacts, pp 29-31, ICOMOS, Paris.

GRIFFITHS MH, LAMBERTH SJ. 2002. Evaluating a marine recreational fishery in South Africa. In: Pitcher TJ, Hollingworth CE (eds), Recreational fisheries: ecological, economic and social evaluation. Oxford: Blackwell Science. pp 227–251.

GRIFFITHS, C. L., VAN SITTERT, L., BEST, P. B., BROWN, A. C., COOK, P. A., CRAWFORD, R. J. M., DAVID, J. H. M., DAVIES, B. R., GRIFFITHS, M. H., HUTCHINGS, K., JERARDINO, A., KRUGER, N., LAMBERT, S., LESLIE, R., MELVILLE-SMITH, R., TARR, R. & VAN DER LINGEN, C. D. 2004. Impacts of human activities on animal life in the Benguela – a historical overview. Oceanography and Marine Biology 42: 303–392.

GRIFFITHS, C.L., HOCKEY, P.A.R., VAN ERKOM SCHURINK, C. & P.J. LE ROUX, 1992. Marine invasive aliens on South African shores: implications for community structure and trophic functioning. In: PAYNE, A.I.L., BRINK, K.H., MANN, K.H., HILBORN, R. (eds), Benguela trophic functioning. South African Journal of Marine Science 12: 713–722.

GRIFFITHS, M. (2002). Life history of South African snoek, Thyrsites atun (Pisces: Gempylidae): a pelagic predator of the Benguela ecosystem. Afr. J. mar. Sci. 25: 383–386.

GRIFFITHS, M.H., 2002. Life history of South African snoek Thyrsites atun (Pisces: Gempylidae): a pelagic predator of the Benguela ecosystem. Fishery Bull., Wash. 100(4): 690-710.

GRIFFITHS, M.H., 2003. Stock structure of snoek Thyrsites atun in the Benguela: a new hypothesis. Afr. J. Mar. Sci., 25: 383-386.

GROENEVELD, J.C., G. CLIFF, S.F.J. DUDLEY, A.J. FOULIS, J. SANTOS & S. P. WINTNER, 2014. Population structure and biology of Shortfin Mako, Isurus oxyrinchus, in the south-west Indian Ocean. Marine and Freshwater Research 65:1045–1058.

GUERRA, A., A.F. GONZÁLEZ, F. ROCHA, J. GRACIA & M. VERRHIONE. 2004. Calamares gigantes varados: victimas de exploraciones acústicas. Investigacion y Ciencia 2004: 35-37.

Gundalf Designer, Cloud vC8.2k, 05 March 2021, Oakwood Computing Associates Limited. (https://www.gundalf.com/).

HALKETT, D. 2003. A report on the archaeological mitigation program at De Beers Namaqualand Mines: March 2002 to June 2003. Unpublished report prepared for De Beers Consolidated Mines. University of Cape Town, Archaeology Contracts Office.

HALL, J.D. & C.S. JOHNSON, 1972. Auditory thresholds of a killer whale (Orcinus orca) Linnaeus. J Acoust. Soc. Am., 52(2): 515-517.

HALL-SPENCER, J., ALLAIN, V. and J.H. FOSSA, 2002. Trawling damage to Northeast Atlantic ancient coral reefs. Proceedings of the Royal Society of London Series B – Biological Sciences 269: 507–511.

HALVORSEN, M.B., CASPER, B.M., WOODLEY, C.M., CARLSON, T.J. & A.N. POPPER, 2012. Threshold for Onset of Injury in Chinook Salmon from Exposure to Impulsive Pile Driving Sounds. PLoS ONE 7(6): e38968.

HALVORSEN, M.B., ZEDDIES, D.G., CHICOINE, D., & A.N. POPPER, 2013. Effects of low-frequency naval sonar exposure on three species of fish. Journal of the Acoustical Society of America, 134: EL205–EL210.

HAMILTON, E. L., 1980, Geoacoustic modelling of the sea floor, J. Acoust. Soc. Am. 68: 1313:1340.

HAMMAR, L., MOLANDER, S., PÅLSSON, J., CRONA SCHMIDTBAUER, J., CARNEIRO, C., JOHANSSON, T., HUME, D., KÅGESTEN, G., MATTSSON, D., TÖRNQVIST, O., ZILLÉN, L., MATTSSON, M., BERGSTRÖM, U., PERRY, D., CALDOW, C. & J. ANDERSEN, 2020. Cumulative impact assessment for ecosystem- based marine spatial planning. Science of The Total Environment, 734: 139024.

HAMPTON, I., 2003. Harvesting the Sea. In: MOLLOY, F. and T. REINIKAINEN (Eds), 2003. Namibia's Marine Environment. Directorate of Environmental Affairs, Ministry of Environment and Tourism, Namibia, 31-69.

HANEY, J.C., HAURY, L.R., MULLINEAUX, L.S. and C.L. FEY, 1995. Sea-bird aggregation at a deep North Pacific seamount. Marine Biology, 123: 1-9.

HANSEN, S., WARD, P. & A. PENNEY, 2013. Identification of vulnerable benthic taxa in the western SPRFMO Convention Area and review of move-on rules for different gear types. La Jolla, United States of America.

HARRINGTON, J.J., McALLISTER, J. and J.M. SEMMENS, J.M., 2010. Assessing the Short-Term Impact of Seismic Surveys on Adult Commercial Scallops (Pecten fumatus) in Bass Strait. Tasmanian Aquaculture and Fisheries Institute, University of Tasmania, 2010.

HARRIS, L.R., HOLNESS, S.D., KIRKMAN, S.P., SINK, K.J., MAJIEDT, P. & A. DRIVER, 2022. National Coastal and Marine Spatial Biodiversity Plan, Version 1.2 (Released 12-04-2022): Technical Report. Nelson Mandela University, Department of Forestry, Fisheries and the Environment, and South African National Biodiversity Institute. South Africa. 280 pp.

HARRIS, L.R., NEL, R., OOSTHUIZEN, H., MEŸER, M., KOTZE, D., ANDERS, D., MCCUE, S. & S. BACHOO, 2018. Managing conflict between economic activities and threatened migratory species toward creating a multiobjective blue economy. Conservation Biology, 32(2): 411-423.

HARRIS, L.R., SINK, K.J., HOLNESS, S.D., KIRKMAN, S.P. AND A. DRIVER, 2020. National Coastal and Marine Spatial Biodiversity Plan, Version 1.0 (Beta 2): Technical Report. South African National Biodiversity Institute, South Africa. 105 pp.

HARRIS, R.E., MILLER, G.W. & W.E. RICHARDSON, 2001. Seal responses to airgun sounds during summer seismic surveys in the Alaskan Beaufort Sea. Mar. Mamm. Sci., 17(4): 795-812.

HART, T AND HALKETT, D. 1992. Phase 1 archaeological assessment of farm Wildevarkens Valley 48. Prepared for Prepared for Willem Buhrmann Associates Town Planners and Valuers.

HART, T. & MILLER. D. 1994. Phase I archaeological and palaeontological survey of the proposed mining area on the farm Velddrif I 10, Velddrif, Western Cape Province. Report prepared by the Archaeology Contracts Office, University of Cape Town, for Lime Sales Limited.

HASSEL, A., KNUTSEN, T., DALEN, J., SKAAR, K., LØKKEBORG, S., MISUND, O.A., ØSTENSEN, Ø., FONN, M. & E.K. HAUGLAND, 2004. Influence of seismic shooting on the lesser sandeel (Ammodytes marinus). ICES J. Mar. Sci., 61: 1165-1173.

HASTIE, G.D., WILSON, B., TUFFT, L.H. & P.M. THOMPSON, 2003. Bottlenose dolphins increase breathing synchrony in response to boat traffic. Marine Mammal Science 19: 74-84.

HASTINGS, M. C. AND POPPER, A. N., 2005, Effects of sound on fish, Sub consultants to Jones & Stokes Under California Department of Transportation Contract No. 43A0139 Report, 82 pp.

HASTINGS, M.C., POPPER, A.N., FINNERAN, J.J. & P.J. LANFORD, 1996. Effect of low frequency underwater sound on hair cells of the inner ear and lateral line of the teleost fish Astronotus ocellatus. J. Acoust. Soc. Am., 99: 1759-1766.

HAWKINS, A.D. & A.A. MYRBERG, 1983. Hearing and sound communication under water. pp 347-405 In: Bioacoustics a comparative approach. Lewis, B. (ed.). Academic Press, Sydney 491 pp.

HAWKINS, A.D., & A.N. POPPER, 2018. Directional hearing and sound source localization by fishes. Journal of the Acoustical Society of America, 144: 3329–3350.

HAWKINS, A.D., 1973. The sensitivity of fish to sounds. Oceanogr. Mar. Biol. Ann. Rev., 11: 291-340.

HAWKINS, A.D., ROBERTS, L. & S. CHEESMAN, 2014. Responses of freeliving coastal pelagic fish to impulsive sounds. Journal of the Acoustical Society of America, 135: 3101–3116.

HAYS, G.C. HOUGHTON, J.D.R., ISAACS, C. KING, R.S. LLOYD, C. and P. LOVELL, 2004. First records of oceanic dive profiles for leatherback turtles, Dermochelys coriacea, indicate behavioural plasticity associated with long-distance migration. Animal Behaviour, 67: 733-743.

HAZIN, F.H.V., PINHEIRO, P.B. & M.K. BROADHURST, 2000. Further notes on reproduction of the blue shark, Prionace glauca, and a postulated migratory pattern in the South Atlantic Ocean. Cienca e Cultura 52: 114–120.

HENSHILWOOD, C. 1996. A revised chronology for pastoralism in southernmost Africa: New evidence of sheep at ca. 2000 B.P. form Blombos Cave, South Africa. Antiquity 70: 945-949.

HEWITT, C.L., CAMPBELL, M.L., THRESHER, R.E. & R.B. MARTIN, 1999. Marine biological invasions of Port Phillip Bay, Victoria. Centre for Research on Introduced Marine Pests Technical Report No. 20. Hobart: CSIRO Marine Research.

HEWITT, C.L., GOLLASCH, S. & D. MINCHIN, 2009. Biological Invasions in Marine Ecosystems: Ecological, Management and Geographic Perspectives - The Vessel as a Vector – Biofouling, Ballast Water and Sediments In: Ecological Studies 204 (eds) G. Rilov and J. A. Crooks.

HEYWARD, A., COLQUHOUN, J., CRIPPS, E., MCCORRY, D., STOWAR, M., RADFORD, B., MILLER, K., MILLER, I. & C. BATTERSHILL, 2018. No evidence of damage to the soft tissue or skeletal integrity of mesophotic corals exposed to a 3D marine seismic survey. Marine Pollution Bulletin, 129(1): 8-13.

HINE, P. J. 2008. An Archaeological Study of Stone-Wall Fish Traps along the Southern Cape Coast, Archaeology, University of Cape Town.

HINE, P., SEALY, J., HALKETT, D. AND HART, T. 2010. "Antiquity of Stone-walled Tidal Fish Traps on the Cape Coast, South Africa." South African Archaeological Bulletin no.65 (191):35-44.

HIRST, A.G. & P.G. RODHOUSE, 2000. Impacts of geophysical seismic surveying on fishing success. Reviews in Fish Biology and Fisheries, 10: 113-118.

HOGG, M.M., TENDAL, O.S., CONWAY, K.W., POMPONI, S.A., VAN SOEST, R.W.M., GUTT, J., KRAUTTER, M. & J.M. ROBERTS, 2010. Deep-sea sponge grounds: reservoirs of biodiversity. UNEP-WCMC Biodiversity Series No. 32. Cambridge, UK: UNEP-WCMC.

HOLLIDAY, D.V., PIEPER, R.E., CLARKE, M.E. & C.F. GREENLAW, 1987. Effects of airgun energy releases on the northern anchovy. API Publ. No 4453, American Petr. Inst. Health and Environmental Sciences Dept., Washington DC. 108pp.

HOLNESS, S., KIRKMAN, S., SAMAAI, T., WOLF, T., SINK, K., MAJIEDT, P., NSIANGANGO, S., KAINGE, P., KILONGO, K., KATHENA, J., HARRIS, L., LAGABRIELLE, E., KIRCHNER, C., CHALMERS, R. and M. LOMBARD, 2014. Spatial Biodiversity Assessment and Spatial Management, including Marine Protected Areas. Final report for the Benguela Current Commission project BEH 09-01.

HOLSMAN, K., JAMEAL SAMHOURI, J., COOK, G., HAZEN, E., OLSEN, E., DILLARD, M., KASPERSKI, S., GAICHAS, S., KELBLE, C.R., FOGARTY, M. & K. ANDREWS, 2017. An ecosystem-based approach to marine risk assessment, Ecosystem Health and Sustainability, 3: 1, e01256.

HORRIDGE, G.A. & P.S. BOULTON, 1967. Prey detection by chaetognaths via a vibration sense. Proc. R. Soc. Lond. B, 168: 413-419.

HORRIDGE, G.A., 1965. Non-motile sensory cilia and neuromuscular junctions in a ctenophore independent effector organ. Proc. R. Soc. Lond. B, 162: 333-350.

HORRIDGE, G.A., 1966. Some recently discovered underwater vibration receptors in invertebrates. In: BARNES, H. (Ed). Some contemporary studies in marine science. Allen and Unwin, London. Pp. 395-405.

HOVLAND, M. & E. THOMSEN, 1997. Cold-water corals – are they hydrocarbon seep related? Marine Geology 137: 159-164.

HOVLAND, M., MORTENSEN, P.B., BRATTEGARD, T., STRASS, P. & K. ROKOENGEN, 1998. Ahermatypic coral banks off mid-Norway: Evidence for a link with seepage of light hydrocarbons. Palaios 13: 189-200.

HOVLAND, M., VASSHUS, S., INDREEIDE, A., AUSTDAL, L. & Ø. NILSEN, 2002. Mapping and imaging deep-sea coral reefs off Norway, 1982-2000. Hydrobiol. 471: 13-17.

HOWARD, J.A.E., JARRE, A., CLARK, A.E. & C.L. MOLONEY, 2007. Application of the sequential t-test algorithm or analyzing regime shifts to the southern Benguela ecosystem. African Journal of Marine Science 29(3): 437-451.

http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/threshold_guidance.html.

HU, M.Y., YAN, H.Y., CHUNG, W., et al. 2009. Acoustically evoked potentials in two cephalopods inferred using the auditory brainstem response (ABR) approach. Comp. Biochem. Phys. A 153: 278-84.

HUBERT, J., CAMPBELL, J., VAN DER BEEK, J. G., DEN HAAN, M. F., VERHAVE, R., VERKADE, L. S. & H. SLABBEKOORN, 2018. Effects of broadband sound exposure on the interaction between foraging crab and shrimp – A field study. Environmental Pollution, 243: 1923–1929.

HUGHES, G. & R. NEL, 2014a. Family Cheloniidae. In: BATES, M.F., BRANCH, W.R., BAUER, A.M., BURGER, M., MARAIS, J., ALEXANDER, G.J., DE VILLIERS, M.S. (eds) Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland. Suricata 1, SANBI, Pretoria.

HUGHES, G. & R. NEL, 2014b. Family Dermochelyidae. In: BATES, M.F., BRANCH, W.R., BAUER, A.M., BURGER, M., MARAIS, J., ALEXANDER, G.J., DE VILLIERS, M.S. (eds) Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland. Suricata 1, SANBI, Pretoria.

HUI, C,A., 1985. Undersea topography and the comparative distributions of two pelagic cetaceans. Fishery Bulletin, 83(3): 472-475.

HUSEBØ, Å., NØTTESTAD, L., FOSSÅ, J.H., FUREVIK, D.M. & S.B. JØRGENSEN, 2002. Distribution and abundance of fish in deep-sea coral habitats. Hydrobiologia 471: 91–99.

HUTCHINGS L., BECKLEY L. E., GRIFFITHS M.H., ROBERTS M. J. SUNDBY S. & VAN DER LINGEN C. 2002. Spawning on the edge: spawning grounds and nursery areas around the southern African coastline. Marine and Freshwater Research 53:307-318.

HUTCHINGS L., NELSON G., HORSTMANN D.A. and R. TARR, 1983. Interactions between coastal plankton and sand mussels along the Cape coast, South Africa. In: Sandy Beaches as Ecosystems. Mclachlan A and T E Erasmus (eds). Junk, The Hague. pp 481-500.

HUTCHINGS, L. 1994. The Agulhas Bank: a synthesis of available information and a brief comparison with other east-coast shelf regions. S. Afr. J. Sci., 90: 179-185.

HUTCHINGS, L. 1994. The Agulhas Bank: a synthesis of available information and a brief comparison with other east-coast shelf regions. S. Afr. J. Sci., 90: 179-185.

HUTCHINGS, L., Beckley, L.E., Griffiths, M.H., Roberts, M.J., Sundby, S. and van der Lingen C. 2002. Spawning on the edge: spawning grounds and nursery areas around the southern African coastline. Marine and Freshwater Research 53: 307-318.

IMO 2004. International Convention for the control and management of ships ballast water and sediments.

INSKEEP, R.R. 1987. "Nelson Bay Cave, Cape Province, South Africa. The Holocene levels. "British Archaeological Reports International Series no. 357:1-485.

IWAMOTO, T. & M.E. ANDERSON, 1994. Review of the grenadiers (Teleostei: Gadiformes) of southern Africa, with descriptions of four new species. Ichthyological Bulletin 61: 1–18.

IWC, 2012. Report of the Scientific Committee. Annex H: Other Southern Hemisphere Whale Stocks Committee 11–23.

IWC, 2012. Report of the Scientific Committee. Annex H: Other Southern Hemisphere Whale Stocks Committee 11–23.

JACKSON, L.F. & S. McGIBBON, 1991. Human activities and factors affecting the distribution of macro-benthic fauna in Saldanha Bay. S. Afr. J. Aquat. Sci., 17: 89-102.

JACOBS, D.W. & J.D. HALL, 1972. Auditory thresholds of a freshwater dolphin, Inia geoffrensis Blaineville. J. Acoust. Soc. Am., 51(2,pt2): 530-533.

JANUARY, D.K., 2018. Mapping Break-Back Thrust Sequence Developments of the Orange Basin (offshore) South Africa. Unpublished MSc Thesis, University of the Western Cape, pp121.

JENSEN, A.S. & G.K. SILBER, 2003. Large Whale Ship Strike Database. NOAA Technical Memorandum NMFS-OPR. Silver Spring, MD: US Department of Commerce.

JENSEN, F. B., KUPERMAN, W. A., PORTER, M. B. AND Schmidt, H., 2011, Computational Ocean Acoustics, Springer-Verlag New York.

JEPSON, P.D., ARBELO, M., DEAVILLE,R., PATTERSON, I.A.P., CASTRO, P., BAKER, J.R., DEGOLLADA, E., ROSS, H.M., HERRÁEZ, P., POCKNELL, A.M., RODRÍGUEZ, F., HOWIE, F.E., ESPINOSA, A., REID, R.J., JABER, J.R., MARTIN, V., CUNNINGHAM, A.A. & A. FERNÁNDEZ, 2003. Gas–bubble lesions in stranded cetaceans. Nature, 425: 575.

JEPSON, P.D., DEAVILLE, R., ACEVEDO-WHITEHOUSE, K,, BARNETT, J., BROWNlow, A., et al., 2013. What Caused the UK's Largest Common Dolphin (Delphinus delphis) Mass Stranding Event? PLoS ONE 8(4): e60953. doi:10.1371/journal.pone.0060953

JOHANSEN, S., LARSEN, O.N., CHRISTENSEN-DALSGAARD, J., SEIDELIN, L., HUULVEJ, T., HELANDER JENSEN, K., LUNNERYD, S-G., BOSTRÖM, M. & M. WAHLBERG, 2016. In-air and underwater hearing in the great cormorant (Phalacrocorax carbo sinensis). In POPPER, A. & A. HAWKINS (Eds.), The Effects of Noise on Aquatic Life II, 875: 505-512.

JOHNSON, C., REISINGER, R., PALACIOS, D., FRIEDLAENDER, A., ZERBINI, A., WILLSON, A., LANCASTER, M. , BATTLE, J., GRAHAM, A., COSANDEY-GODIN, A., JACOB T., FELIX, F., GRILLY, E., SHAHID, U., HOUTMAN, N., ALBERINI, A., MONTECINOS, Y., NAJERA, E. & S. KELEZ, 2022. Protecting Blue Corridors, Challenges and Solutions for Migratory Whales Navigating International and National Seas. WWF, Oregon State University, University of California, Santa Cruz, Publisher: WWF International, Switzerland.

JOHNSON, C.S., 1967. Sound detection thresholds in marine mammals. pp. 247-260. In: Tavolga, W.N. (ed.) Marine bioacoustics, Vol. 2. Pergammon, Oxford, U.K. 353 pp.

JOHNSON, C.S., 1986. Masked tonal thresholds in the bottlenosed porpoise. J. Acoust. Soc. Am., 44(4): 965-967.

JOINT NATURE CONSERVATION COMMITTEE (JNCC), 2010. JNCC guidelines for minimising the risk of disturbance and injury to marine mammals from seismic surveys. August 2010

JOINT NATURE CONSERVATION COMMITTEE (JNCC), 2017. JNCC guidelines for minimising the risk of injury to marine mammals from geohysical surveys. August 2017. 28pp.

JONES, D. 2014. Brulpadda-1AX Megafaunal Report. Survey report for TOTAL E & P South Africa BV. Global Marine Research Ltd. pp.46.

JONSSON, P.R., HAMMAR, L., WÅHLSTRÖM, I., et al. 2021. Combining seascape connectivity with cumulative impact assessment in support of ecosystem-based marine spatial planning. J Appl Ecol., 58: 576–586.

KAIFU, K., AKAMATSU, T. and S. SEGAWA, 2008. Underwater sound detection by cephalopod statocyst. Fisheries Sci. 74: 781-86.

KANWISHER, J.W. & S.H. RIDGWAY, 1983. The physiological ecology of whales and porpoises. Scientific American, 248: 110–120.

KAPLAN, J. 1996. Archaeological investigation, Saldanha Steel Project. Report prepared for van Riet and Louw Landscape Architects. ACRM. Riebeek West.

KAPLAN, J. 1998. Archaeological Study Proposed Public Access Road to the Port of Saldanha. Report prepared for Crowther Campbell and Associates. ACRM. Riebeek West

KAPLAN, J. 2004. Phase 1 Archaeology Impact Assessment: erf 86, Jacobsbaai. Report for Withers Environmental Consultants. Riebeek West: Agency for Cultural Resource Management.

KAPLAN, J. 2008. Archaeological and palaeontological importance of the Alexkor Diamond Mining Area, Northern Cape. Report prepared for Site Plan Consulting. ACRM, Riebeek West.

KAPLAN, J. 2011. Archaeological Impact Assessment proposed Port Nolloth Desalination Plant, Northern Cape. Report prepared for Enviro Logic. ACRM Cape Town.

KARENYI, N., 2014. Patterns and drivers of benthic macrofauna to support systematic conservation planning for marine unconsolidated sediment ecosystems. PhD Thesis, Nelson Mandela Metropolitan University, South Africa.

KARENYI, N., SINK, K. & R. NEL, 2016. Defining seascapes for marine unconsolidated shelf sediments in an eastern boundary upwelling region: The southern Benguela as a case study. Estuarine, Coastal and Shelf Science 169: 195–206.

KASTAK, D., SCHUSTERMAN, R.J., SOUTHALL, B.L. & C.J. REICHMUTH, 1999. Underwater temporary threshold shift in three species of pinniped, J. Acoust. Soc. Am., 106: 1142–1148.

KATSANEVAKIS, S., WALLENTINUS, I., ZENETOS, A., LEPPÄKOSKI, E., ÇINAR, M.E., OZTÜRK, B., GRABOWSKI, M., GOLANI, D. & A.C. CARDOSO, 2014, 'Impacts of invasive alien marine species on ecosystem services and biodiversity: a pan-European review', Aquatic Invasions 9(4), pp. 391–423.

KAVANAGH, A.S., NYKÄNEN, M., HUNT, W., RICHARDSON, N. & M.J. JESSOPP, 2019. Seismic surveys reduce cetacean sightings across a large marine ecosystem. Scientific Reports, 9(1): 1-10.

KEEN, E.M., SCALES, K.L., RONE, B.K., HAZEN, E.L., FALCONE, E.A. & G.S. SCHORR, 2019. Night and day: diel differences in ship strike risk for fin whales (Balaenoptera physalus) in the California current system. Front. Mar. Sci., 6: 730.

KEEN, K., BELTRAN, R., & PIROTTA, E. & D. COSTA, 2021. Emerging themes in Population Consequences of Disturbance models. Proceedings of the Royal Society B: Biological Sciences. 288. 20210325. 10.1098/rspb.2021.0325.

KENDALL, M.A. and S. WIDDICOMBE, 1999. Small scale patterns in the structure of macrofaunal assemblages of shallow soft sediments. Journal of Experimental Marine Biology and Ecology, 237:127-140.

KENNY, A.J., REES, H.L., GREENING, J. and S. CAMPBELL, 1998. The effects of marine gravel extraction on the macrobenthos at an experimental dredge site off north Norfolk, U.K. (Results 3 years post-dredging). ICES CM 1998/V:14, pp. 1-8.

KENYON, N.H., AKHMETZHANOV, A.M, WHEELER, A.J., VAN WEERING, T.C.E., DE HAAS, H. and M.K. IVANOV, 2003. Giant carbonate mud mounds in the southern Rockall Trough. Marine Geology 195: 5-30.

KERSHAW, J.L., RAMP, C.A., SEARS, R., PLOURDE, S., BROSSET, P., MILLER, P.J.O., et al., 2021. Declining reproductive success in the Gulf of St. Lawrence’s humpback whales (Megaptera novaeangliae) reflects ecosystem shifts on their feeding grounds. Glob. Change Biol., 27: 1027–1041.

KETOS ECOLOGY, 2009. 'Turtle Guards': A method to reduce the marine turtle mortality occurring in certain seismic survey equipment. www.ketosecology.co.uk.

KETTEN, D.R., 1998. Marine Mammal Auditory Systems: A summary of audiometric and anatomical data and its implications for underwater acoustic impacts. NOAA Tech. Memo., NOAA-TM-NMFS-SWFSC-256.

KETTEN, D.R., LIEN, J. & S. TODD, 1993. Blast injury in humpback whale ears: evidence and implications. J. Acoust. Soc. Am., 94(3 Pt 2): 1849-1850.

KIRKMAN, S.P., KOTZE, D., MCCUE, S., SEAKAMELA, M., MEŸER, M., HLATI, K. & H. OOSTHUIZEN, 2015. Cape fur seal foraging behaviour. In: VERHEYE, H., HUGGETT, J. & R. CRAWFORS (Eds) State of the Oceans and Coasts Around South Africa - 2015 Report Card.

KIRKMAN, S.P., YEMANE, D., OOSTHUIZEN, W.H., MEYER, M.A., KOTZE, P.G.H., SKRYPZECK, H., VAZ VELHO, F., UNDERHILL, L.G., 2013. Spatio-temporal shifts of the dynamic Cape fur seal population in southern Africa, based on aerial censuses (1972-2009). Marine Mammal Science 29: 497-524.

KOLSKI, W.R. & S.R. JOHNSON, 1987. Behavioral studies and aerial photogrammetry. Sect. 4 In : Responses of bowhead whales to an offshore drilling operation in the Alaskan Beaufort Sea, autumn 1986. Rep. from LGL Ltd., King City, Ont., for Dep. Indian Affairs & Northern Dev., Hull, Que. 150 p.

KOPASKA-MERKEL D.C. & D.W. HAYWICK, 2001. Carbonate mounds: sedimentation, organismal response, and diagenesis. Sedimentary Geology, 145: 157-159.

KOPER, R.P & S. PLÖN, 2012. The potential impacts of anthropogenic noise on marine animals and recommendations for research in South Africa. EWT Research & Technical Paper No. 1. Endangered Wildlife Trust, South Africa.

KOSHELEVA, V., 1992. The impact of air guns used in marine seismic explorations on organisms living in the Barents Sea. Contr. Petro Piscis II `92 Conference F-5, Bergen, 6-8 April, 1992. 6p.

KOSlow, J.A., 1996. Energetic and life history patterns of deep-sea benthic, benthopelagic and seamount associated fish. Journal of Fish Biology, 49A: 54-74.

KOSTYUCHENKO, L.P., 1971. Effects of elastic waves generated in marine seismic prospecting of fish eggs in the Black Sea. Hydrobiol. J., 9 (5): 45-48.

KRIEGER, K.J. & B.L. WING, 2002. Megafauna associations with deepwater corals (Primnoa spp.) in the Gulf of Alaska. Hydrobiologia 471: 83–90.

KYHN, L.A., WISNIEWSKA, D.M., BEEDHOLM, K., TOUGAARD, J., SIMON, M., MOSBECH, A., et al. 2019. Basin-wide contributions to the underwater soundscape by multiple seismic surveys with implications for marine mammals in Baffin Bay, Greenland. Mar. Pollut. Bull., 138: 474–490.

LA BELLA, G., CANNATA, S., FROGLIA, C., MODICA, A., RATTI, S. & G. RIVAS, 1996. First assessment of effects of air-gun seismic shooting on marine resources in the central Adriatic Sea. In: SPE Health, Safety and Environment in Oil and Gas Exploration and Production Conference. OnePetro.

LACOURSIÈRE-ROUSSEL, A., BOCK, D.G., CRISTESCU, M.E., GUICHARD, F., GIRARD, P., LEGENDRE, P. & C.W. MCKINDSEY 2012. Disentangling invasion processes in a dynamic shipping–boating network. Molecular Ecology 21: 4227–4241.

LADICH, F. & R.R. FAY, 2013. Auditory evoked potential audiometry in fish. Reviews in Fish Biology and Fisheries, 23: 317–364.

LAGABRIELLE, E.. 2009. Preliminary report: National Pelagic Bioregionalisation of South Africa. Cape Town: South African National Biodiversity Institute.

LAMBARDI, P., LUTJEHARMS, J.R.E., MENACCI, R., HAYS, G.C. and P. LUSCHI, 2008. Influence of ocean currents on long-distance movement of leatherback sea turtles in the Southwest Indian Ocean. Marine Ecology Progress Series, 353: 289–301.

LAMBERTH SJ, SAUER, WHH, MANN BQ, BROUWER SL, CLARK BM AND C ERASMUS. 1997. The status of the South African beach-seine and gill-net fisheries. S. Afr. J. mar. Sci. 18: 195– 202.

LAMBERTH SJ. 2006. White sharks and other chondrichthyan interactions with the beach-seine (treknet) fishery in False Bay, South Africa. African Journal of Marine Science 28: 723–727.

LAMMERS, M.O., AU, W.W.L. & D.L. HERZING, 2003. The broadband social acoustic signaling behavior of spinner and spotted dolphins, Journal of the Acoustical Society of America, 114: 1629-1639.

LANDRØ, M., AMUNDSEN, L., AND BARKER, D., 2011, High-frequency signals from air-gun arrays, Geophysics, vol. 76, pp. Q19–Q27.

LANE, S.B. and R.A. CARTER, 1999. Generic Environmental Management Programme for Marine Diamond Mining off the West Coast of South Africa. Marine Diamond Mines Association, Cape Town, South Africa. 6 Volumes.

LANGE, L., 2012. Use of demersal bycatch data to determine the distribution of soft-bottom assemblages off the West and South Coasts of South Africa. PhD thesis, University of Cape Town

LARGE, S.I., FAY, G., FRIEDLAND, K.D. & J.S. LINK, 2015. Quantifying Patterns of Change in Marine Ecosystem Response to Multiple Pressures. PLoS ONE 10(3): e0119922. doi:10.1371/journal.

LARSEN, O.N., WAHLBERG, M. & J. CHRISTENSEN-DALSGAARD, 2020. Amphibious hearing in a diving bird, the great cormorant (Phalacrocorax carbo sinensis). Journal of Experimental Biology, 223: jeb217265 doi: 10.1242/jeb.217265.

LAVENDER, A.L., BARTOL, S.M. and I.K. BARTOL, 2014. Ontogenetic investigation of underwater hearing capabilities in loggerhead sea turtles (Caretta caretta) using a dual testing approach. J. Exp. Biol. 217: 2580–2589. http://dx.doi.org/10.1242/jeb.096651.

LAWS, M., HATTON, L. AND HAARTSEN, M., 1990, Computer Modelling of Clustered Airguns, First Break, 8(9): 331-338.

LAWS, R. M., HALLIDAY, D., HOPPERSTAD, J-F., GEREZ, D., SUPAWALA, M., ÖZBEK, A., et al., 2018. Marine vibrators: The new phase of seismic exploration. Geophysical Prospecting, 67(6): 1443-1471.

LAWS, R. M., PARKES, G. E., AND HATTON, L., 1988, Energy-interaction: The long-range interaction of seismic sources, Geophysical Prospecting, 36: 333-348.

LAWS, R.M. (Ed.), 2009. Antarctic Seals: Research Methods and Techniques. Cambridge University Press, Cambridge. 390pp.

LE GOUVELLO, D.Z.M., HART-DAVIS, M.G., BACKEBERG, B.C. & R. NEL, 2020b. Effects of swimming behaviour and oceanography on sea turtle hatchling dispersal at the intersection of two ocean current systems. Ecological Modelling, 431:109130.

LEATHERWOOD, S., AWBREY, F.T. & J.A. THOMAS, 1982. Minke whale response to a transiting survey vessel. Report of the International Whaling Commission 32: 795-802.

LEE-DADSWELL, G.R., 2009. Theoretical examination of the absorption of energy by snow crabs exposed to seismic air-gun pulses: stage 2-improvements to model and examination of resonances. Technical Report, OEER Association.

LEENEY, R.H., POST, K., HAZEVOET, C.J. AND S.H. ELWEN, 2013. Pygmy right whale records from Namibia. African Journal of Marine Science 35(1): 133-139.

LEITE, L., CAMPBELL, D., VERSIANI, L., ANCHIETA, J., NUNES, C.C., THIELE, T., 2016. First report of a giant squid (Architeuthis dux) from an operating seismic vessel. Marine Biodiversity Records, 9: 26. DOI 10.1186/s41200-016-0028-3

LEMOS, L.S., HAXEL, J.H., OLSEN, A., BURNETT, J.D., SMITH, A., CHANDLER, T.E., NIEUKIRK, S.L., LARSON, S.E., HUNT, K.E. & L.G. TORRES, 2021. Sounds of stress: Assessment of relationships between ambient noise, vessel traffic, and gray whale stress hormones. Proc R Soc B Biol Sci: (in press).

LENHARDT, M., MOEIN, S., MUSICK, J. and D. BARNARD, 1994. Evaluation of the response of loggerhead sea turtles (Caretta caretta) to a fixed sound source. Prepared for the U.S. Army Corps of Engineers, Waterways Experiment Station Tech Report Pp

LENHARDT, M.L., 1994. Seismic and very low frequency sound induced behaviors in captive loggerhead marine turtles (Caretta caretta). Paper presented at: Fourteenth Annual Symposium on Sea Turtle Biology and Conservation.

LENHARDT, M.L., BELLMUND, S., BYLES, R.A., HARKINS, S.W. & J.A. MUSICK, 1983. Marine turtle reception of bone conducted sound. J. Aud. Res., 23: 119-125.

LEUNG-NG, S. & S. LEUNG, 2003. Behavioral response of Indo-Pacific humpback dolphin (Sousa chinensis) to vessel traffic. Mar. Env. Res., 56: 555-567.

LEVIN, P.S., et al. 2014. Guidance for implementation of integrated ecosystem assessments: a US perspective. ICES Journal of Marine Science, 71:1198–1204.

LEVIN, P.S., FOGARTY, M.J., MURAWSKI, S.A. & D. FLUHARTY, 2009. Integrated ecosystem assessments: developing the scientific basis for ecosystem-based management of the ocean. PLoS Biology, 7: e1000014.

LEWIS, B., 1983. Bioacoustics - a comparative approach. Academic Press, Sydney 491 pp.

LEWIS, D., 2022. Searcher Seismic Orange Basin South Africa: 3D Seismic Survey Underwater Acoustic Modelling. Prepared by SLR Consulting Australia Pty Ltd for Searcher Seismic Africa. Pp59.

LI, B., PINE, M. AND CHILDERHOUSE, S., 2021, Sound modelling and field validation for Māui 4D Seismic Survey in the Taranaki Basin offshore New Zealand, Acoustics 2021 (to be published).

LIEN, J., TODD, S. STEVICK, P., MARQUES, F. & D. KETTEN, 1993. The reaction of humpback whales to underwater explosions: orientation, movements and behaviour. J. Acoust. Soc. Am., 94(3, Pt. 2): 1849.

LIPINSKI, M.R., 1992. Cephalopods and the Benguela ecosystem: trophic relationships and impacts. S. Afr. J. Mar. Sci., 12 : 791-802.

LJUNGBLAD, D.K., WURSIG, B., SWARTZ, S.L. & J.M. KEENE, 1988. Observations on the behavioural responses of bowhead whales (Balaena mysticetus) to active geophysical vessels in the Alaskan Beaufort Sea. Arctic, 41(3): 183-194.

LOCARNINI, R. A., MISHONOV, A. V., ANTONOV, J. I., BOYER, T. P., GARCIA, H. E., BARANOVA, O. K., ZWENG, M. M., AND JOHNSON, D. R., 2010, World Ocean Atlas 2009, Volume 1: Temperature. S. Levitus, Ed. NOAA Atlas NESDIS 68, U.S. Government Printing Office, Washington, D.C., 184 pp.

LOEFER, J.K., SEDBERRY, G.R. & J.C. MCGOVERN, 2005. Vertical movements of a shortfin mako in the Western North Atlantic as determined by pop-up satellite tagging. Southeastern Naturalist 4, 237-246.

LØKKEBORG S. & A.V. SOLDAL, 1993. The influence of seismic exploration with airguns on cod (Gadus morhua) behaviour and catch rates. ICES mar. Sci Symp., 196: 62-67.

LØKKEBORG, S., 1991. Effects of a geophysical survey on catching success in longline fishing ICES CM. 40: 1-9.

LØKKEBORG, S., ONA, E., VOLD, A., SALTHAUG, A., & J.M. JECH, 2012. Sounds from seismic air guns: Gear-and species-specific effects on catch rates and fish distribution. Canadian Journal of Fisheries and Aquatic Sciences, 69: 1278–1291.

LOMBARD, A.T., STRAUSS, T., HARRIS, J., SINK, K., ATTWOOD, C. and L. HUTCHINGS, 2004. National Spatial Biodiversity Assessment 2004: South African Technical Report Volume 4: Marine Component

LOMBARTE, A.,YAN, H.Y, POPPER, A.N., CHANG, J.C. & C. PLATT 1993. Damage and regeneration of hair cell ciliary bundles in a fish ear following treatment with gentamicin. Hearing Research, 66:166-174.

LUCKE, K., SEIBERT, U., LEPPER, P.A. & M.A. BLANCHET, 2009. Temporary shift in masked hearing thresholds in a harbor porpoise (Phocoena phocoena) after exposure to seismic airgun stimuli, Journal of the Acoustical Society of America, 125: 4060-4070.

LUDYNIA, K., 2007. Identification and characterisation of foraging areas of seabirds in upwelling systems: biological and hydrographic implications for foraging at sea. PhD thesis, University of Kiel, Germany.

LUKE, K., SEIBERT, U., LEPPER, P.A. & M.A. BLANCHET, 2009. Temporary shift in masked hearing thresholds in a harbor porpoise (Phocoena phocoena) after exposure to seismic airgun stimuli, Journal of the Acoustical Society of America, 125: 4060-4070.

LUSSEAU, D., 2004. The hidden cost of tourism: Effects of interactions with tour boats on the behavioral budget of two populations of bottlenose dolphins in Fiordland, New Zealand. Ecology and Society 9 (1): Part. 2.

LUSSEAU, D., 2005. Residency pattern of bottlenose dolphins Tursiops spp. in Milford Sound, New Zealand, is related to boat traffic. Marine Ecology Progress Series 295: 265-272.

LUSSEAU, D., BAIN, D.E., WILLIAMS, R. & J.C. SMITH, 2009. Vessel traffic disrupts the foraging behavior of southern resident killer whales Orcinus orca. Endangered Species Research 6: 211-221.

MacISSAC, K., BOURBONNAIS, C., KENCHINGTON, E.D., GORDON JR. and S. GASS, 2001. Observations on the occurrence and habitat preference of corals in Atlantic Canada. In: (eds.) J.H.M. WILLISON, J. HALL, S.E. GASS, E.L.R. KENCHINGTON, M. BUTLER, and P. DOHERTY. Proceedings of the First International Symposium on Deep-Sea Corals. Ecology Action Centre and Nova Scotia Museum, Halifax, Nova Scotia.

MacLEOD, C.D. & A. D'AMICO, 2006. A review of beaked whale behaviour and ecology in relation to assessing and mitigating impacts of anthropogenic noise. Journal of Cetacean Research and Management 7(3): 211–221.

MacPHERSON, E. and A. GORDOA, 1992. Trends in the demersal fish community off Namibia from 1983 to 1990. South African Journal of Marine Science 12: 635-649.

MADSEN, P.T., CARDER, D.A., AU, W.W.L., NACHTIGALL, P.E., MOHL, B. & S. RIDGWAY, 2003. Sound production in sperm whale (L), Jounal of the Acoustical Society of America, 113: 2988.

MADSEN, P.T., CARDER, D.A., BEDHOLM, K. & S.H. RIDGWAY, 2005a. Porpoise clicks from a sperm whale nose - Convergent evolution of 130 kHz pulses in toothed whale sonars?, Bioacoustics, 15: 195-206.

MADSEN, P.T., JOHNSON, M., DE SOTO, N.A., ZIMMER, W.M.X. & P. TYACK, 2005b. Biosonar performance of foraging beaked whales (Mesoplodon densirostris), Journal Of Experimental Biology, 208: 181-194.

MADSEN, P.T., JOHNSON, M., MILLER, P.J.O., AGUILAR SOTO, N., LYNCH, J. & P. TYACK, 2006. Quantative measures of air gun pulses recorded on sperm whales (Physeter macrocephalus) using acoustic tags during controlled exposure experiments. J. Acoust. Soc. Am., 120(4): 2366-2379.

MADSEN, P.T., MØHL, B., NIELSEN, K. & M. WAHLBERG, 2002a. Male sperm whale behaviour during exposures to distant seismic survey pulses. Aquatic Mammals 28: 231–240.

MADSEN, P.T., WAHLBERG, M. & B. MOHL, 2002b. Male sperm whale (Physeter macrocephalus) acoustics in a high-latitude habitat: implications for echolocation and communication, Behav. Ecol. Sociobiol., 53: 31-41.

MAJIEDT, P., HOLNESS, S., SINK, K., OOSTHUIZEN, A. & P. CHADWICK, 2013. Systematic Marine Biodiversity Plan for the West Coast of South Africa. South African National Biodiversity Institute, Cape Town. Pp 46.

MALAN, A., WEBLEY, L., HALKETT, D AND HART, T. 2013. People and Places on the West Coast since 1600. In. Jerardino, A. Malan, A., and Braun, D. eds. The Archaeology of the West Coast of South Africa. Cambridge Monographs in Archaeology 84, Bar International Series 2526.

MALME , C.I. MILES, P.R., CLARK, C.W., TYACK, P. & J.E. BIRD, 1983. Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behaviour. BBN Rep. 5366. Rep. from Bolt Beranek and Newman Inc., Cambridge, MA, for U.S. Minerals Manage. Serv. Anchorage, AK, USA.

MALME , C.I. MILES, P.R., CLARK, C.W., TYACK, P. & J.E. BIRD, 1984. Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behaviour. Phase II: January 1984 migration. BBN Rep. 5586. Rep. from Bolt Beranek and Newman Inc., Cambridge, MA, for U.S. Minerals Manage. Serv. Anchorage, AK, USA.

MALME, C. I., WURSIG, B., BIRD, J.E. & P. TYACK, 1986. Behavioural responses of gray whales to industrial noise: Feeding observations and predictive modelling. BBN Rep 6265. Outer Cont. Shelf Environ. Assess. Progr., Final Rep. Princ. Invest., NOAA, Anchorage AK, USA.

MALME, C.I., MILES, P.R., TYACK, P., CLARK, C.W. & J.E. BIRD, 1985. Investigation of the potential effects of underwater noise from petroleum industry activities on feeding humpback whale behavior. BBN Report 5851, OCS Study MMS 85-0019. Report from BBN Laboratories Inc., Cambridge, MA, for U.S. Minerals Management Service, NTIS PB86-218385. Bolt, Beranek, and Newman, Anchorage, AK.

MAMA COCO SEA Project, 2015. A Review of Seismic Mitigation Measures used along the coast of Northern South America, from North Brazil up to Columbia. Reference Document for the MaMa CoCo SEA Steering Committee, pp76.

MANHIRE, ANTHONY. 1987. Later Stone Age settlement patterns in the sandveld of the south-western Cape Province, South Africa. Oxford: British Archaeological Reports (International Series 35I/Cambridge Monographs in African Archaeology 21).

MANIWA, Y., 1976. Attraction of bony fish, squid and crab by sound. Pp 271-283. In: SCHUIJF, A. and HAWKINS, A.D. (Eds.) Sound reception in fish. Elsevier, New York.

MANN, D.A., HIGGS, D.M., TAVOLGA, W.N., SOUZA, M.J. & A.N. POPPER, 2001. Ultrasound detection by clupeiform fishes. J. Acoust. Soc. Am., 109: 3048-3054.

MANSFIELD, K.L., WYNEKEN, J., PORTER, W.P. & J. LUO, 2014. First satellite tracks of neonate sea turtles redefine the 'lost years' oceanic niche. Proc. R. Soc. B 281: 20133039.

MARTIN, K.J., ALESSI, S.C., GASPARD, J.C., TUCKER, A.D., BAUER, G.B. & D.A. MANN, 2012. Underwater hearing in the loggerhead turtle (Caretta caretta): a comparison of behavioral and auditory evoked potential audiograms. J. Exp. Biol., 215: 3001–3009. http://dx.doi.org/ 10.1242/jeb.066324.

MARTIN, M.J., GRIDLEY, T., ROUX, J.P. & S.H. ELWEN, 2020. First Abundance Estimates of Heaviside's (Cephalorhynchus heavisidii) and Dusky (Lagenorhynchus obscurus) Dolphins Off Namibia Using a Novel Visual and Acoustic Line Transect Survey. Front Mar Sci., 7: 1–20.

MASSEY, J. & J. FORDE, 2015. Cold-water corals and offshore hydrocarbon operations on the Irish Atlantic Margin – Report from the Workshop 1st December 2014, Dublin, Ireland. 61pp.

MATE, B.R., BEST, P.B., LAGERQUIST, B.A. and , M.H. WINSOR, 2011. Coastal, offshore and migratory movements of South African right whales revealed by satellite telemetry. Marine Mammal Science, 27(3): 455-476.

MATE, B.R., LAGERQUIST, B.A., WINDSOR, M., GERACI, J. & J.H. PRESCOTT, 2005. Movements and dive habits of a satellite-monitoring longfinned pilot whales (Globicephala melas) in the northwet Atlantic. Marine Mammal Science 21(10): 136-144.

MATISHOV, G.G., 1992. The reaction of bottom-fish larvae to airgun pulses in the context of the vulnerable Barents Sea ecosystem. Contr. Petro Pisces II '92 F-5, Bergen, Norway, 6-8 April, 1992. 2pp.

MATTHEWS, M. N. AND MACGILLIVRAY, A. O., 2013, Comparing modeled and measured sound levels from a seismic survey in the Canadian Beaufort Sea, Proceedings of meetings on acoustics Acoustical Society of America, 2 – 7 June 2013, Montreal, Canada.

MATTHEWS, S.G. and G.C. PITCHER, 1996. Worst recorded marine mortality on the South African coast. In: YASUMOTO, T, OSHIMA, Y. and Y. FUKUYO (Eds), Harmful and Toxic Algal Blooms. Intergovernmental Oceanographic Commission of UNESCO, pp 89-92.

MAYFIELD, S., BRANCH, G.M. and A.C. COCKCROFT, 2005. Role and efficacy of marine protected areas for the South African rock lobster, Jasus lalandii. Marine and Freshwater Research, 56: 913-924.

McALPINE, D.F., 2018. Pygmy and Dwarf Sperm Whales: Kogia breviceps and K. sima. In Encyclopedia of Marine Mammals (3rd ed., Issue June 2018, p936–938).

McCARTHY, E., MORETTI, D., THOMAS, L., DIMARZIO, N., MORRISSEY, R., et al., 2011. Changes in spatial and temporal distribution and vocal behavior of Blainville's beaked whales (Mesoplodon densirostris) during multiship exercises with mid-frequency sonar. Mar. Mamm. Sci., 27(3): E206–E226.

MCCAULEY, R. D., DUNCAN, A. J., GAVRILOV, A. N. AND CATO, D. H., 2016, Transmission of marine seismic survey, air gun array signals in Australian waters. Proceedings of ACOUSTICS 2016, 9-11 November 2016, Brisbane, Australia.

MCCAULEY, R.D. 1994. Seismic surveys. In: Swan, J.M., Neff, J.M., Young, P.C. (Eds.). Environmental implications of offshore oil and gas development in Australia - The findings of an Independent Scientific Review. APEA, Sydney, Australia, 695 pp.

McCAULEY, R.D. 1994. Seismic surveys. In: Swan, J.M., Neff, J.M., Young, P.C. (Eds.). Environmental implications of offshore oil and gas development in Australia - The findings of an Independent Scientific Review. APEA, Sydney, Australia, 695 pp.

McCAULEY, R.D., CATO, D.H. & A.F. JEFFREY, 1996. A study on the impacts of vessel noise on humpback whales in Hervey Bay. Rep from Department of Marine Biology, James Cook University, Townsville, Australia to Department of Environment and Heritage, Qld, Australia. 137 pp.

McCAULEY, R.D., DAY, R.D., SWADLING, K.M., FITZGIBBON, Q.P., WATSON, R.A. & J.M. SEMMENS, 2017. Widely used marine seismic survey air gun operations negatively impact zooplankton. Nature Ecology and Evolution, 1: 0195

McCAULEY, R.D., FEWTRELL J. & A.N. POPPER, 2003. High intensity anthropogenic sound damages fish ears. J. Acoust. Soc. Am., 113: 638-642.

McCAULEY, R.D., FEWTRELL, J., DUNCAN, A.J., JENNER, C., JENNER, M-N, PENROSE, J.D., PRINCE, R.I.T., ADHITYA, A., MURDOCH, J. & K. MCCABE, 2000. Marine seismic surveys: Analysis and propagation of air-gun signals; and effects of air-gun exposure on humpback whales, sea turtles, fishes and squid. Report produced for the Australian Petroleum Production Exploration Association. 198 pp.

McDONALD, M.A., HILDEBRAND, J.A. & S.C. WEBB, 1995. Blue and fin whales observed on a seafloor array in the Northeast Pacific. J. Acoust. Soc. Am., 98(2,pt1): 712-721.

McDONALD, M.A., HILDEBRAND, J.A., WEBB, S., DORMAN, L. & C.G. FOX, 1993. Vocalisations of blue and fin whales during a mid-ocean airgun experiment. J. Acoust. Soc. Am., 94(3, Pt. 2): 1894.

McHURON, E.A., SCHWARZ, L.K., COSTA, D.P. & M. MANGEL, 2018. A state-dependent model for assessing the population consequences of disturbance on income-breeding mammals. Ecological Modelling, 385: 133- 144.

McINNES, A.M., McGEORGE, C., GINSBERG, S., PICHEGRU, L. & P.A. PISTORIUS, 2017. Group foraging increases foraging efficiency in a piscivorous diver, the African penguin. R. Soc. open sci.,4: 170918170918.

McLACHLAN, A., 1980. The definition of sandy beaches in relation to exposure: a simple rating system. S. Afr. J. Sci., 76: 137-138.

MEAD, A., CARLTON, J.T., GRIFFITHS, C.L. & M. RIUS, 2011. Revealing the scale of marine bioinvasions in developing regions: a South African re-assessment. Biological Invasions 13: 1991–2008.

MEEKAN, M.G., SPEED, C.W., McCAULEY, R.D., FISHER, R., BIRT, M., CURREY-RANDALL, L., SEEMENS, J.M., NEWMAN, S.J., CURE, K., STOWAR, M., VAUGHAN, B. & M.J.G. PARSONS, 2021. A large-scale experiment finds no evidence that a seismic survey impacts a demersal fish fauna. Proceedings of the National Academy of Sciences, 118. 10.1073/pnas.2100869118.

MEEKAN, M.G., SPEED, C.W., McCAULEY, R.D., SEEMENS, J.M., NEWMAN, S.J., FISHER, R. & M.J.G. PARSONS, 2020. The effect of marine seismic surveys on the movement, abundance and community structure of demersal fish assemblages on the North West Shelf. The APPEA Journal, 60(2):480.

MELCÓN, M.L., CIMMINS, A.J., KEROSKY, S.M., ROCHE, L.K., WIGGINS, S.M. & J.A. HILDERBRAND, 2012. Blue whales respond to anthropogenic noise, PLoS One, 7: e32681.

MEYNECKE, J.-.O, DE BIE, J., BARRAQUETA, J.-L.M., SEYBOTH, E., DEY, S.P., LEE, S.B., SAMANTA, S., VICHI, M., FINDLAY, K., ROYCHOUDHURY, A. & B. MACKEY, 2021. The Role of Environmental Drivers in Humpback Whale Distribution, Movement and Behavior: A Review. Front. Mar. Sci., 8: 720774.

MEYNECKE, J.-O., SEYBOTH, E., DE BIE, J., MENZEL BARRAQUETA, J.-L., CHAMA, A., PRAKASH DEY, S., et al., 2020. Responses of humpback whales to a changing climate in the Southern Hemisphere: priorities for research efforts. Mar. Ecol., 41: e12616.

MILLER, I. & E. CRIPPS, 2013. Three dimensional marine seismic survey has no measurable effect on species richness or abundance of a coral reef associated fish community. Marine Pollution Bulletin, 77, 63–70.

MILLER, P.J., BIASSONI, N., SAMUELS, A. & P.L. TYACK, 2000. Whale songs lengthen in response to sonar. Nature, 405(6789): 903.

MILLER, P.J.O., JOHNSON, M.P., MadSEN, P.T., BIASSONI, N., QUERO, M. and P.L. TYACK, 2009. Using at-sea experiments to study the effects of airguns on the foraging behaviour of sperm whales in the Gulf of Mexico. Deep-Sea Research, 56(7): 1168-1181.

MITCHELL-INNES, B.A. & D.R. WALKER. 1991. Short-term variability during an Anchor Station study in the southern Benguela upwelling system. Phytoplankton production and biomass in relation to species changes. Prog. Oceanogr., 28: 65-89.

MOEIN, S.E., MUSICK, J.A., KEINATH, J.A., BARNARD, D.E., LENHARDT, M. & R. GEORGE, 1994. Evaluation of seismic sources for repelling sea turtles from hopper dredges. Report for US Army Corps of Engineers, from Virginia Institute of Marine Science, VA USA.

MOEIN-BARTOL, S., J.A. MUSICK & M.L. LENHARDT, 1999. Auditory evoked potentials of the loggerhead sea turtle (Caretta caretta). Copeia, 1999: 836-840.

MOLDAN, A.G.S., 1978. A study of the effects of dredging on the benthic macrofauna in Saldanha Bay. South African Journal of Science, 74: 106-108.

MONTEALEGRE-QUIJANO, S. & C.M. VOOREN, 2010. Distribution and abundance of the life stages of the blue shark Prionace glauca in the Southwest Atlantic. Fisheries Research 101: 168–179.

MONTEIRO, P.M.S. & A.K. VAN DER PLAS, 2006. Low Oxygen Water (low) variability in the Benguela System: Key processes and forcing scales relevant to forecasting. In: SHANNON, V., HEMPEL, G., MALANOTTE-RIZZOLI, P., MOLONEY, C. and J. WOODS (Eds). Large Marine Ecosystems, Vol. 15, pp 91-109.

MOONEY, A.T., HANLON, R.T., CHRISTENSEN-DALSGAARD, J., et al., 2010. Sound detection by the longfin squid (Loligo pealei) studied with auditory evoked potentials: sensitivity to low-frequency particle motion and not pressure. J. Exp. Biol., 213: 3748–59.

MOONEY, T., HANLON, R.T., CHRISTENSEN-DALSGAARD, J., MADSEN, P.T., KETTEN, D.R. & P.E. NACHTIGALL, 2012. The potential for sound sensitivity in cephalopods. In: POPPER, A.N. & A.D. HAWKINS (Eds) The Effects of Noise on Aquatic Life , pp125-128. New York, NY: Springer Science+Business Media, LLC.

MOONEY, T.A., SAMSON, J.E., SCHLUNK, A.D., ZACARIAS, S., 2016. Loudness-dependent behavioral responses and habituation to sound by the longfin squid (Doryteuthis pealeii). J. Comp. Physiol., 202: 489–501.

MOORE, A. & J.L.S. COBB, 1986. Neurophysiological studies on the detection of mechanical stimuli in Ophiura ophiura. J. Exp. Mar. Biol. Ecol. 104: 125-141.

MOORE, P.W.B. & R.J. SCHUSTERMAN, 1987. Audiometric responses of northern fur seals, Callorhinus ursinus. Mar. Mamm. Sci., 3(1): 31 - 53.

MORANT, P.D., 2006. Environmental Management Programme Report for Exploration/Appraisal Drilling in the Kudu Gas Production Licence No 001 on the Continental Shelf of Namibia. Prepared for Energy Africa Kudu Limited. CSIR Report CSIR/NRE/ECO/2006/0085/C.

MORISAKA, T., KARCZMARSKI, L., AKAMATSU, T., SAKAI, M., DAWSON, S. & M. THORNTON, 2011. Echolocation signals of Heaviside's dolphins (Cephalorhynchus heavisidii), Journal of the Acoustical Society of America 129: 449-457.

MORIYASU, M., ALLAIN, R., BENHALIMA, K. & R. CLAYTOR, 2004. Effects of Seismic and Marine Noise on Invertebrates: A Literature Review. http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ResDocs-DocRech/2004/RES2004 126 e.pdf.

MORRIS, D. 2006. Phase 1 Archaeological Impact Assessment for the proposed Port Nolloth Mari Culture Park, Northern Cape. Report prepared for Richtersveld Municipality. McGregor Museum, Kimberley.

MORRIS, D. 2008. Archaeological and Heritage Phase 1, Impact Assessment for proposed upgrading of Sishen Mine Diesel Depot Storage Capacity at Kathu, Northern Cape. Kimberley: McGregor Museum.

MORTON, A.B. & H.K. SYMONDS, 2002. Displacement of Orcinus orca (L.) by high amplitude sound in British Columbia, Canada. ICES J. Mar. Sci., 59(1): 71–80.

MOSTERT, B.P., BICCARD, A., DUNA, O. & B.M. CLARK, 2016. Baseline survey of the benthic marine environment in the South African diamond mining Concession areas 1B and 1C. Report prepared for Alexkor and Placer Resource Management by Anchor Environmental Consultants, Report No. 1696/1

MOURA, J.F., ACEVEDO-TREJOS, E., TAVARES, D.C., MEIRELLES, A.C.O., SILVA, C.P.N., OLIVEIRA, L.R., SANTOS, R.A., WICKERT, J.C., MACHADO, R., SICILIANO, S. & A. MERICO, 2016. Stranding events of Kogia whales along the Brazilian coast. PLoS ONE, 11(1): 1–15.

MULLER, C.F.J. 1942. Die geskiedenis van die vissery aan die Kaap tot aan die middel van die 18de eeu. Argief–jaarboek vir Suid–Afrikaanse Geskiedenis, 5de Jaargang, deel I: 1–100.

MULLIN, K., HOGGARD, W., RODEN, C., LOHOEFENER, R., ROGERS, C. & B. TAGGART, 1991. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. OCS Study MMS 91-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA, USA.

MUSSOLINE, S.E., RISCH, D., HATCH, L.T., WEINRICH, M.T., WILEY, D.N., THOMPSON, M.A., CORKERON, P.J. & S.M. VAN PARIJS, 2012. Seasonal and diel variation in North Atlantic right whale up-calls: implications for management and conservation in the northwestern Atlantic Ocean, Endangered Species Research 17: 17-26.

NACHTIGALL, P.E, AU, W.W.L., PAlowSKI, J.L. & P.W.B. MOORE, 1995. Risso's dolphin (Grampus griseus) hearing thresholds in Kaneohe Bay, Hawaii. In: Kastelin, R.A., Thomas, J.A., and Nachtigall, P.E. (Eds.). Sensory systems of aquatic mammals. De Spil Publ. Woerden, Netherlands.

NACHTIGALL, P.E., AU, W.W.L. & J. PAlowSKII, 1996. Low frequency hearing in three species of odontocete. J. Acoust. Soc. Am., 100(4;pt2): 2611.

National Marine Fisheries Service (NMFS), 2018, 2018 Revisions to: Technical guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandu, NMFS-OPR-59.

National Marine Fisheries Services (NMFS), 2013, Marine mammals: Interim Sound Threshold Guidance (webpage), National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

NATIONAL MARINE FISHERIES SERVICES (NMFS), 2013. Marine mammals: Interim Sound Threshold Guidance (webpage), National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

National Marine Fisheries Services (NMFS), 2016, Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Acoustics Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Administration, U.S. Department of Commerce, NOAA. NOAA Technical Memorandum NMFS-OPR-55. 178 pp.

National Research Council of the U.S. National Academies (NRC), 2003, Ocean Noise and Marine Mammals (National Academy Press, Washington, District of Columbia), 192 pp.

NATIONAL SCIENCE FOUNDATION (NSF) (U.S.), U.S. Geological Survey, and National Oceanic and Atmospheric Administration (NOAA) (U.S.), 2011. Final Programmatic Environmental Impact Statement/Overseas, Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey, National Science Foundation, Arlinton, VA.

National Science Foundation (NSF) (U.S.), U.S. Geological Survey, and National Oceanic and Atmospheric Administration (NOAA) (U.S.), 2011, Final Programmatic Environmental Impact Statement/Overseas, Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey, National Science Foundation, Arlinton, VA.

NECKER, R., 2000. The avian ear and hearing. In WHITTOW, G.C. (editor) Avian Physiology. Academic Press, San Diego. Pages 21-38.

NEDELEC, S.L., SIMPSON, S.D., MORLEY, E.L., NEDELEC, B. & A.N. RADFORD, 2015. Impacts of regular and random noise on the behaviour, growth and development of larval Atlantic cod (Gadus morhua). Proceedings of the Royal Society B 282.

NELMS, S.E., PINIAK, W.E.D., CAROLINE R.WEIR, C.R. and B.J. GODLEY, 2016. Seismic surveys and marine turtles: An underestimated global threat? Biological Conservation, 193: 49–65.

NELSON G. and L. HUTCHINGS, 1983. The Benguela upwelling area. Prog. Oceanogr., 12: 333-356.

NELSON, G., 1989. Poleward motion in the Benguela area. In: Poleward Flows along Eastern Ocean Boundaries. NESHYBA et al. (eds) New York; Springer: 110-130 (Coastal and Estuarine Studies 34).

NEW ZEALAND DEPARTMENT OF CONSERVATION, 2013. Code of Conduct for Minimising Acoustic Disturbance of Marine Mammals from Seismic Survey Operations. Publishing Team, Department of Conservation, Wellington, pp36.

NEWMAN, G.G. and D.E. POLLOCK, 1971. Biology and migration of rock lobster Jasus lalandii and their effect on availability at Elands Bay, South Africa. Investl. Rep. Div. Sea Fish. S. Afr., 94: 1-24.

NICOL, S., BOWIE, A., JARMON, S., LANNUZEL, D., MEINERS, K.M., et al. 2010. Southern Ocean iron fertilization by baleen whales and Antarctic krill. Fish and Fisheries, 11: 203–209.

NIENABER, G. S. 1989. Khoekhoense stamname: 'n voorlopige verkenning. Pretoria: Raad vir Geesreswetenskaplike Navosring (Academica).

NIEUKIRK, S.L., MELLINGER, D.K., MOORE, S.E., KLINCK, K., DZIAK, R.P. & J. GOSLIN, 2012. Sounds from airguns and fin whales recorded in the mid-Atlantic Ocean, 1999–2009. Journal of the Acoustical Society of America, 131: 1102–1112.

NOAA, 1998. Fact Sheet: Small Diesel Spills (500-5000 gallons) Available at: http://response.restoration.noaa.gov/oilaids/diesel.pdf

NORRIS, J.C. & S. LEATHERWOOD, 1981. Hearing in the bowhead whale, Balaena mysticetus, as estimated from cochlear morphology. Pp 745-787. In: Albert, T.F. (ed.). Tissue structural studies and other investigations on the biology of endangered whales in the Beaufort Sea, Vol. II. Rep. from Dept. Vet. Sci., Univ. Maryland, College Park, MD, for US Bur. Land manage., Anchorage, AK. 953 pp (2 vol.) NTIS PB86-153566.

NOWACEK, D.P. BRÖKER, K., DONOVAN, G., GAILEY, G., RACCA, R., REEVES, R.R., VEDENEV, A.I., WELLER, D.W. & B.L. SOUTHALL, 2013. Responsible Practices for Minimizing and Monitoring Environmental Impacts of Marine Seismic Surveys with an Emphasis on Marine Mammals. Aquatic Mammals, 39: 356-377.

NOWACEK, D.P., CLARK, C.W., DONOVAN, G., GAILEY, G., GOLDEN, J., JASNY, M., MANN, D.A., MILLER, P.J., RACCA, R., REEVES, R.R., ROSENBAUM, H., SOUTHALL, B., VEDENEV, A. & D.W. WELLER, 2015. Marine seismic surveys and ocean noise: mitigation, monitoring and a plan for international management. 21st Biennial Conference on the Biology of Marine Mammals, San Francisco, CA, USA, 13-18 December.

NOWACEK, D.P., CLARK, C.W., MANN, D., MILLER, P.J.O., ROSENBAUM H.C., GOLDEN, J.S., JASNY, M., KRASKA, J. & B.L. SOUTHALL, 2015. Marine Seismic Surveys and Ocean Noise: Time for coordinated and prudent planning. Frontiers in Ecology and the Environment, 13: 378–386.

NOWACEK, D.P., THORNE, L.H., JOHNSTON, D.W. & P.L. TYACK, 2007. Responses of cetaceans to anthropogenic noise. Mammal Rev., 37(2): 81-115.

NRC, 2003. Ocean noise and marine mammals. National Academy Press, Washington, DC.

NRC, 2005. Marine mammal populations and ocean noise, determining when noise causes biologically significant effects. The National Academy Press, Washington, DC.

O'HARA, J. & J.R. WILCOX, 1990. Avoidance responses of loggerhead turtles, Caretta caretta, to low frequency sound. Copeia, 1990: 564-567.

OCEANMIND LIMITED, 2020. A Geospatial Analysis of Vessel Traffic in Important Marine Mammal Areas. Using the Automatic Identification System to Monitor the Important Marine Mammal Areas (01Sep2018 – 01Sep2019). Report by WWF-IUCN-IWC-OceanMind, pp409.

OFFUT, G.C., 1970. Acoustic stimulus perception by the American lobster Homarus americanus (Decapoda). Experentia, 26: 1276-1278.

OLYOTT, L.J.H., SAUER, W.H.H. & BOOTH, A.J. 2007. Spatial patterns in the biology of the chokka squid, Loligo reynaudii on the Agulhas Bank, South Africa. Rev Fish Biol Fisheries 17, 159–172.

OOSTHUIZEN W.H., 1991. General movements of South African (Cape) fur seals Arctocephalus pusillus pusillus from analysis of recoveries of tagged animals. S. Afr. J. Mar. Sci., 11: 21-30.

OOSTHUIZEN, A. AND M.J. ROBERTS. 2009. Bottom temperature and in situ development of chokka squid eggs (Loligo vulgaris reynaudii) on mid-shelf spawning grounds, South Africa, ICES Journal of Marine Science, Volume 66, Issue 9: 1967–1971.

PACKARD, A., KARLSEN, H.E. & O. SAND, 1990. Low frequency hearing in cephalopods. J. Comp. Physiol., 166: 501-505.

PALAN, K.J., 2017. Submarine canyon evolution of the Southwest Cape continental margin. MSc Thesis, University of KwaZulu-Natal, South Africa.

PARENTE, C.L., LONTRA. J.D. & M.E. ARAÚJO, 2006. Ocurrence of sea turtles during seismic surveys in northeastern Brazil. Biota Neotrop., 6(1), www.biotaneotropica.org.br/ v6n1/pt/abstract?article+bn00306012006. ISSN 1676-0611

PARKER, S.J., PENNEY, A.J. & M.R. CLARK, 2009. Detection criteria for managing trawl impacts on vulnerable marine ecosystems in high seas fisheries of the South Pacific Ocean. Marine Ecology Progress Series 397: 309–317.

PARKES, G. E., ZIOLKOWSKI, A. M., HATTON L. AND HAUGLAND T., 1984, The signature of an airgun array: computation from near-field measurements – practical considerations, Geophysics, 49: 105-111.

PARKINGTON, J. 1976. Coastal settlement between the mouths of the Berg and Olifants rivers, Cape Province. South African Archaeological Bulletin 3 1: 127-140.

PARKINGTON, J. AND HALL, M. 1987, Papers in the prehistory of the Western Cape, South Africa , BAR international series, 332 , British Archaeological Reports, Oxford.

PARKINGTON, J., POGGENPOEL, C. BUCHANAN. W., ROBEY. T., MAUHIRE, A. & SEALY, J. 1988. Holocene coastal settlement patterns in the western Cape. In: Bailey. G. & Parkington, J. (eds). The archaeology of prehistoric coastlines: 2241. Cambridge: Cambridge University Press.

PARKINGTON, J.E., YATES, R., MANHIRE, A. & HALKETT, D. 1986. The social impact of pastoralism in the south Western Cape. Journal of Anthropological Archaeology 5: 313-329

PARKINGTON. J., NILSSEN, P. REELER. C. & HENSHILWOOD, C. 1992. Making sense of space at Dune Field Midden campsite. Western Cape, South Africa. Southern African Field Archaeology 1: 63-71.

PARKINS, C.A. & J.G.FIELD, 1998. The effects of deep sea diamond mining on the benthic community structure of the Atlantic 1 Mining Licence Area. Annual Monitoring Report – 1997. Prepared for De Beers Marine (Pty) Ltd by Marine Biology Research Institute, Zoology Department, University of Cape Town. pp. 44.

PARRY, D.M., KENDALL, M.A., PILGRIM, D.A. & M.B. JONES, 2003. Identification of patch structure within marine benthic landscapes using a remotely operated vehicle. J. Exp. Mar. Biol. Ecol., 285– 286: 497–511.

PARRY, G.D. & A. GASSON, 2006. The effect of seismic surveys on catch rates of rock lobsters in western Victoria, Australia, Fish. Res., 79: 272–284.

PARRY, G.D., HEISLERS, S., WERNER, G.F., ASPLIN, M.D. & A. GASON, 2002. Assessment of Environmental Effects of Seismic Testing on Scallop Fisheries in Bass Strait. Marine and Freshwater Resources Institute (Report No. 50).

PARSONS, E.C., DOLMAN, S.J., JASNY, M., ROSE, N.A., SIMMONDS, M.P. & A.J. WRIGHT, 2009. A critique of the UK's JNCC seismic survey guidelines for minimising acoustic disturbance to marine mammals: best practise? Mar. Pollut. Bull., 58: 643−651.

PATENAUDE, N.J., RICHARDSON, W.J., SMULTEA, M.A., KOSKI, W.R., MILLER, G.W., WÜRSIG, B. & C.R. GREENE, JR., 2002. Aircraft sound and disturbance to bowhead and beluga whales dur¬ing spring migration in the Alaskan Beaufort Sea. Marine Mammal Science 18: 309-335.

PATON, D., DI PRIMIO, R., KUHLMANN, G. AND VAN DER SPUY, D., 2007, Insights into the Petroleum System Evolution of the southern Orange Basin, South Africa, SOUTH AFRICAN JOURNAL OF GEOLOGY, 2007, VOLUME 110 PAGE 261-274, doi:10.2113/gssajg.110.2-3.261.

PAXTON, A.B., TAYLOR, J.C., NOWACEK, D.C., DALE, J., COLE, E., VOSS, C.M. & C.H. PETERSON, 2017. Seismic survey noise disrupted fish use of a temperate reef. Marine Policy, 78: 68–73.

PAYNE, A.I.L. and R.J.M. CRAWFORD, 1989. Oceans of Life off Southern Africa. Vlaeberg, Cape Town, 380 pp.

PEARSON, W.H., SKALSKI, J.R. & C.I. MALME, 1992. Effects of sounds from a geophysical survey device on behaviour of captive rockfish (Sebastes spp.). Can J. Fish. Aquat. Sci., 49: 1343-1356.

PEÑA, H., HANDEGARD, N.O. & E. ONA, 2013. Feeding herring schools do not react to seismic airgun surveys. ICES Journal of Marine Science, 70: 1174–1180.

PENN, N. 1996. Robben Island, 1488–1805. In: Deacon, H. (ed.) The Island: A History of Robben Island, 1488-1805: 1–4. Bellville: Mayibuye Books.

PENNEY, A.J., KROHN, R.G. & C.G. WILKE. 1992. A description of the South African tuna fishery in the southern Atlantic Ocean. ICCAT Col. Vol. Sci. Pap. XXIX(1) : 247-253.

PENNEY, A.J., PULFRICH, A., ROGERS, J., STEFFANI, N. and V. MABILLE, 2007. Project: BEHP/CEA/03/02: Data Gathering and Gap Analysis for Assessment of Cumulative Effects of Marine Diamond Mining Activities on the BCLME Region. Final Report to the BCLME mining and petroleum activities task group. December 2007. 410pp.

PENRY, G.S., 2010. Biology of South African Bryde's whales. PhD Thesis. University of St Andrews, Scotland, UK.

PENRY, G.S., HAMMOND, P.S., COCKCROFT, V.G., BEST, P.B., THORNTON, M. & J.A. GRAVES, 2018. Phylogenetic relationships in southern African Bryde's whales inferred from mitochondrial DNA: further support for subspecies delineation between the two allopatric populations. Conservation Genetics, 19: 1349–1365.

PERRY, C., 1998. A review of the impacts of anthropogenic noise on cetaceans. Document SC/50/E9 submitted to the scientific committee of the International Whaling Commission, Muscat, Oman, 1998. 28 pp + 8 pp appendices.

PERRY, J., 2005. Environmental Impact Assessment for Offshore Drilling the Falkland Islands to Desire Petroleum Plc. 186pp

PETERS, I., BEST, P.B. & M. THORNTON, 2011. Abundance estimates of right whales on a feeding ground off the west coast of South Africa. Paper SC/S11/RW11 submitted to the IWC Southern Right Whale Assessment Workshop, Buenos Aires 13-16 Sept. 2011.

PGS Heritage (Pty) Ltd, 2024. Heritage Impact Assessment - Proposed Searcher West Coast 3D Reconnaissance Project Project Name: ZA24-010_Orange Basin MC3D MSS.

PHAM, C.K., VANDEPERRE, F., MENEZES, G., PORTEIRO, F., ISIDRO, E. & T. MORATO, 2015. The importance of deep-sea vulnerable marine ecosystems for demersal fish in the Azores. Deep-Sea Research Part I: Oceanographic Research Papers 96: 80–88.

PHILLIP, H., SEALY, J., HALKETT, D., AND HART, T. 2010. "Antiquity of Stone-walled Tidal Fish Traps on the Cape Coast, South Africa." South African Archaeological Bulletin no. 65 (191): 35-44.

Pisces Environmental Services (Pty) Ltd, 2024. Biodiversity and Ecosystem Services Assessment - PROPOSED 3D SEISMIC SURVEY IN THE ORANGE BASIN OFF THE WEST COAST OF SOUTH AFRICA.

PICHEGRU, L., NYENGERA, R., McINNES, A.M. and P. PISTORIUS, 2017. Avoidance of seismic survey activities by penguins. Nature: Scientific Reports, 7: 16305. DOI:10.1038/s41598-017-16569

PIDCOCK, S., BURTON, C. & M. LUNNEY, 2003. The potential sensitivity of marine mammals to mining and exploration in the Great Australian Bight Marine Park Marine Mammal Protection Zone. An independent review and risk assessment report to Environment Australia. Marine Conservation Branch. Environment Australia, Cranberra, Australia. pp. 85.

PIDCOCK, S., BURTON, C. AND M. LUNNEY. 2003. The potential sensitivity of marine mammals to mining and exploration in the Great Australian Bight Marine Park Marine Mammal Protection Zone. An independent review and risk assessment report to Environment Australia. Marine Conservation Branch. Environment Australia, Canberra, Australia. pp. 85.

PILE, A.J. & C.M. YOUNG, 2006. The natural diet of a hexactinellid sponge: benthic--pelagic coupling in a deep-sea microbial food web. Deep Sea Research Part I: Oceanographic Research Papers 53: 1148-1156.

PILLAR, S.C., 1986. Temporal and spatial variations in copepod and euphausid biomass off the southern and and south-western coasts of South Africa in 1977/78. S. Afr. J. mar. Sci., 4: 219-229.

PILLAR, S.C., BARANGE, M. and L. HUTCHINGS, 1991. Influence of the frontal sydtem on the cross-shelf distribution of Euphausia lucens and Euphausia recurva (Euphausiacea) in the Southern Benguela System. S. Afr. J. mar. Sci., 11 : 475-481.

PINIAK, W., ECKERT, S., HARMS, C. & E. STRINGER, 2012. Underwater hearing sensitivity of the leatherback sea turtle (Dermochelys coriacea): assessing the potential effect of anthropogenic noise. In: U.S Department of the Interior Bureau of Ocean Energy Management (Ed.), U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Headquarters, Herndon, VA. OCS Study BOEM 2012-01156.

PINIAK, W.E.D., MANN, D.A., HARMS, C.A., JONES, T.T. & S.A. ECKERT, 2016. Hearing in the Juvenile Green Sea Turtle (Chelonia mydas): A Comparison of Underwater and Aerial Hearing Using Auditory Evoked Potentials. PLoS ONE 11(10): e0159711.

PIROTTA, E., BOOTH, C.G., COSTA, D.P., et al. 2018. Understanding the population consequences of disturbance. Ecol Evol., 8: 9934–9946. https://doi.org/10.1002/ece3.4458.

PIROTTA, E., BROOKES, K.L., GRAHAM, I.M. & P.M. THOMPSON, 2014. Variation in harbour porpoise activity in response to seismic survey noise. Biol. Lett. 10: 4.

PIROTTA, V., GRECH, A., JONSEN, I.D., LAURANCE, W.F. & R.G. HARCOURT, 2019. Consequences of global shipping traffic for marine giants. Frontiers in Ecology and the Environment, 17(1): 39-47.

PITCHER, G.C., 1998. Harmful algal blooms of the Benguela Current. IOC, World Bank and Sea Fisheries Research Institute Publication. 20 pp.

PLÖN, S., 2004. The status and natural history of pygmy (Kogia breviceps) and dwarf (K. sima) sperm whales off Southern Africa. PhD Thesis. Department of Zoology & Entomology (Rhodes University), p. 551.

POGGENPOEL, C. A. 1987. "The implication of fish bone assemblages from Eland's Bay Cave, Tortoise Cave and Diepkloof Rock Shelter for changes in the Holocene history of the Verlorenvlei. In: Parkington, J. & Hall, M., eds. Papers in the prehistory of the western Cape." British Archaeological Reports International Series no. 332:212-236.

POMILLA, C. & H.C. ROSENBAUM, 2005. Against the current: an inter-oceanic whale migration event. Biol. Lett., 1: 476-479.

POPPER A. N., HAWKINS A. D., FAY R. R., MANN D. A., BARTOL S., CARLSON T. J., COOMBS S., ELLISON W. T., GENTRY R. L., HALWORSEN M. B., LOKKEBORG S., ROGERS P. H., SOUTHALL B. L., ZEDDIES D. G. AND TAVOLGA W. N., 2014, ASA S3/SC1.4 TR-2014 Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI.

POPPER, A., HAWKINS, A., FAY, R., MANN, D., BARTOL, S., CARLSON, T., COOMBS, S., ELLISON, W.,GENTRY, R., HALVORSEN, M., LØKKEBORG, S., ROGERS, P., SOUTHALL, B., ZEDDIES, D., TAVOLGA,W., 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report Prepared by ANSI-Accredited Standards Committee S3/SC1 and Registered with ANSI. 978-3-319-06658-5. Springer International Publishing.

POPPER, A.N. & A.D. HAWKINS, 2018. The importance of particle motion to fishes and invertebrates. The Journal of the Acoustical Society of America, 143: 470–486.

POPPER, A.N. & A.D. HAWKINS, 2019. An overview of fish bioacoustics and the impacts of anthropogenic sounds on fishes. Journal of Fish Biology, 94:692-713.

POPPER, A.N. & C.R. SCHILT, 2008. Hearing and acoustic behavior (basic and applied). In: WEBB, J.F., R.R. FAY, & A.N. POPPER, eds. Fish bioacoustics. New York: Springer Science + Business Media, LLC.

POPPER, A.N. & R.R. FAY, 1973. Sound detection and processing by fish: critical review and major research questions. Brain Behav. Evol., 41: 14-38.

POPPER, A.N. & R.R. FAY, 1999. The auditory periphery in fishes. In: FAY, R.R. & A.N. POPPER (Eds.) Comparative hearing: Fish and amphibians. Springer, Sydney, pp.43-100

POPPER, A.N., 1980. Sound emission and detection by delphinids. Pp 1-52. In: Herman M. (ed.) Cetacean behaviour; Mechanisms and functions. John Wiley and Sons, New York. 463 pp.

POPPER, A.N., 2003. Effects of anthropogenic sounds on fishes. Fisheries, 28: 24-31.

POPPER, A.N., 2008. Effects of Mid- and High-Frequency Sonars on Fish. Environmental BioAcoustics, LLC Rockville, Maryland 20853. Contract N66604-07M-6056 Naval Undersea Warfare Center Division Newport, Rhode Island. 52pp.

POPPER, A.N., FAY, R.R., PLATT, C. & O. SAND, 2003. Sound detection mechanisms and capabilities of teleost fishes. In: COLLIN, S.P. & N.J. MARSHALL, (Eds.) Sensory processing in aquatic environments. Springer-Verlag, New York. Pp. 3-38.

POPPER, A.N., FEWTRELL, J., SMITH, M.E. & R.D. McCAULEY, 2004. Anthropogenic sound: Effects on the behavior and physiology of fishes. J. Mar. Technol. Soc., 37: 35-40.

POPPER, A.N., GROSS, J.A., CARLSON, T.J., SKALSKI, J., YOUNG, J.V., HAWKINS, A.D. & D. ZEDDIES, 2016. Effects of exposure to the sound from seismic airguns on pallid sturgeon and paddlefish. PLoS One, 11: e0159486.

POPPER, A.N., HALVORSEN, M.B., KANE, A.S., MILLER, D.L., SMITH, M.E., SONG, J., et al., 2007. The effects of high-intensity, lowfrequency active sonar on rainbow trout. Journal of the Acoustical Society of America, 122: 623–635.

POPPER, A.N., HAWKINS, A.D., FAY, R.R., MANN, D.A., BARTOL, S., CARLSON, T.J., COOMBS, S., ELLISON, W.T., GENTRY, R.L., HALWORSEN, M.B., LOKKEBORG, S., ROGERS, P.H., SOUTHALL, B.L., ZEDDIES, D.G. & W.N. TAVOLGA, 2014, ASA S3/SC1.4 TR-2014 Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI.

POPPER, A.N., SALMON, M. & HORCH, K.W. 2001. Acoustic detection and communication by decapod crustaceans. J. Comp. Physiol. A, 187: 83-89.

POPPER, A.N., SMITH, M.E., COTT, P.A., HANNA, B.W,, MACGILLIVRAY, A.O., AUSTIN, M.E & MANN, D.A. 2005. Effects of exposure to airgun use on three fish species. J. Acoust. Soc. Am., 117: 3958 – 3971.

PORTER, M. B. AND BUCKER, H. P., 1987, Gaussian beam tracing for computing ocean acoustic fields, J. Acoust. Soc. Amer. 82, 1349—1359.

PORTER, M. B., 2019, The BELLHOP Manual and User's Guide: PRELIMINARY DRAFT, Heat, Light, and Sound Research, Inc. La Jolla, CA, USA.

PORTER, M. B., 2020, Acoustics Toolbox in Ocean Acoustics Library (http://oalib.hlsresearch.com/).

POST, A.L., WASSENBERG, T.J.and V. PASSlow, 2006. Physical surrogates for macrofaunal distributions and abundance in a tropical gulf. Marine and Freshwater Research, 57: 469-483.

PRAMIK, B., BELL, M.L., GRIER, A. & A. LINDSAY, 2015. Field Testing the AquaVib: an Alternate Marine Seismic Source. SEG Technical Program Expanded Abstracts: 181-185.

PRDW, 2013. Impact Assessment for Proposed Exploration Drilling in the Orange Basin Deep Water Licence Area off the West Coast of South Africa. Drill Cuttings and Oil Spill Modelling Specialist Study, November 2013. 126pp.

PRZESLAWSKI, R, HUANGA, Z., ANDERSON, J., CARROLL, A.G., EDMUNDS, M., HURT, L. and S. WILLIAMS, 2018. Multiple field-based methods to assess the potential impacts of seismic surveys on scallops. Marine Pollution Bulletin, 129: 750-761.

PRZESLAWSKI, R., BROOKE, B., CARROLL, A.G. & M. FELlowS, 2018. An integrated approach to assessing marine seismic impacts: Lessons learnt from the Gippsland Marine Environmental Monitoring project. Ocean. Coast. Manag., 160: 117–123.

PRZESLAWSKI, R., BRUCE, B., CARROLL, A., ANDERSON, J., BRADFORD, R., DURRANT, A., EDMUNDS, M., FOSTER, S., HUANG, Z., HURT, L., LANSDELL, M., LEE, K., LEES, C., NICHOLS, P. and S. WILLIAMS, 2016. Marine Seismic Survey Impacts on Fish and Invertebrates: Final Report for the Gippsland Marine Environmental Monitoring Project. Record 2016/35. Geoscience Australia, Canberra. http://dx.doi.org/10.11636/Record.2016.035

PRZESLAWSKI, R., BYRNE, M., MELLIN, C., 2015. A review and meta-analysis of the effects of multiple abiotic stressors on marine embryos and larvae. Glob. Chang. Biol. 21: 2122–2140.

PULFRICH, A. 2021. Proposed 2D and 3D multi-client seismic survey in the Orange Basin off the West Coast of South Africa: Biodiversity and ecosystem services assessment. June 2021: P. 306.

PULFRICH, A. and A.J. PENNEY, 1999. The effects of deep-sea diamond mining on the benthic community structure of the Atlantic 1 Mining Licence Area. Annual Monitoring Report – 1998. Prepared for De Beers Marine (Pty) Ltd by Marine Biology Research Institute, Zoology Department, University of Cape Town and Pisces Research and Management Consultants CC. pp 49.

PULFRICH, A., 2014. Basic Assessment and Environmental Management Programme for Well Drilling in the Orange Basin Deepwater Block off the South African West Coast. Marine Faunal Assessment. Prepared for CCA Environmental (Pty) Ltd. on behalf of Shell South Africa Upstream B.V. January 2014. 152pp.

PULFRICH, A., PENNEY, A.J., BRANDÃO, A., BUTTERWORTH, D.S. and M. NOFFKE, 2006. Marine Dredging Project: FIMS Final Report. Monitoring of Rock Lobster Abundance, Recruitment and Migration on the Southern Namibian Coast. Prepared for De Beers Marine Namibia, July 2006. 149pp.

PUNSLY RG, NAKANO H. 1992. Analysis of variance and standardization of longline hook rates of bigeye tuna (Thunnus obesus) and yellowfin tuna (Thunnus albacares) in the eastern Pacific Ocean during 1975–1987. Int Am Trop Tuna Comm Bull 20:165–184.

PURDON, J., 2018. Calming the Waves: using legislation to protect marine life from seismic surveys. Policy Insights, 58: 17pp.

PURDON, J., SHABANGU, F., PIENAAR, M., SOMERS, M.J. & K.P. FINDLAY, 2020a. South Africa's newly approved marine protected areas have increased the protected modelled habitat of nine odontocete species SUPPLEMENT 2. Mar Ecol Prog Ser 633:1–21.

PURDON, J., SHABANGU, F., PIENAAR, M., SOMERS, M.J. & K.P. FINDLAY, 2020b. Cetacean species richness in relation to anthropogenic impacts and areas of protection in South Africa's mainland Exclusive Economic Zone. Ocean Coast Manag., 197: 105292

PURDON, J., SHABANGU, F.W., YEMANE, D., PIENAAR, M., SOMERS, M.J. & K. FINDLAY, 2020c. Species distribution modelling of Bryde's whales, humpback whales, southern right whales, and sperm whales in the southern African region to inform their conservation in expanding economies. PeerJ. 8:e9997. doi: 10.7717/peerj.9997. PMID: 33024637; PMCID: PMC7518163.

RAES, M & A. VANREUSEL, 2005. The metazoan meiofauna associated with a cold-water coral degradation zone in the Porcupine Seabight (NE Atlantic). Cold-water corals and ecosystems. Springer. pp 821–847.

RANKIN, S. & W.E. EVANS, 1998. Effect of low frequency seismic exploration signals on the cetaceans of the Gulf of Mexico. In: The World Marine Mammal Science Conference, Monaco, 20-24 January 1998, Society for Marine Mammalogy and the European Cetacean Society, Centre de Recherche sur les Mammifères Marins, La Rochelle, France, p. 110.

RANKIN, S., BAUMANN-PICKERING, S., YACK, T. & J. BARlow, 2011. Description of sounds recorded from Longman's beaked whale, Indopacetus pacificus, Journal of the Acoustical Society of America: express letters, 130.

RAPER, P.E. AND BOUCHER M. (EDS.) 1988. Robert Jacob Gordon, Cape Travels, 1777 to 1786. Vol.2. Johannesburg: The Brenthurst Press.

RAVEN-HART, R. 1967. Before Van Riebeeck. Published by Struik (Pty) Ltd.

REYES REYES, M.V., BESSEGA, M.A.I. & S.J. DOLMAN, 2016. Review of legislation applied to seismic surveys to mitigate effects on marine mammals in Latin America. In:Proceedings of Meetings on Acoustics, p. 32002.

RICHARDSON W. J., CHARLES R. G. J., CHARLES I. M. AND DENIS H. T, 1995, Marine mammals and noise: Academic press.

RICHARDSON, A.J., MATEAR, R.J. & A. LENTON, 2017. Potential impacts on zooplankton of seismic surveys. CSIRO, Australia 34 pp.

RICHARDSON, W.J. & B. WÜRSIG, 1997. Influences of man-made noise and other human actions on cetacean behaviour. Marine and Freshwater Behaviour and Physiology 29: 183-209.

RICHARDSON, W.J., FRAKER, M.A., WURSIG, B. & R.S. WELLS, 1985a. Behaviour of bowhead whales Balaena mysticetus summering in the Beaufort Sea: Reactions to industrial activities. Biol. Conserv., 32(3): 195 - 230.

RICHARDSON, W.J., GREENE, C.R., JR., KOSKI, W.R. & M.A. SMULTEA, 1991. Acoustic effects of oil production activities on bowhead and white whales visible during spring migration near Pt. Barrow, Alaska-1990 phase: Sound propagation and whale responses to playbacks of continuous drilling noise from an ice platform, as studied in pack ice conditions. Unpublished report to U.S. Minerals Management Service, Procurement Operations, Herndon, Virginia: Contract 14-12-0001-30412 (LGL Report TA848-)

RICHARDSON, W.J., GREENE, C.R., MALME, C.I. & THOMSON, D.H. 1995. Marine Mammals and Noise. Academic Press, San Diego, CA.

RICHARDSON, W.J., WELLS, R.S. & B. WURSIG, 1985b. Disturbance responses of bowheads, 1980-84. In: Richardson, W.J. (ed.) Behaviour, disturbance responses and distribution of bowhead whales Balaena mysticetus in the eastern Beaufort Sea, 1980-84. OCS Study

RICHARDSON, W.J., WURSIG, B. & C.R. GREENE, 1986. Reactions of bowhead whales, Balaena mysticetus, to seismic explorations in the Canadian Beaufort sea. J Acoust. Soc. Am., 79(4): 1117-1128.

RICHTER, C., DAWSON, S. & E. SLOOTEN, 2006. Impacts of commercial whale watching on male sperm whales at Kaikoura, New Zealand. Marine Mammal Science 22: 46-63.

RICHTER, C.F., DAWSON, S.M. & E. SLOOTEN, 2003. Sperm whale watching off Kaikoura, New Zealand: Effects of current activities on surfacing and vocalisation patterns. Science for Conservation Report No. 219. Department of Conservation, Wellington, New Zealand.

RIDGWAY, S.H., 1983. Dolphin hearing and sound production in health and illness. pp.247-296. In: Far, R.R and Gourevitch, G. (Eds.). Hearing and other senses. Amphora press, Groton, CT. 405 pp.

RIDGWAY, S.H., E.G. WEVER, J.G. MCCORMICK, J. PALIN & J.H. ANDERSON, 1969. Hearing in the giant sea turtle, Chelonia mydas. Proceedings of the National Academy of Sciences USA, 64: 884-890.

RIPPLE, W.J., ESTES, J.A., SCHMITZ, O.J., CONSTANT, V., KAYLOR, M.J., LENZ, A., MOTLEY, J.L., SELF, K.E., TAYLOR, D.S. & C. WOLF, 2016. What is a trophic cascade?. Trends in ecology & evolution, 31(11):.842-849.

RISCH, D., CORKERON, P.J., ELLISON, W.T. & S.M. VAN PARIJS, 2012. Changes in Humpback Whale Song Occurrence in Response to an Acoustic Source 200 km Away. PLoS ONE 7(1): e29741.

ROBERTS, J.M. & J.D. GAGE, 2003. Scottish Association for Marine Science Work Package 3 of ACES project: To describe the deep-water coral ecosystem, its dynamics and functioning; investigate coral biology and behaviour and assess coral sensitivity to natural and anthropogenic stressors. Final Report to the Atlantic Coral Ecosystem Study," Internal SAMS Report, 2003.

ROBERTS, M. J., & SAUER, W. H. H. 1994. Environment: the key to understanding the South African chokka squid (Loligo vulgaris reynaudii) life cycle and fishery?. Antarctic Science, 6(2), 249-258.

ROBERTS, M.J., 2005. Chokka squid (Loligo vulgaris reynaudii) abundance linked to changes in South Africa's Agulhas Bank ecosystem during spawning and the early life cycle. ICES Journal of Marine Science, 62: 33–55.

ROBERTS, M.J., 2005. Chokka squid (Loligo vulgaris reynaudii) abundance linked to changes in South Africa's Agulhas Bank ecosystem during spawning and the early life cycle. ICES Journal of Marine Science, 62: 33–55.

ROBERTSHAW, P.T. 1979. Excavations at Duiker Eiland, Vredenburg District, Cape Province. Annals of the Cape Provincial Museums. Vol 1(1): 1-26.

ROBERTSON, F.C., KOSKI, W.R., THOMAS, T.A., RICHARDSON, W.J., WURSIG, B. & A.W. TRITES, 2013. Seismic operations have variable effects on dive-cycle behavior of bowhead whales in the Beaufort Sea. Endanger. Species Res., 21 (2): 143–160.

ROEL, B.A. AND ARMSTRONG, M.J. 1991. The round herring Etrumeus whiteheadi and anchovy Engraulis capensis off the east coast of southern Africa. S. Afr. J. mar. Sci., 11: 227-249.

ROEL, B.A., 1987. Demersal communities off the west coast of South Africa. South African Journal of Marine Science 5: 575-584.

ROGERS, A.D., 1994. The biology of seamounts. Advances in Marine Biology, 30: 305–350.

ROGERS, A.D., 2004. The biology, ecology and vulnerability of seamount communities. IUCN, Gland, Switzerland. Available at: www.iucn.org/themes/ marine/pubs/pubs.htm 12 pp.

ROGERS, A.D., CLARK, M.R., HALL-SPENCER, J.M. and K.M. GJERDE, 2008. The Science behind the Guidelines: A Scientific Guide to the FAO Draft International Guidelines (December 2007) For the Management of Deep-Sea Fisheries in the High Seas and Examples of How the Guidelines May Be Practically Implemented. IUCN, Switzerland, 2008.

ROGERS, J. & J.M. BREMNER, 1991. The Benguela Ecosystem. Part VII. Marine-geological aspects. Oceanogr. Mar. Biol. Ann. Rev., 29: 1-85.

ROGERS, J., 1977. Sedimentation on the continental margin off the Orange River and the Namib Desert. Unpubl. Ph.D. Thesis, Geol. Dept., Univ. Cape Town. 212 pp.

ROGERS, J., 1979. Dispersal of sediment from the Orange River along the Namib Desert coast. S. Afr. J. Sci., 75: 567 (abstract).

ROGERS, P.H., HAWKINS, A.D., POPPER, A.N., FAY, R.R. & M.D., GRAY, 2016. Parvulescu revisited: Small tank acoustics for bioacousticians. In: POPPER, A.N., HAWKINS, A.D. (Eds.), Effects of Noise on Aquatic Life II. Springer, New York, pp. 933–941.

ROLLAND, R.M., PARKS, S.E. HUNT, K.E., CASTELLOTE, M., CORKERON, P.J., NOWACEK, D.P., WASSER, S.K. &S.D. KRAUS, 2012. Evidence that ship noise increases stress in right whales. Proceedings of the Royal Society B: Biological Sciences, 279 (1737): 2363-2368.

ROLLINSON, D., WANLESS, R. & P. RYAN, 2017. Patterns and trends in seabird bycatch in the pelagic longline fishery off South Africa. African Journal of Marine Science 39: 9–25.

ROMAN, J. & J.J. McCARTHY, 2010. The Whale Pump: Marine Mammals Enhance Primary Productivity in a Coastal Basin. PLoS ONE 5(10): e13255. doi:10.1371/

ROMANO, T.A., KEOGH, M.J., KELLY, C., FENG, P., BERK, L., SCHLUNDT, C.E., CARDER, D.A. & J.J. FINNERAN, 2004. Anthropogenic sound and marine mammal health: measures of the nervous and immune systems before and after intense sound exposure., Canadian Journal of Fisheries and Aquatic Sciences, 61: 1124–1134.

ROSENBAUM, H.C., MAXWELL, S., KERSHAW, F. and B.R. MATE, 2014. Long-range movement of Humpback Whales and Their Overlap with Anthropogenic Activities in the South Atlantic Ocean. Conservation Biology, 28(2): 604-615.

ROSENBAUM, H.C., POMILLA, C., MENDEZ, M., LESLIE, M.S., BEST, P.B., FINDLAY, K.P., MINTON, G., ERSTS, P.J., COLLINS, T., ENGEL, M.H., BONATTO, S., KOTZE, P.G.H., MEŸER, M., BARENDSE, J., THORNTON, M., RAZAFINDRAKOTO, Y., NGOUESSONO, S., VELY, M. and J. KISZKA, 2009. Population structure of humpback whales from their breeding grounds in the South Atlantic and Indian Oceans. PLoS One, 4 (10): 1-11.

ROSS, G.J.B. 1984. The smaller cetaceans of the east coast of southern Africa. Ann. Cape. Prov. Mus. (nat. Hist.)., 15 (2).

ROSS, G.J.B., 1979. Records of pygmy and dwarf sperm whales, genus Kogia, from southern Africa, with biological notes and some comparisons. Annals of the Cape Province Museum (Natural History) 11: 259-327.

ROSS, G.J.B., COCKCROFT V.G. & D.S. BUTTERWORTH, 1987. Offshore distribution of bottlenosed dolphins in Natal coastal waters and Algoa Bay, Eastern Cape. S. Afr. J. Zool. 22: 50-56.

ROUX, J-P., BEST, P.B. and P.E. STANDER. 2001. Sightings of southern right whales (Eubalaena australis) in Namibian waters, 1971-1999. J. Cetacean Res. Manage. (Special Issue). 2: 181–185.

ROUX, J-P., BRADY, R. and P.B. BEST, 2011. Southern right whales off Namibian and their relationship with those off South Africa. Paper SC/S11/RW16 submitted to IWC Southern Right Whale Assessment Workshop, Buenos Aires 13-16 Sept. 2011.

ROUX, J-P., BRADY, R. and P.B. BEST, 2015. Does Disappearance Mean Extirpation? The Case of Right Whales off Namibia. Marine Mammal Science, 31 (3): 1132–52. doi:10.1111/mms.12213.

ROWAT, D. & M. GORE, 2007. Regional scale horizontal and local scale vertical movements of whale sharks in the Indian Ocean off Seychelles. Fisheries Research 84: 32–40.

ROWAT, D., 2007. Occurrence of the whale shark (Rhincodon typus) in the Indian Ocean: a case for regional conservation. Fisheries Research, 84: 96-101.

RUIZ, G.M. & J.T. CARLTON, 2003. Invasion vectors: a conceptual framework for management. In: RUIZ, G.M. & J.T. CARLTON (eds), Invasive species: vectors and management strategies. Washington, DC: Island Press. pp 459–504.

RUIZ, G.M., FOFONOFF, P.W., CALTON, J.T., WONHAM, M.J. & A.H. HINES, 2000. Invasion of coastal marine communities in North America: Apparent patterns, processes, and biases. Annual Review of Ecology and Systematics 31: 481–531.

SADR, K., GRIBBLE, J. & EUSTON-BROWN, G. 1992. The Vredenburg Survey, 1991-1992 Season.

SÆTRE, R. & E. ONA, 1996. Seismiske undersøkelser og skader på fiskeegg og -larver; en vurdering av mulige effekter på bestandsnivå. Havforskningsinstituttet, Fisken og Havet, 8 - 1996. 25pp.

SALAS, F., MARCOS, C., NETO, J.M., PATRICIO, J., PÉREZ-RUZAFA, A. and J.C. MARQUES, 2006. User-friendly guide for using benthic ecological indicators in coastal and marine quality assessment. Ocean and Coastal management 49: 308-331.

SALMON, M., JONES, T.T. & K.W. HORCH, 2004. Ontogeny of diving and feeding behavior in juvenile sea turtles; leatherback sea turtles (Dermochelys coriacea L) and green sea turtles (Chelonia mydas L) in the Florida Current. J. Herpetol. 38: 36–43.

SALTER, E. & J. FORD, 2001. Holistic Environmental Assessment and Offshore Oil Field Exploration and Production. Mar Poll. Bull., 42(1): 45-58.

SAMARRA, F.I.P., DEECKE, V.B., VINDING, K., RASMUSSEN, M.H., SWIFT, R.J. & P.J.O. MILLER, 2010. Killer whales (Orcinus orca) produce ultrasonic whistles, Journal of the Acoustical Society of America, 128.

SAMSON, J.E., MOONEY, T.A., GUSSEKLOO, S.W.S. & R.T. HANLON, 2014. Graded behavioural responses and habituation to sound in the common cuttlefish Sepia officianalis. Journal of Experimental Biology, 217: 4347-4355.

SANTULLI, A., MODICA, A., MESSINA, C., CEFFA, L., CURATOLO, A., RIVAS, G., FABI, G. & V. D'AMELIO, 1999. Biochemical Responses of European Sea Bass (Dicentrarchus labrax L.) to the Stress Induced by Off Shore Experimental Seismic Prospecting. Mar. Poll. Bull., 38(12): 1105-1114.

SARNOCIŃSKA, J., TEILMANN, J., BALLE, J.D., VAN BEEST, F.M., DELEFOSSE, M. & J. TOUGAARD, 2020. Harbor porpoise (Phocoena phocoena) reaction to a 3D seismic airgun survey in the North Sea. Frontiers in Marine Science, 6: 824.

SAUER, W. H. H., SMALE, M. J., & LIPINSKI, M. R. (1992). The location of spawning grounds, spawning and schooling behaviour of the squid Loligo vulgaris reynaudii (Cephalopoda: Myopsida) off the Eastern Cape Coast, South Africa. Marine Biology, 114(1), 97-107

SAUNDERS, P. M. AND FOFONOFF, N. P., 1976, Conversion of pressure to depth in the ocean, Deep-Sea Res. 23: 109-111.

SAVAGE, C., FIELD, J.G. and R.M. WARWICK, 2001. Comparative meta-analysis of the impact of offshore marine mining on macrobenthic communities versus organic pollution studies. Mar Ecol Prog Ser., 221: 265-275.

SCHALL, E., THOMISCH, K., BOEBEL, O. et al. 2021. Humpback whale song recordings suggest common feeding ground occupation by multiple populations. Sci. Rep., 11, 18806. https://doi.org/10.1038/s41598-021-98295-z

SCHLUNDT, C.E., FINNERAN, J.J., CARDER, D., & S.H. RIDGWAY, 2000. Temporary shifts in masked hearing thresholds (MTTS) of bottlenose dolphins, Tursiops truncatus, and white whales, Delphinapterus leucas, after exposure to intense tones. J. Acoust. Soc. Am., 107: 3496–3508.

SCHOLIK, A.R. & H.Y. YAN, 2001. Effects of underwater noise on auditory sensitivity of a cyprinid fish. Hearing Res., 152: 17-24.

SCHOLIK, A.R. & H.Y. YAN, 2002. The effects of noise on the auditory sensitivity of the bluegill sunfish, Lepomis macrochirus. Comp. Biochem. Physiol., 133A: 43-52.

SCHOLZ, D., MICHEL, J., SHIGENAKA, G. & R. HOFF, 1992. Biological resources. In: An Introduction to Coastal habitats and Biological Resources for Oil Spill Response. Report HMRAD 92-4 pp (4)-1-66. NOAA Hazardous Materials Response and Assessment Division, Seattle.

SCHÖN, P.-J., SAUER, W.H.H., ROBERTS, M.J., 2002. Environmental influences on spawning aggregations and jig catches of chokka squid Loligo vulgaris reynaudii: a “black box” approach. Bulletin of Marine Science, 71: 783–800.

SCHULTZ, O. 2010. Belonging to the West Coast: An ethnography of St Helena Bay in the context of marine resource scarcity. Masters thesis, University of Cape Town.

SCHUSTERMAN, R.J., 1981. Behavioral capabilities of seals and sea lions: A review of their hearing, visual, learning and diving skills. Psychol. Rec., 31(2): 125-143.

SCHWEITZER, F. R. 1979. Excavations at at Die Kelders, Cape Province, South Africa: The Holocene deposits. Annals of the South African Museum 78: 101-232

SCHWEITZER, F.R. 1979. "Excavations at Die Kelders, Cape Province, South Africa. The Holocene deposits." Annals of the South African Museum no. 78 (10):101-233.

SCHWEITZER, F.R., AND M.L. WILSON. 1982. "Byneskranskop 1: a Late Quaternary living site in the southern Cape Province, South Africa." Annals of the South African Museum no. 88 (1):1- 203.

SEAKAMELA, S.M., KOTZE, P.G.H. & S.A. McCUE, 2021. 18. Unusual Mortality level of Kogiid whales in 2020. In: KIRKMAN, S.P., HUGGETT, J.A., LAMONT, T. & M.C. PFAFF (Eds.) Oceans and Coasts Annual Science Report 2020. Department of Forestry, Fisheries and the Environment, p23.

SEAKAMELA, S.M., KOTZE, P.H.G., MCCUE, S.A. & S. BENJAMIN, 2022. 23. The first satellite tracking of movements of long-finned pilot whales in South Africa. In: KIRKMAN, S.P., HUGGETT, J.A., LAMONT, T. & T. HAUPT (Eds.) Oceans and Coasts Annual Science Report 2021. Department of Forestry, Fisheries and the Environment, p26.

SEAKAMELA, S.M., KOTZE, P.H.G., McCUE, S.A., DE GOEDE, J., LAMONT, T., PIETERSE, J., SMITH, M. & T. ANTHONY, 2022. 25. Mortality event of Cape fur seals in South Africa during 2021. In: KIRKMAN, S.P., HUGGETT, J.A., LAMONT, T. & T. HAUPT (Eds.) Oceans and Coasts Annual Science Report 2021. Department of Forestry, Fisheries and the Environment, p28.

SEAKAMELA, S.M., McCUE, S.A. & P.G.H. KOTZE, 2020. Unusual mortality events of whales of the genus Kogia along the South Afrcan coastline. Top Predator Research Programme, Report for External Distribution, July 2020, Department of Environment, Forestry and Fisheries, pp15.

SEAKAMELA, S.M., MEŸER, M.A., KOTZE, P.G.H., MCCUE, S. & S.P. KIRKMAN, 2015. Humpback whale (Megaptera novaeangliae): Suspended migration or confused individuals off the east coast? In: VERHEYE, H., HUGGETT, J. & R. CRAWFORS (Eds) State of ohe Oceans and Coasts Around South Africa - 2015 Report Card.

SEALY, J., AND YATES, R. (1994). The chronology of the introduction of pastoralism to the Cape, South Africa. Antiquity 68: 58-67.

SHABANGU, F.W. & R.K. ANDREW, 2020. Clicking throughout the year: sperm whale clicks in relation to environmental conditions off the west coast of South Africa. Endanger Species Res., 43:475–494

SHABANGU, F.W., FINDLAY, K.P., YEMANE, D., STAFFORD, K.M., VAN DEN BERG, M., BlowS, B. & R.K. ANDREW, 2019. Seasonal occurrence and diel calling behaviour of Antarctic blue whales and fin whales in relation to environmental conditions off the west coast of South Africa. J. Mar. Syst., 190: 25−39.

SHABANGU, F.W., PHILLIPS, M., GEJA, Y., BALI, A., PETERSEN, J., MHLONGO, N., MERKLE, D. & J. COETZEE, 2019. Branch: Fisheries Management Scientific Working Group – Small Pelagics. Final Results of the 2019 Pelagic Biomass Survey. Fisheries/2019/DEC/SWG-PEL/41Rev

SHANNON L.V. AND PILLAR S.C. 1986. The Benguela ecosystem 3. Plankton. In Oceanography and Marine Biology. An Annual Review 24. Barnes M. (Ed.). Aberdeen; University Press: 65-170.

SHANNON L.V. and S. PILLAR, 1985. The Benguela Ecosystem III. Plankton. Oceanography and Marine Biology: An Annual Review, 24: 65-170.

SHANNON, L., VAN DER ELST, R. & R. CRAWFORD, 1989. Tunas, bonitos, spanish mackerels and billfish. In: PAYNE, A. & R. CRAWFORD (eds), Oceans of Life off southern Africa. Cape Town, South Africa: Vlaeberg Publishers. pp 188–197.

SHANNON, L.J., C.L. MOLONEY, A. JARRE and J.G. FIELD, 2003. Trophic flows in the southern Benguela during the 1980s and 1990s. Journal of Marine Systems, 39: 83 - 116.

SHANNON, L.V. and F.P. ANDERSON, 1982. Application of satellite ocean colour imagery in the study of the Benguela Current system. S. Afr. J. Photogrammetry, Remote Sensing and Cartography, 13(3): 153-169.

SHANNON, L.V. and G. NELSON, 1996. The Benguela: Large scale features and processes and system variability. In: The South Atlantic: Present and Past Circulation. WEFER, G., BERGER, W. H., SIEDLER, G. and D. J. WELLS (eds.). Berlin; Springer: 163-210.

SHANNON, L.V. and J.G. FIELD, 1985. Are fish stocks food-limited in the southern Benguela pelagic ecosystem ? Mar. Ecol. Prog. Ser., 22(1) : 7-19.

SHANNON, L.V. and M.J. O'TOOLE, 1998. BCLME Thematic Report 2: Integrated overview of the oceanography and environmental variability of the Benguela Current region. Unpublished BCLME Report, 58pp

SHANNON, L.V., 1985. The Benguela Ecosystem. Part 1. Evolution of the Benguela, physical features and processes. Oceanogr. Mar. Biol. Ann. Rev., 23: 105-182.

SHAUGHNESSY P.D., 1979. Cape (South African) fur seal. In: Mammals in the Seas. F.A.O. Fish. Ser., 5, 2: 37-40.

SHELTON, P.A. 1986. Life-history traits displayed by neritic fish in the Benguela Current Ecosystem. In: The Benguela and Comparable Ecosystems, Payne, A.I.L., Gulland, J.A. and Brink, K.H. (Eds.). S. Afr. J. mar. Sci., 5: 235-242.

SHILLINGTON, F. A., PETERSON, W. T., HUTCHINGS, L., PROBYN, T. A., WALDRON, H. N. and J. J. AGENBAG, 1990. A cool upwelling filament off Namibia, South West Africa: Preliminary measurements of physical and biological properties. Deep-Sea Res., 37 (11A): 1753-1772.

SHINE, K., 2006. Biogeographic patterns and diversity in demersal fish off the south and west coasts of south Africa: Implications for conservation. MSc thesis, Universty of Cape Town.

SHINE, K.H., 2008. Biogeographic Patterns and Assemblages of Demersal Fishes on the south and west coasts of South Africa. BCLME Project BEHP/BAC/03/03 Report. Cape Town, South Africa: Benguela Current Large Marine Ecosystem Programme.

SICILIANO, S., DE MOURA, J.F., BARATA, P.C.R., DOS PRAZERES RODRIGUES D., MORAES ROGES, E., LAINE DE SOUZA, R., HENRIQUE OTT P. AND M. TAVARES, 2013. An unusual mortality of humpback whales in 2010 on the central-northern Rio de Janeiro coast, Brazil. Paper to International Whaling Commission SC63/SH1

SIERRA-FLORES, R., ATACK, T., MIGAUD, H. & A. DAVIE, 2015. Stress response to anthropogenic noise in Atlantic cod Gadus morhua L. Aquacultural Engineering, 67: 67–76.

SIESSER, W.G., SCRUTTON, R.A. & E.S.W. SIMPSON, 1974 . Atlantic and Indian Ocean margins of southern Africa. In: Burk CA, Drake CL (eds), The Geology of Continental Margins. New York: Springer-Verlag. pp 641–654.

SIMMONDS, M.P. & L.F. LOPEZ – JURADO, 1991. Whales and the military. Nature, 351: 448.

SIMMONDS, M.P., DOLMAN, S.J., JASNY, M., PARSONS, E.C.M., WEILGART, L., WRIGHT, A.J. & R. LEAPER, 2014. Marine noise pollution – increasing recognition but need for more practical action. J. Ocean Technol., 9: 71–90

SIMON, C., MATTHEW, P. AND DAVID, P., 2018, Results of deployment of acoustic monitoring equipment for Taranaki Ltd for 2018 Māui 4D Seismic Survey, Report No. PM-18-Shell-Report 3 Results of acoustic equipment deployment 2018 Māui 4D MSS-v1.1.

SIMPSON, E.S.W. & E. FORDER, 1968. The Cape Submarine Canyon. Fisheries Bulletin South Africa. 5: 35–38.

SIMRAD, P., LACE, N., GOWANS, S., QUINTANA-RIZZO, E., KUCZAJ II, S.A., WELLS, R.S. & D.A. MANN, 2012. Low frequency narrow-band calls in bottlenose dolphins (Tursiops truncatus): Signal properties, function, and conservation implications, Journal of the Acoustical Society of America 130: 3068-3076.

SINK, K. & T. SAMAAI, 2009. Identifying Offshore Vulnerable Marine Ecosystems in South Africa. Unpublished Report for South African National Biodiversity Institute, 29 pp.

SINK, K. J., HARRIS, L. R., SKOWNO, A. L., LIVINGSTONE, T., FRANKEN, M., PORTER, S., ATKINSON, L. J., BERNARD, A., CAWTHRA, H., CURRIE, J., DAYARAM, A., DE WET, W., DUNGA, L. V., FILANDER, Z., GREEN, A., HERBERT, D., KARENYI, N., PALMER, R., PFAFF, M., MAKWELA, M., MACKAY, F., VAN NIEKERK, L., VAN ZYL, W., BESSINGER, M., HOLNESS, S., KIRKMAN, S. P., LAMBERTH, S., LÜCK-VOGEL, M., 2019, Chapter 3: Marine Ecosystem Classification and Mapping. In: Sink KJ, van der Bank MG, Majiedt PA, Harris LR, Atkinson LJ, Kirkman SP, Karenyi N (eds), 2019, South African National Biodiversity Assessment 2018 Technical Report Volume 4: Marine Realm. South African National Biodiversity Institute, Pretoria. South Africa. http://hdl.handle.net/20.500.12143/6372.

SINK, K., HOLNESS, S., HARRIS, L., MAJIEDT, P., ATKINSON, L., ROBINSON, T., KIRKMAN, S., HUTCHINGS, L., LESLIE, R., LAMBERTH, S., KERWATH, S., VON DER HEYDEN, S., LOMBARD, A., ATTWOOD, C., BRANCH, G., FAIRWEATHER, T., TALJAARD, S., WEERTS, S., COWLEY, P., AWAD, A., HALPERN, B., GRANTHAM, H. & T. WOLF, 2012. National Biodiversity Assessment 2011: Technical Report. Volume 4: Marine and Coastal Component. South African National Biodiversity Institute, Pretoria.

SINK, K.J., VAN DER BANK, M.G., MAJIEDT, P.A., HARRIS, L.R., ATKINSON, L.J., KIRKMAN, S.P. & N. KARENYI (eds), 2019. South African National Biodiversity Assessment 2018 Technical Report Volume 4: Marine Realm. South African National Biodiversity Institute, Pretoria. South Africa.

SIVLE, L.D., VEREIDE, E.H., DE JONG, K., FORLAND, T.N., DALEN, J. & H. WEHDE, 2021. Effects of Sound from Seismic Surveys on Fish Reproduction, the Management Case from Norway. J. Mar. Sci. Eng., 9: 436. https://doi.org/10.3390/jmse9040436

SKALSKI, J.R., PEARSON, W.H. & C.I. MALME, 1992. Effects of sounds from a geophysical survey device on catch-per-unit-effort in a hook-and -line fishery for Rockfish (Sebastes spp.) Can J. Fish. Aquat. Sci., 49: 1357-1365.

SLABBEKOORN, H. & W. HALFWERK, 2009. Behavioural ecology: Noise annoys at community level. Current Biology, 19: R693–R695.

SLABBEKOORN, H., DALEN, J., DE HAAN, D., WINTER, H.V., RADFORD, C., AINSLIE, M.A., HEANEY, K.D., VAN KOOTEN, T., THOMAS, L. & J. HARWOOD, 2019. Population-level consequences of seismic surveys on fishes: An interdisciplinary challenge. Fish and Fisheries 20(4): 653-685.

SLEIGH, D. 1993. Die Buiteposte: VOC-buiteposte onder Kaapse bestuur 1652-1795. HAUM: Pretoria.

SLOTTE, A., HANSEN, K., DALEN, J. & E. ONA, 2004. Acoustic mapping of pelagic fish distribution and abundance in relation to a seismic shooting area off the Norwegian west coast. Fisheries Research, 67: 143–150.

SLR CONSULTING AUSTRALIA, 2019. Proposed Offshore Exploration Drilling in PEL83, Orange Basin, Namibia. Underwater Noise Preliminary Modelling Prediction and Impact Assessment. Prepared for SLR Consulting (Namibia)(Pty) Ltd. July 2019. 47pp.

SLR CONSULTING AUSTRALIA, 2020. TEPNA Blocks 2912 and 2913B 3D Seismic Survey: Sound Transmission Loss Modelling. Prepared by SLR Consulting Australia Pty Ltd for SLR Consulting (Cape Town) on behalf of Total Exploration and Production Namibia B.V. pp56.

SLR CONSULTING AUSTRALIA, 2021. Searcher Seismic Orange Basin South Africa: 2D and 3D Seismic Survey Underwater Acoustic Modelling. Prepared by SLR Consulting Australia Pty Ltd for SLR Consulting (Cape Town) on behalf of Spectrum Geo South Africa. pp69.

SLR CONSULTING AUSTRALIA, 2024. 3D Seismic Survey Underwater Acoustics Modelling Project ZA24-010_Orange Basin MC3D MSS.

SMALE, M.J., ROEL, B.A., BADENHORST, A. & J.G. FIELD, 1993. Analysis of demersal community of fish and cephalopods on the Agulhas Bank, South Africa. Journal of Fisheries Biology 43:169-191.

SMITH, A, B. 1987. Seasonal exploitation of resources on the Vredenburg Peninsula after 2000 BP. In Parkington, J. E., and Hall, M. (eds.), Papers in the Prehistory of the Western Cape, South Africa, BAR International Series 332 (ii), Oxford, pp. 393-402.

SMITH, A. & MUTTI, B. (eds). 1992. Guide to Archaeological Sites in the south-western Cape. For the South African Association of Archaeologists Conference July 5-9.

SMITH, A. 2006. Kasteelberg: A Pastoralist Sealing Camp in Western Cape Province, South Africa. The Journal of Island and Coastal Archaeology 1(1): 109-122.

SMITH, G.G & G.P. MOCKE, 2002. Interaction between breaking/broken waves and infragravity-scale phenomena to control sediment sediment suspension and transport in the surf zone. Marine Geology, 187: 320-345.

SMITH, LAURAJANE. 2015. "Intangible Heritage: A challenge to the authorised heritage discourse?" Revista d'etnologia de Catalunya 40: 133-142

SMITH, M.E. & J.D. MONROE, 2016. Causes and consequences of sensory hair cell damage and recovery in fishes. In J. SISNEROS (Ed.), Fish hearing and bioacoustics (pp. 393–417). New York, NY: Springer.

SMITH, M.E., A.B. COFFIN, D.L. MILLER, & A.N. POPPER, 2006. Anatomical and functional recovery of the goldfish (Carassius auratus) ear following noise exposure. Journal of Experimental Biology, 209: 4193-4202.

SMITH, M.E., KANE, A.S. & A.N. POPPER, 2004. Noise-induced stress response and hearing loss in goldfish (Carassius auratus). J. Exp. Biol., 207: 427-435.

SMITH, M.H.D. 1985. Boerepioniers van die Sandveld. Pretoria: Raad vir Geesteswetenskaplike Navorsing.

SMULTEA, M.A., KIECKHEFER, T.R. & A.E. BOWLES, 1995. Response of humpback whales to an observation aircraft as observed from shore near Kauai, Hawaii, 1994. Final Report for the 1994 Marine Mammal Research Program of the Acoustic Thermometry of Ocean Climate (ATOC) study. Prepared by the Bioacoustics Research Program of the Cornell Laboratory of Ornithology, Cornell University, Ithaca, NY, USA. 46 p.

SMULTEA, M.A., MOBLEY, J.R., FERTL, D. & G.L. FULLING, 2008. An unusual reaction and other observations of sperm whales near fixed-wing aircraft. Gulf and Caribbean Research 20: 75-80.

SOLAN, M., HAUTON, C., GODBOLD, J.A., WOOD, C.L., LEIGHTON, T.G. & P. WHITE, 2016. Anthropogenic sources of underwater sound can modify how sediment-dwelling invertebrates mediate ecosystem properties. Sci. Rep., 6: 20540.

SOLÉ, M., LENOIR, M., DURFORT, M., LÓPEZ-BEJAR, M., LOMBARTE, A., VAN DER SCHAAR, M., ANDRÉ, M., 2013a. Does exposure to noise from human activities compromise sensory information from cephalopod statocysts? Deep-Sea Res. II Top. Stud. Oceanogr. 95: 160–181.

SOLÉ, M., LENOIR, M., DURFORT, M., LÓPEZ-BEJAR, M., LOMBARTE, A., ANDRÉ, M., 2013b. Ultrastructural Damage of Loligo vulgaris and Illex coindetii statocysts after Low Frequency Sound Exposure. PLoS ONE 8(10): e78825. doi:10.1371/journal.pone.0078825

SOUDIJN, F.H., VAN KOOTEN, T., SLABBEKOORN, H. & A.M. DE ROOS, 2020. Population-level effects of acoustic disturbance in Atlantic cod: a size-structured analysis based on energy budgets. Proceedings of the Royal Society B 287(1929): 20200490.

SOUTH AFRICAN DEEP-SEA TRAWLING INDUSTRY ASSOCIATION: Spatial boundaries for the South African hake-directed trawling industry. Prepared by Capricorn Fisheries Monitoring cc (July 2008).

SOUTHALL B. L., FINNERAN J. J., REICHMUTH C., NACHTIGALL P. E., KETTEN D. R., BOWLES A. E., ELLISON W. T., NOWACEK D. P., TYACK P. L., 2019, Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects. Aquatic Mammals 2019, 45(2), 125-232, DOI 10.1578/AM.45.2.2019.125.

SOUTHALL, B., BOWLES, A., ELLISON, W., FINNERAN, J., GENTRY, R., GREENE, C. JR., KASTAK, D., KETTEN, D., MILLER, J., NACHTIGALL, P., RICHARDSON, W., THOMAS, J., TYACK, P., 2007, Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. Aquatic Mammals, 33(4), 411-521.

SOUTHALL, B.L., A.E. BOWLES, W.T. ELLISON, J.J. FINNERAN, R.L. GENTRY, C.R. GREENE, JR., D. KASTAK, D.R. KETTEN, J.H., MILLER, P.E. NACHTIGALL, W.J. RICHARDSON, J.A. THOMAS & P.L. TYACK, 2007. Marine mammal noise exposure criteria: initial scientific recommendations. Aquatic Mammals, 33(4): 411-522.

SOUTHALL, B.L., FINNERAN, J.J., REICHMUTH, C., NACHTIGALL, P.E., KETTEN, D.R., BOWLES, A.E., ELLISON, W.T., NOWACEK, D.P. & P.L. TYACK, 2019. Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects. Aquatic Mammals 2019, 45(2), 125-232, DOI 10.1578/AM.45.2.2019.125.

SOUTHALL, B.L., ROWLES, T., GULLAND, F., BAIRD, R.W. & P.D. JEPSON, 2008. Final report of the Independent Scientific Review Panel investigating potential contributing factors to a 2008 mass stranding of melon-headed whales (Peponocephala electra) in Antsohihy, Madagascar.

SOWMAN M. (2006). Subsistence and small-scale fisheries in South Africa: a ten-year review. Marine Policy 30: 60-73.

SPOONER, E., KARNAUSKAS, M., HARVEY, C.J., KELBLE, C., ROSELLON-DRUKER, J., KASPERSKI, S., LUCEY, S.M., ANDREWS, K.S., GITTINGS, S.R., MOSS, J.H., GOVE, J.M., SAMHOURI, J.F., ALLEE, R.J., BOGRAD, S.J., MONACO, M.E., CLAY, P.M., ROGERS, L.A., MARSHAK, A., WONGBUSARAKUM, S., BROUGHTON, K. & P.D. LYNCH, 2021. Using Integrated Ecosystem Assessments to Build Resilient Ecosystems, Communities, and Economies, Coastal Management, 49:1, 26-45, DOI: 10.1080/08920753.2021.1846152

SPRFMA, 2007. Information describing seamount habitat relevant to the South Pacific Regional Fisheries Management Organisation.

STEFFANI, C.N. and A. PULFRICH, 2007. Biological Survey of the Macrofaunal Communities in the Atlantic 1 Mining Licence Area and the Inshore Area between Kerbehuk and Lüderitz 2001 – 2004 Surveys. Prepared for De Beers Marine Namibia, March 2007, 288pp.

STEFFANI, C.N., 2009b. Assessment of Mining Impacts on Macrofaunal Benthic Communities in the Northern Inshore Area of the De Beers ML3 Mining Licence Area - 18 Months Post-mining. Prepared for De Beers Marine (South Africa), 47pp.

STEFFANI, C.N., 2010a. Biological monitoring surveys of the benthic macrofaunal communities in the Atlantic 1 Mining Licence Area - 2008. Prepared for De Beers Marine Namibia (Pty) Ltd. pp. 40 + Appendices.

STEFFANI, C.N., 2010b. Benthic grab monitoring survey in the Atlantic 1 Mining Licence Area -2009- sediment composition. Prepared for De Beers Marine Namibia (Pty) Ltd. pp. 19 + Appendix.

STEFFANI, C.N., 2010c. Assessment of mining impacts on macrofaunal benthic communities in the northern inshore area of the De Beers Mining Licence Area 3 – 2010 . Prepared for De Beers Marine (South Africa). pp 30 + Appendices.

STEFFANI, C.N., 2012a. Assessment of Mining Impacts on Macrofaunal Benthic Communities in the Northern Inshore Area of the ML3 Mining Licence Area - 2011. Prepared for De Beers Marine (South Africa), July 2012, 54pp.

STEFFANI, C.N., 2012b. Assessment of mining impacts on macrofaunal benthic communities in the northern inshore area of mining licence area 3.

STEFFANI, C.N., 2014. Assessment of mining impacts on macrofaunal benthic communities in the northern inshore area of mining licence area MPT 25-2011.

STEFFANI, N., 2007a. Biological Baseline Survey of the Benthic Macrofaunal Communities in the Atlantic 1 Mining Licence Area and the Inshore Area off Pomona for the Marine Dredging Project. Prepared for De Beers Marine Namibia (Pty) Ltd. pp. 42 + Appendices.

STEFFANI, N., 2007b. Biological Monitoring Survey of the Macrofaunal Communities in the Atlantic 1 Mining Licence Area and the Inshore Area between Kerbehuk and Bogenfels. 2005 Survey. Prepared for De Beers Marine Namibia (Pty) Ltd. pp. 51 + Appendices.

STEFFANI, N., 2009a. Biological monitoring surveys of the benthic macrofaunal communities in the Atlantic 1 Mining Licence Area and the inshore area - 2006/2007. Prepared for De Beers Marine Namibia (Pty) Ltd. pp. 81 + Appendices.

STEFFANI, N., SEDICK, S., ROGERS, J. & M.J. GIBBONS, 2015. Infaunal benthic communities from the inner shelf off Southwestern Africa are characterised by generalist species. PLoS ONE 10(11): e0143637. doi:10.1371/journal.pone.0143637.

STENEVIK, E.K., VERHEYE, H.M., LIPINSKI, M.R., OSTROWSKI, M. and T. STRØMME, 2008. Drift routes of Cape hake eggs and larvae in the southern Benguela Current system. Journal of Plankton Research Vol. 30:10. Pp. 1147 – 1156.

STEWART, B.S., EVANS, W.E. & F.T. AWBREY, 1982. Effects of man-made waterborne noise on behaviour of belukha whales (Delphinapterus leucas) in Bristol Bay, Alaska. Unpublished report for National Oceanic and Atmospheric Administration, Juneau, Alaska, by Hubbs/Sea World Research Institute, San Deigo, California. HSWRI Technical Report 82-145.

STONE, C.J. & M.L. TASKER, 2006. The effects of seismic airguns on cetaceans in UK waters. Journal of Cetacean Research and Management, 8: 255–263.

STONE, C.J., 2003. The effects of seismic activity on marine mammals in UK waters, 1998-2000. JNCC Report No 323. Joint Nature Conservation Committee, Aberdeen. ISSN 0963-8091.

STONE, C.J., HALL, K., MENDES, S. & M.L. TASKER, 2017. The effects of seismic operations in UK waters: analysis of Marine Mammal Observer data. J. Cetacean Res. Manage., 16: 71-85.

STREEVER, B., RABORN, S.W., KIM, K.H., HAWKINS, A.D. & A.N. POPPER, 2016. Changes in fish catch rates in the presence of airgun sounds in Prudhoe Bay, Alaska. Arctic, 69: 346–358.

STRØMME, T., LIPINSKI, M.R. & P. KAINGE, 2015. Life cycle of hake and likely management implications. Rev. Fish. Biol. Fisheries, DOI 10.1007/s11160-015-9415-9

SUZUKI, H., HAMADA, E., SAITO, K., MANIWA, Y. & Y. SHIRAI, 1980. The influence of underwater sound on marine organisms. J. Navig., 33: 291-295.

TAUNTON-CLARK, J., 1985. The formation, growth and decay of upwelling tongues in response to the mesoscale windfield during summer. In: South African Ocean Colour and Upwelling Experiment. Shannon L.V. (ed.). Sea Fisheries Research Institute, Cape Town. pp 47-62.

TAVOLGA, W.N. & J. WOODINSKY, 1963. Auditory capacities in fish. Pure tone thresholds in nine species of marine teleosts. Bull. Am. Mus. Nat. Hist., 126: 177-239.

THIEBAULT, A., CHARRIER, I., AUBIN, T., GREEN, D.B. & P.A. PISTORIUS, 2019. First evidence of underwater vocalisations in hunting penguins, PeerJ 7:e8240 DOI 10.7717/peerj.8240

THIEBAULT, A., MULLERS, R.H.E., PISTORIUS, P.A. & Y. TREMBLAY, 2014. Local enhancement in a seabird: Reaction distances and foraging consequence of predator aggregations. Behav. Ecol., 25: 1302 1310.

THIEBAULT, A., MULLERS, R.H.E., PISTORIUS, P.A. & Y. TREMBLAY, 2016. Seabird acoustic communication at sea: A new perspective using bio-logging devices. Sci. Rep., 6: 4 10.

THOMAS, J., CHUN, N., AU, W.W.L. & K. PUGH, 1988. Underwater audiogram of a false killer whale (Pseudorca crassidens). J. Acoust. Soc. Am., 84(3): 936-940.

THOMISCH, K., 2017. Distribution patterns and migratory behavior of Antarctic blue whales. Reports on Polar and Marine Research 707: pp194. doi:10.2312/BzPM_0707_2017

THOMISCH, K., BOEBEL, O., BACHMANN, J., FILUN, D., NEUMANN, S., SPIESECKE, S. & I. VAN OPZEELAND, 2019. Temporal patterns in the acoustic presence of baleen whale species in a presumed breeding area off Namibia. Mar. Ecol. Prog. Ser., 620: 201-214.

THOMISCH, K., BOEBEL, O', CLARK, C.W., HAGEN, W., SPIESECKE, S., ZITTERBART, D.P. and I. VAN OPZEELAND, 2016. Spatio-temporal patterns in acoustic presence and distribution of Antarctic blue whales Balaenoptera musculus intermedia in the Weddell Sea. doi: 10.3354/esr00739.

THOMPSON, P.M., BROOKES, K.L., GRAHAM, I.M., BARTON, T.R., NEEDHAM, K., BRADBURY, G., et al., 2013. Short-term disturbance by a commercial two dimensional seismic survey does not lead to long-term displacement of harbour porpoises. Proc. R. Soc. B Biol. Sci., 280: 8. doi: 10.1098/rspb.2013.2001

THRESHER, R.E., 1999. Diversity, impacts and options for managing invasive marine species in Australian waters. Australian Journal of Environmental Management 6: 164–74.

TISSOT, B.N., YOKLAVICH, M.M., LOVE, M.S., YORK, K. & M. AMEND, 2006. Benthic invertebrates that form habitat on deep banks off southern California, with special reference to deep sea coral. Fishery Bulletin 104: 167–181.

TOLLEFSON, J., 2017. Airgun blasts kill plankton. Nature, 546: 586-587.

TURL, C.W., 1993. Low-frequency sound detection by a bottlenose dolphin. J. Acoust. Soc. Am., 94(5): 3006-3008.

TURNPENNY, A.W.H., NEDWELL, J.R., 1994. The effects on marine fish, diving mammals and birds of underwater sound generated by seismic surveys. Rep. from Fawley Aquatic Research Laboratories Ltd. 40 pp + 9 pp appendices.

TYACK, P.L. & C.W. CLARK, 2000. Communication and acoustic behavior of dolphins and whales. In: Au, W.W.L. & R.R. Fay (Eds) Hearing by Whales and Dolphins, Springer, New York, pp. 156-224.

TYACK, P.L., 2008. Implications from marine mammals of large-scale changes in the marine acoustic environment, Journal of Mammalogy, 89: 549-558.

TYACK, P.L., ZIMMER, W.M.X., MORETTI, D., SOUTHALL, B.L., CLARIDGE, D.E., DURBAN, J.W., CLARK, C.W., et al., 2011. Beaked Whales Respond to Simulated and Actual Navy Sonar, 6(3). doi:10.1371/journal.pone.0017009

TYARKS, S.C., ANICETO, A.S., AHONEN, H., PEDERSEN, G. & U. LINDSTRØM, 2021. Humpback Whale (Megaptera novaeangliae) Song on a Subarctic Feeding Ground. Frontiers in Marine Science, https://doi.org/10.3389/fmars.2021.669748.

UNITED STATES DEPARTMENT OF THE INTERIOR, 2007. Notice to Lessees and Operators (NTL) of federal oil, gas, and sulphur leases in the outer continental shelf, Gulf of Mexico OCS Region: Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program. NTL No. 2007-G02.

VAAGE, S., STRANDNESS, S. AND UTHEIM, T., 1984, Signatures from single airguns, Geophysical Prospecting, 31: 87-97.

VAN BEEST, F.M., TEILMANN, J., HERMANNSEN, L., GALATIUS, A., MIKKELSEN, L., SVEEGAARD, S., BALLE, J.D., DIETZ, R. & J. NABE-NIELSEN, 2018. Fine-scale movement responses of free-ranging harbour porpoises to capture, tagging and short-term noise pulses from a single airgun. R. Soc. open sci., 5: 170110. http://dx.doi.org/10.1098/rsos.170110

VAN DALFSEN, J.A., ESSINK, K., TOXVIG MADSEN, H., BIRKLUND, J., ROMERO, J. and M. MANZANERA, 2000. Differential response of macrozoobenthos to marine sand extraction in the North Sea and the Western Mediterranean. ICES J. Mar. Sci., 57: 1439–1445.

VAN DEN BERG, G.L., VERMEULEN, E., VALENZUELA, L.O., et al. 2020. Decadal shift in foraging strategy of a migratory southern ocean predator. Global Change Biology, 27: 1052–1067.

VAN DER ELST, R. 1976. Game fish of the east coast of southern Africa. I: The biology of the elf Pomatomus saltatrix (Linneaus) in the coastal waters of Natal. ORI Investl. Rep., 44. 59pp.

VAN DER ELST, R. 1981. A Guide to the Common Sea Fishes of Southern Africa. Struik, Cape Town: 367pp.

VAN DER KNAAP, I., REUBENS, J., THOMAS, L., AINSLIE, M.A., WINTER, H.V., HUBERT, J., MARTIN, B. & H. SLABBEKOORN, 2021. Effects of a seismic survey on movement of free-ranging Atlantic cod. Current Biology, 31(7): 1555-1562.

VAN DER LINGEN C.D. AND J.J. VAN DER WESTHUIZEN (2013). Spatial distribution of directed sardine catches around South Africa, 1987-2012. Scientific Working Group document, Department of Agriculture, Forestry and Fisheries, FISHERIES/2013/OCT/SWG-PEL/33, 9 pp.

VAN DER WAL, S., ECKERT, S.A., LOPEZ-PLANA, J.O., HERNANDEZ, W. & K.L. ECKERT, 2016. Innovative measures for mitigating potential impacts on sea turtles during seismic surveys. In: SPE International Conference and Exhibition on Health, Safety, Security, Environment, and Social Responsibility, p. Society of Petroleum Engineers, Stavanger, Norway.

VAN DER WOUDE, S.E., 2009. Bottlenose dolphins (Tursiops truncatus) moan as low in frequency as baleen whales, Journal of the Acoustical Society of America, 126: 1552-1562.

VAN DER WOUDE, S.E., 2009. Bottlenose dolphins (Tursiops truncatus) moan as low in frequency as baleen whales. Journal of the Acoustical Society of America, 126: 1552-1562.

VAN SITTERT, L. 2001. Velddrift. The Making of a South African Company Town. Urban History 28, 2 (2001). Cambridge University Press.

VAN WEELDEN, C., TOWERS, J.R. & T. BOSKER, 2021. Impacts of climate change on cetacean distribution, habitat and migration. Clim. Change Ecol., 1: 100009.

VAN WYK, B. 2016. Indigenous Rights, Indigenous Epistemologies, and Language: (Re)Construction of Modern Khoisan Identities. Knowledge Cultures 4(4), pp. 33-45.

VERMEULEN, E., WILKINSON, C., & G. VAN DEN BERG, 2020. Report of the 2019 South African southern right whale aerial survey. Report to IWC. 10.13140/RG.2.2.29556.37766.

VILARDO, C. & A. BARBOSA, 2018. Can you hear the noise? Environmental licensing of seismic surveys in Brazil faces uncertain future after 18 years protecting biodiversity. Perspectives in Ecology and Conservation, 16. 10.1016/j.pecon.2017.11.005.

VILLEGAS-AMTMANN, S., SCHWARZ, L.K., GAILEY, G., SYCHENKO, O. & D.P. COSTA, 2017. East or west: the energetic cost of being a gray whale and the consequence of losing energy to disturbance. Endangered Species Research, 34: 167-183.

VILLEGAS-AMTMANN, S., SCHWARZ, L.K., SUMICH, J.L. & D.P. COSTA, 2015. A bioenergetics model to evaluate demographic consequences of disturbance in marine mammals applied to gray whales. Ecosphere, 6(10): art183.

VISSER, G.A., 1969. Analysis of Atlantic waters off the coast of southern Africa. Investigational Report Division of Sea Fisheries, South Africa, 75: 26 pp.

VU, E. T., RISCH, D., CLARK, C.W., GAYLORD, S., HATCH, L.T., THOMPSON, M.A., WILEY, D.N. & S.M. VAN PARIJS, 2012. Humpback whale song occurs extensively on feeding grounds in the western North Atlantic Ocean, Aquatic Biology, 14: 175-183.

WALKER, D.R and W.T. PETERSON, 1991. Relationships between hydrography, phytoplankton production, biomass, cell size and species composition, and copepod production in the southern Benguela upwelling system in April 1988. S. Afr. J. mar. Sci., 11: 289-306

WARD, K. 2009. Networks of Empire: Forced Migration in the Dutch East India Company. Cambridge: Cambridge University Press.

WARD, L.G., 1985. The influence of wind waves and tidal currents on sediment resuspension in Middle Chesapeake Bay. Geo-Mar. Letters, 5: 1-75.

WARDLE, C.S., CARTER, T.J., URQUHART, G.G., JOHNSTONE, A.D.F., ZIOLKOWSKI, A.M., HAMPSON, G. & D. MACKIE, 2001. Effects of seismic air guns on marine fish. Cont. Shelf Res., 21: 1005-1027.

WARTZOK, D., A.N. POPPER, J. GORDON, & J. MERRILL, 2004. Factors affecting the responses of marine mammals to acoustic disturbance. Mar. Technology Soc. J., 37(4): 6-15.

WARWICK, R.M., 1993. Environmental impact studies on marine communities: Pragmatical considerations. Australian Journal of Ecology, 18: 63-80.

WASSON, K., ZABIN, C.J., BEDINGER, L., CRISTINA DIAZ, M. & J.S. PEARSE, 2001. Biological invasions of estuaries without international shipping: the importance of intraregional transport. Biological Conservation 102: 143–153.

WATKINS, W.A. & D. WARTZOK, 1985. Sensory biophysics of marine mammals. Mar. Mamm. Sci., 1(3): 219-260.

WATKINS, W.A. & W.E. SCHEVILL, 1977. Sperm whale codas. Journal of the Acoustical Society of America 62: 1485-90 + disk in pocket.

WATKINS, W.A., 1981. Activities and underwater sounds of fin whales. Scientific Reports of the Whales Research Institute 33: 83-117.

WATKINS, W.A., 1986. Whale reactions to human activities in Cape Cod waters. Mar. Mamm. Sci., 2(4): 251-262.

WEBB, C.L.F. & N.J. KEMPF, 1998. The impact of shallow water seismic surveys in sensitive areas. Society for Petroleum Engineers Technical Paper SPE46722.

WEBLEY, L. 2009. Archaeological Impact Assessment: Port Nolloth Borrow Pits, Richtersveld Municipality, Northern Cape. Report prepared for the Richtersveld Municipality. Archaeology Contracts Office.

WEILGART, L., 2013. A review of the impacts of seismic airgun surveys on marine life. Submitted to the CBD Expert Workshop on Underwater Noise and its Impacts on Marine and Coastal Biodiversity, 25-27 February 2014, London, UK.

WEILGART, L.S., 2007a. A brief review of known effects of noise on marine mammals, International Journal of Comparative Psychology, 20: 159-168.

WEILGART, L.S., 2007b. The impacts of anthropogenic ocean noise on cetaceans and implications for management. Canadian Journal of Zoology. 85(11): 1091-1116.

WEIR, C.R, DOLMAN, S.J. & M.P. SIMMONDS, 2006. Marine mammal mitigation during seismic surveys and recommendations for worldwide standard mitigation guidance. Paper presented to IWC SC, SC/58/E12.

WEIR, C.R. & S.J. DOLMAN, 2007. Comparative review of the regional marine mammal mitigation guidelines implemented during industrial seismic surveys, and guidance towards a worldwide standard. J. Int. Wildl. Law Policy 10: 1–27.

WEIR, C.R. 2008. Short-Finned Pilot Whales (Globicephala macrorhynchus) Respond to an Airgun Ramp-up Procedure off Gabon. Aquatic Mammals, 34(3): 349-354,

WEIR, C.R., 2007. Observations of Marine Turtles in Relation to Seismic Airgun Sound off Angola. Marine Turtle Newsletter, 116: 17-20.

WEIR, C.R., 2011. Distribution and seasonality of cetaceans in tropical waters between Angola and the Gulf of Guinea. African Journal of Marine Science 33(1): 1-15.

WEIR, C.R., COLLINS, T., CARVALHO, I. & H.C. ROSENBAUM, 2010. Killer whales (Orcinus orca) in Angolan and Gulf of Guinea waters, tropical West Africa. Journal of the Marine Biological Association of the U.K. 90: 1601–1611.

WELLER, D.W., IVASHCHENKO, Y.V., TSIDULKO, G.A., BURDIN, A.M., & R.L. BROWNELL, 2002. Influence of seismic surveys on western gray whales off Sakhalin Island, Russia in 2001. Document SC/54/BRG14 submitted to the Scientific Committee of the International Whaling Commission, 2002.

WEVER, E., HERMAN, P., SIMMONS, J. & D. HERTZLER, 1969. Hearing in the Blackfooted Penguin, Spheniscus demersus, as Represented by the Cochlear Potentials. PNAS 63(3): 676-680.

WHEELER, A.J., KOZACHENKO, M., BEYER, A., FOUBERT, A., HUVENNE, V.A.I., KLAGES, M., MASSON, D.G., OLU-LE ROY, K. and J. THIEDE, 2005. Sedimentary processes and carbonate mounds in the Belgica Mound province, Porcupine Seabight, NE Atlantic. In: Cold-water Corals and Ecosystems, FREIWALD, A and J.M. ROBERTS, (eds). Springer-Verlag Berlin Heidelberg pp. 571-603.

WHITE, M.J., NORRIS, J., LJUNGBLAD, D., BARON, K. & G. DI SCIARRA, 1978. Auditory thresholds of two beluga whales (Delphinapterus leucas). HSWRI Tech Rep. 78-109. Report from Hubbs/ Sea World Res. Inst., San Diego, Ca. 35pp.

WHITE, R.W., GILLON, K.W., BLACK, A.D. & J.B. REID, 2001. Vulnerable concentrations of seabirds in Falkland Islands waters.. JNCC, Peterborough.

WHITEHEAD, H., 2002. Estimates of the current global population size and historical trajectory for sperm whales. Marine Ecology Progress Series, 242: 295-304.

WHITlow, W. L. A. AND HASTINGS, M. C., 2008, Principles of Marine Bioacoustics, Springer.

WICKENS, P., 1994. Interactions between South African Fur Seals and the Purse-Seine Fishery. Marine Mammal Science, 10: 442–457.

WIGLEY, R.A. & J.S. COMPTON, 2006. Late Cenozoic evolution of the outer continental shelf at the head of the Cape Canyon, South Africa. Marine Geology, 226: 1–23.

WIGLEY, R.A., 2004. Sedimentary facies from the head of the Cape Canyon: Insights into the Cenozoic evolution of the western margin of South Africa. PhD Thesis, University of Cape Town, South Africa.

WILKINSON, C., 2021. Estimating population changes in humpback whales (Megaptera novaeangliae) migrating past Cape Vidal, South Africa. MSc Thesis, Cape Peninsula University of Technology, pp108.

WILLIAMS, R., WRIGHT, A.J., ASHE, E., BLIGHT, L.K., BRUINTJES, R., CANESSA, R., CLARK, C.W.,CULLIS-SUZUKI, S., DAKIN, D.T., ERBE, C., HAMMOND, P.S., MERCHANT, N.D., O'HARA,P.D., PURSER, J., RADFORD, A.N., SIMPSON, S.D., THOMAS, L. & M.A. WALE, 2015. Impacts of anthropogenic noise on marine life: publication patterns, newdiscoveries, and future directions in research and management. Ocean Coast.Manage., 115: 17–24,

WILSON, M. L. 1990. Strandlopers and shell middens. Masters dissertation, University of Cape Town.

WILSON, P., THUMS, M., PATTIARATCHI, C., MEEKAN, M., PENDOLEY, K., FISHER, R. & S. WHITING, 2018. Artificial light disrupts the nearshore dispersal of neonate flatback turtles Natator depressus. Marine Ecology Progress Series, 600: 179-192.

WINN, H.E. & L.K. WINN, 1978. The song of the humpback whale Megaptera novaeangliae in West-Indies, Marine Biology, 47: 97-114.

WITHROW, D.E., 1983. Gray whale research in Scammon's Lagoon (Laguna Ojo de Liebre). Cetus 5(1): 8-13.

WRIGHT, A.J. et al. 2007. Anthropogenic Noise as a Stressor in Animals: A Multidisciplinary Perspective, International Journal of Comparative Psychology, 20: 250-273.

WÜRSIG, B., LYNN, S.K., JEFFERSON, T.A. & K.D. MULLIN, 1998. Behaviour of cetaceans in the northern Gulf of Mexico relative to survey ships and aircraft. Aquatic Mammals 24: 41-50.

YAZVENKO, S.B., McDONALD, T.L., BLOKHIN, S.A., JOHNSON, S.R. et al. 2007. Distribution and abundance of western gray whales during a seismic survey near Sakhalin Island, Russia. Environ. Monit. Assess., 134: 45−73.

YEMANE, D., MAFWILA, S.K., KATHENA, J., NSIANGANGO, S.E. & S.P. KIRKMAN, 2015. Spatio-temporal trends in diversity of demersal fish species in the Benguela current large marine ecosystem region. Fisheries Oceanography, 24(S1): 102-121.

ZAJAC, R.N., LEWIS, R.S., POPPE, L.J., TWICHELL, D.C., VOZARIK, J., and M.L. DIGIACOMO-COHEN, 2000. Relationships among sea-floor structure and benthic communities in Long Island Sound at regional and benthoscape scales. J. Coast. Res., 16: 627– 640.

ZETTLER, M.L., BOCHERT, R. and F. POLLEHNE. 2009. Macrozoobenthos diversity in an oxygen minimum zone off northern Namibia. Marine Biology 156:1949-1961.

ZETTLER, M.L., BOCHERT, R. and F. POLLEHNE. 2013. Macrozoobenthic biodiversity patterns in the northern province of the Benguela upwelling system. African Journal of Marine Science, 35(2): 283-290.

ZIOLKOWSKI, A. M., 1970, A method for calculating the output pressure waveform from an airgun, Geophys.J.R.Astr.Soc., 21: 137-161.

ZIOLKOWSKI, A. M., PARKES, G. E., HATTON, L. AND HAUGLAND, T., 1982, The signature of an airgun array: computation from near-field measurements including interactions, Geophysics, 47: 1413-1421.

ZONFRILLO, B., 1992. The menace of low-flying aircraft to Ailsa Craig. Scottish Bird News, 28 :4.

ZOUTENDYK, P., 1992. Turbid water in the Elizabeth Bay region: A review of the relevant literature. CSIR Report EMAS-I 92004.

ZOUTENDYK, P., 1995. Turbid water literature review: a supplement to the 1992 Elizabeth Bay Study. CSIR Report EMAS-I 95008.

15 APPENDICES

Appendix A: EAP CV

Appendix B: Public Participation

Appendix C: Specialist Reports

Appendix D: Impact Assessment Matrix

Appendix E: Environmental Management Programme

Appendix F: Rehabilitation, Decommissioning and Closure Plan

Appendix G: Additional Information