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ENVIRONMENTAL BASIC ASSESSMENT REPORT

PROPOSED TGS ORANGE BASIN RECONNAISSANCE PERMIT

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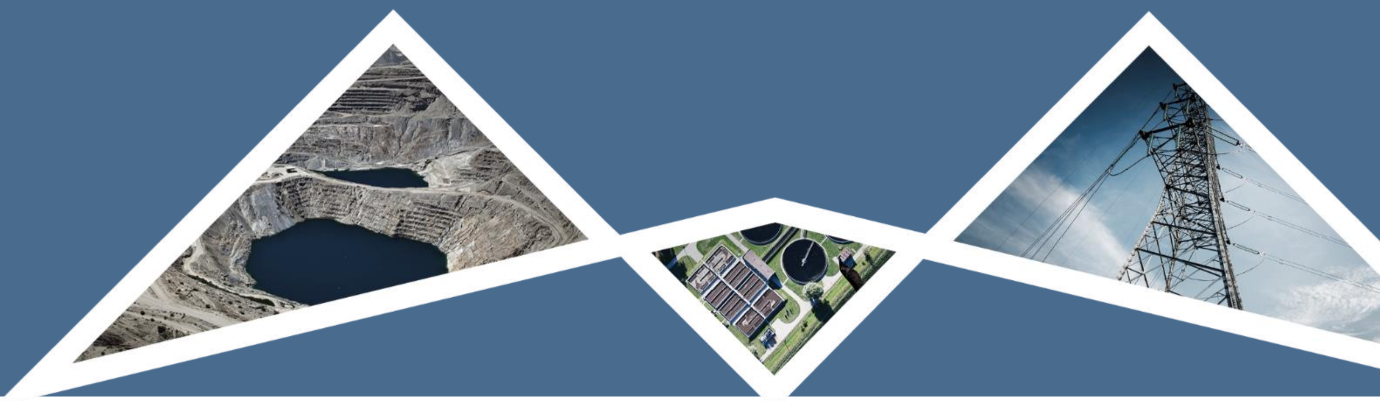

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ACRONYMS AND ABBREVIATIONS

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
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
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

TGS Geophysical Company (UK) (hereafter TGS) has applied for Environmental Authorization (EA) for a 3D seismic survey off the West Coast of South Africa. Environmental Impact Management Services (Pty) Ltd (EIMS) has been appointed by TGS 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 120 km offshore of St Helena Bay, extending north along the western coastline to approximately 230 km offshore of Hondeklip Bay over a number of petroleum licence blocks. The Application Area for the proposed 3D seismic survey is approximately 57 400 km^2 in extent. It is proposed that a single survey vessel equipped with seismic sources and streamers be used. The proposed 3D survey would be supported by up to two escort vessels. The 3D survey will take in the order of 70 days including downtime.

A Basic Assessment (BA) process is being undertaken to accompany the EA 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.

PUBLIC PARTICIPATION PROCESS

The PPP for the proposed project has been 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 commenting period so far have been captured in the Public Participation Report (PPR) in Appendix 2. This BA report is being made available for public review from 21 October 2022 to 21 November 2022. A high-level summary of the key comments and concerns raised to date are presented below:

- Effects on migratory patterns of fauna 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;
- Previous Public Consultation Processes have been viewed as a “tick box exercise”;
- Impact on indigenous cultural heritage, historical connection to the sea;
- EIMS’ independence if the applicant pays for the services rendered;
- Alternative technologies to seismic surveys;

- Cumulative impacts; and
- 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.

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.
- 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.

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

- Perceived 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 5) 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 has been extensive, and every effort has been made to include representatives of all stakeholders in the study area. The main conclusions from each of the specialist studies are presented below.

NOISE / ACOUSTICS

The zones of potential injuries for fish species with a swim bladder (e.g. snoek), turtles and fish eggs and fish larvae are predicted to be within 180 m from the array source (noise source). However, fish species without swim bladders have higher injury impact thresholds, and therefore have smaller zones of potential injuries within 90 m from the airgun array source.

The zones of potential mortal injuries for fish species with a swim bladder, fish eggs, and fish larvae are predicted to be within 30 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 80 m from the adjacent survey lines for fish with a swim bladder for all the operation scenarios considered. Fish without swim bladder are not expected to suffer or any potential injury. The zones of temporary auditory threshold shift (TTS) effect for fish species with and without swim bladders are predicted to be within 2.9 km 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.

Three (3) long range modelling source locations are proposed for the 3D seismic survey. The modelling is representative of the noise propagation within the proposed 3D seismic area. Source location L1 is adjacent to the marine sensitive area (Tripp Seamount – located to the north and outside of the Application Area), L2 represents the average depth of the south survey area and L3 is located towards the deeper water environment of the survey area. 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. Thus, it can be said that he sound levels don't change equally over vertical and horizontal distance from the source due to the shape of the sea floor and the direction of the noise source.

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 in all locations for propagation paths towards shoreline directions.

For all source locations and except for downslope sections, 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.

In terms of the impact from immediate exposure to individual airgun array pulses, the maximum zones of PTS effect for sea turtles are predicted to be within 19 m from the source location. On the other hand, the maximum zones of TTS effect for sea turtles are predicted to be within 24 m of the source array. The behavioural disturbance for sea turtles caused by the immediate exposure to individual pulses are predicted to be within 1.3 km of the source array.

In terms of the impact from cumulative exposure to multiple airgun array pulses, the 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 500 m of the source array.

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 shoaling large pelagic fish, turtles, seals, or cetaceans are observed within the zone of impact.
- Baseline noise measurements can provide useful information (prior to operations) when interpreting underwater noise predictions for the introduction of a new noise source. As such, it is recommended that underwater noise measurements be implemented that would include the deployment of underwater sound monitoring equipment to establish an actual baseline prior to the commencement of the survey and then operational levels of noise during the survey.

MARINE ECOLOGY

The Reconnaissance Permit Area, which is approximately 57 400 km^2 in size, is located in water depths ranging from ~1 500 m to nearly 4 000 m off the South African West Coast between Alexander Bay and Cape Columbine. The seabed sediments comprise sandy muds. Although influenced by the Benguela Current the Reconnaissance

Permit area is located on the western extent of the coastal upwelling cells. Winds come primarily from the southeast, whereas virtually all swells throughout the year come from the S and SSW direction. The bulk of the seawater in the study area is South Atlantic Central Water characterised by low oxygen concentrations, especially at depth. Surface waters in the Reconnaissance Permit Application area will primarily be nutrient poor and clear, being beyond the influence of coastal upwelling, with seasonal (September to March) nutrient peaks expected on the eastern edge of the Reconnaissance Permit Area during periods of upwelling.

The Application 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' (outside of the Application Area). Geological features of note in, and adjacent to, the Application Area are Child's Bank situated at about 31°S and Tripp Seamount situated at about 29°40'S. Two canyons, the Cape Canyon and Cape Valley also occur to the south, but outside of, 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 Application Area lies well offshore of these MPAs. There is some overlap of the Reconnaissance Permit Area with the Orange Seamount and Canyon Complex Ecologically and Biologically Significant Areas (EBSAs). Critical biodiversity areas (CBAs) within the Reconnaissance Permit area include both CBA1 (natural) and CBA2 (natural areas), with a small section of CBA2 (restore) being located in the north.

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 highest sensitivities in response to the proposed 3D surveys are:

- Humpback whales, which migrate through the area between June and November (inclusive);
- Sperm whales, beaked whales and other odontocetes that frequent offshore waters;
- Large migratory pelagic fish and shark species that show seasonal association with Child's Bank and Tripp Seamount;
- Leatherback turtles which frequent offshore waters in low numbers and aggregate around seamounts to feed on jellyfish; and
- Various pelagic Albatross, Petrel, Storm Petrel and Shearwater species.

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

The potential impacts of the seismic survey programme on fisheries relate to :

- Exclusion of fishing vessels from accessing fishing ground;
- the impact on catch rates as a result of increased noise levels associated with the seismic survey operation;
- accidental loss of equipment from the survey array; and
- 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 500m 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 an immediate impact that would endure for the duration of the proposed survey (~70 days). 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 Reconnaissance Permit area. With the implementation of the project controls and mitigation measures, the residual impact of the proposed survey is of LOW NEGATIVE significance to large pelagic longline and tuna pole-line sectors. There is no impact expected on the demersal trawl, midwater trawl, demersal longline, small pelagic purse-seine, linefish, west coast rock lobster, netfish and small-scale fishing sectors.

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. 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. A sound transmission loss modelling study (SLR 2021) identified predicted 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 (PTS) and TTS) and behavioural disturbance due to either immediate impact from single airgun pulses or cumulative effects of exposure to multiple airgun pulses over a period of 24 hours. Based on the current project description, sound levels for the seismic survey could notionally be expected to attenuate to below levels for behavioural disturbance at a distance of 4 km from the source. The spatial extent of the impact of sound (produced by the airgun array) on catch rates is expected to be regional, although localised at any one time. The impact is considered to be of immediate duration and reversible without additional time or cost. Based on the distance of fishing grounds from the Reconnaissance Permit area, only the large pelagic longline and tuna pole-line sectors are considered to be susceptible to the effects 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 NEGATIVE significance. <u>There is no impact expected on the demersal trawl, midwater trawl, demersal longline, small pelagic purse-seine, linefish, west coast rock lobster, netfish and small-scale fishing sectors.</u>

The Reconnaissance Permit area is situated in the Orange Basin, offshore of the shelf break and offshore of grounds of importance for many of South Africa's commercial fishing sectors, as well as small-scale and recreational fisheries. The large pelagic longline sector operates across the extent of the Reconnaissance Permit area, with activity focussed along the continental shelf break. The Application Area does not overlap key spawning or nursery areas therefore the risk of noise disturbance to spawning behaviour and fishery recruitment is considered unlikely.

In order to mitigate the impacts on the large pelagic longline sector, it is recommended that the survey avoid taking place during June and July. 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 survey. These include; Department of Forestry, Fisheries and the Environment (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 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.

HERITAGE ASSESSMENT

The scientific studies conducted for this project identified impacts on fishing stock as low for all species. By inference, a potential impact (albeit low) 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 positively impact the potential negative impacts on the cultural heritage of the communities to be impacted.

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. A pre-mitigation negative impact 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 on heritage resources is rated as MEDIUM. The potential residual impact on heritage resources, 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.

SOCIAL ASSESSMENT

TGS'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 ecosystem 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, overfishing and businesses such as factories that come and go and often and do not leave in a socially responsible way.

TGS, 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 by previous applicants from a community perspective. If TGS 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 have 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 majority of local people are opposed to the project. 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. 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. From a social perspective it is recommended that the project proceed subject to the mitigation measures (i.e. meaningful consultation, local research, education, and awareness raising in the project-affected communities) forming part of the conditions for authorisation and being implemented prior to the commencement of the actual survey.

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 detail is provided in Section 11 of this report):

- Plan seismic surveys to avoid sensitive areas and periods for some marine fauna: Movement of migratory cetaceans (particularly baleen whales) from their southern feeding grounds into low latitude waters (June/July and late October/November), and their aggregation on the summer feeding grounds between St Helena Bay and Dassen Island from late October to late December and ensure that migration paths are not blocked by seismic operations. If possible, the survey should be undertaken from North to South to avoid these feeding aggregations;

- 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 Passive Acoustic Monitoring (PAM) technology, which detects some animals through their vocalisations;
- 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 Marine Mammal Observers (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) 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;
- Avoid operating during June and July, in order to avoid periods of peak fishing effort by the large pelagic longline sector;
- Prior to the commencement of seismic survey activities the key stakeholders should be consulted and informed of the proposed seismic survey programme;
- An experienced FLO 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. It is anticipated that this can be achieved through the implementation of the mitigation measures in the Social Impact Assessment.

- TGS should develop a community engagement protocol that is based on the San Code of Research Ethics. This should be done in consultation with the affected communities. This should include a communication strategy and grievance mechanism.
- TGS should contribute to assisting with collaboration on independent research on how fish species on the West Coast such as snoek respond to seismic surveying. TGS will further contact relevant scientific research institutions to offer the potential of collaborating in independent on-water research during the survey.
- Baseline noise measurements can provide useful information (prior to operations) when interpreting underwater noise predictions for the introduction of a new noise source. As such, it is recommended that underwater noise measurements be implemented that would include the deployment of underwater sound monitoring equipment to establish an actual baseline prior to the commencement of the survey and then operational levels of noise during the survey.
- Consult with communities on potential ways in which to make a positive contribution to the communities.

1 INTRODUCTION

TGS Geophysical Company (UK) (hereafter TGS) has applied for Environmental Authorization for a 3D seismic survey off the West Coast of South Africa. Environmental Impact Management Services (Pty) Ltd (EIMS) has been appointed by TGS to prepare and submit an application for Environmental Authorisation (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 120 km offshore of St Helena Bay (closesed point), extending north along the western coastline to approximately 230 km offshore of Hondeklip Bay over a number of petroleum licence blocks. The Application Area for the proposed 3D seismic survey is approximately 57 400 km^2 in extent. It is proposed that a single survey vessel equipped with seismic sources and streamers be used. The proposed 3D survey would be supported by up to two escort vessels. The 3D survey will take in the order of 70 days including downtime.

A Basic Assessment (BA) process is being undertaken to accompany the application for the EA 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 Application Area corner coordinate points are listed in Table 1 below. Close towns or points of interest include Cape Town, Hout Bay, Saldanha, Lamberts Bay, Hondeklip Bay and Port Nolloth.

Table 1: Application Area Corner Coordinate Points

Point	Latitude	Longitude	Point	Latitude	Longitude
1	32°59'53.46"S	16°35'02.75"E	6	30°40'16.36"S	13°20'38.26"E
2	32°59'57.95"S	13°53'17.25"E	7	30°32'53.92"S	13°35'15.39"E
3	32°39'06.43"S	13°53'26.20"E	8	30°15'21.82"S	14°04'05.31"E
4	32°09'29.22"S	13°58'04.38"E	9	30°15'27.76"S	14°52'28.65"E
5	31°31'44.64"S	13°39'01.12"E			

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
	i. 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	6, 8 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;	6, 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;	6, 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;	6, 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;	11.1 11.2 11.3 11.4
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;	11.2
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
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 TGS 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 Reconnaissance Permit Application. The contact details of the EIMS consultant's and EAP's who compiled this Report are as follows:

- Name: GP Kriel (compiler)/ Liam Whitlow (Reviewer)
- Tel No: + 27 11 789 7170
- Fax No: +27 86 571 9047
- E-mail address: tgs@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 29 years' experience in conducting EIA's. Please refer to the EIMS website (www.eims.co.za) for further details of expertise and experience.

GP holds an M.Env.Sci (Water Sciences) Cum Laude from the North-West University (Potchefstroom Campus) and has been employed as an Environmental Consultant since 2007. GP is a Registered Professional Natural Scientist (South African Council for Natural and Scientific Professions) and a Registered Environmental Assessment Practitioner (Environmental Assessment Practitioners Association of South Africa). He has delivered presentations locally and internationally concerning the use of bio-indicators for the determination of water quality, and has experience in a wide variety of environmental management projects including: Environmental Impact Assessments, Basic Assessments, Geographic Information Systems (GIS), Environmental Compliance Monitoring, Environmental Awareness Training, Aquatic Ecological Assessments, Drinking and Waste Water Treatment Process Audits, Wetland Delineation and Assessments, ISO 14001 Aspect Registers, Water Use Licence Applications, Waste Management Licence Applications, Integrated Waste and Water Management Plans (IWWMP) and Green House Gas Assessments.

Liam holds a B. Sc. Hons degree in Environmental Management and has completed an additional B. Sc. honours course in applied limnology. In addition, he has completed a higher certificate in Project Management with Damelin Business School and a course on ISO14001 Auditing Principles and Environmental Management Systems Auditor Training. Liam is a registered professional natural scientist with the South African Council for Natural Scientific Professions. Liam's professional experience, gained over more than 21 years, lies mainly with environmental impact assessments including project managing significantly large EIA's in the mining and infrastructure sectors. Liam's other experience includes ISO14001, Site Assessments, Water-use licensing, Environmental monitoring, and Environmental Management Plans. Liam's experience lies mainly within South Africa, but he has been involved in projects in both Lesotho and Botswana.

The Curriculum Vitae of the EAP responsible for the compilation of this Report is included in Appendix 1.

1.3 SPECIALIST CONSULTANTS

Specialist studies have been undertaken to address the key impacts that require further investigation, and these include:

- Acoustic Technical Report – SLR Consulting Australia (Pty) Ltd;
- Marine Ecological Assessment – Pisces Environmental Services (Pty) Ltd;
- Fisheries Assessment – undertaken by CapMarine (Pty) Ltd;
- Heritage Assessment – PGS Heritage (Pty) Ltd; and
- Social Assessment –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 specialist reports that informed this BA report are included in Appendix 3.

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 120 km offshore of St Helena Bay, extending north along the western coastline to approximately 230 km offshore of Hondeklip Bay over a number of petroleum licence blocks.
Application Area	Proposed 3D Seismic Application Area: approximately 57 400 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; • Kamiesberg 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; • 12/3/248 ER; and • Open area.

The locality of the proposed Application Area is shown in Figure 1. The proposed project area is located between approximately 120 km offshore of St Helena Bay, extending north along the western coastline to approximately 230 km offshore of Hondeklip Bay over a number of petroleum licence blocks. The Application Area for the proposed 3D seismic survey is approximately 57 400 km^2 in extent.

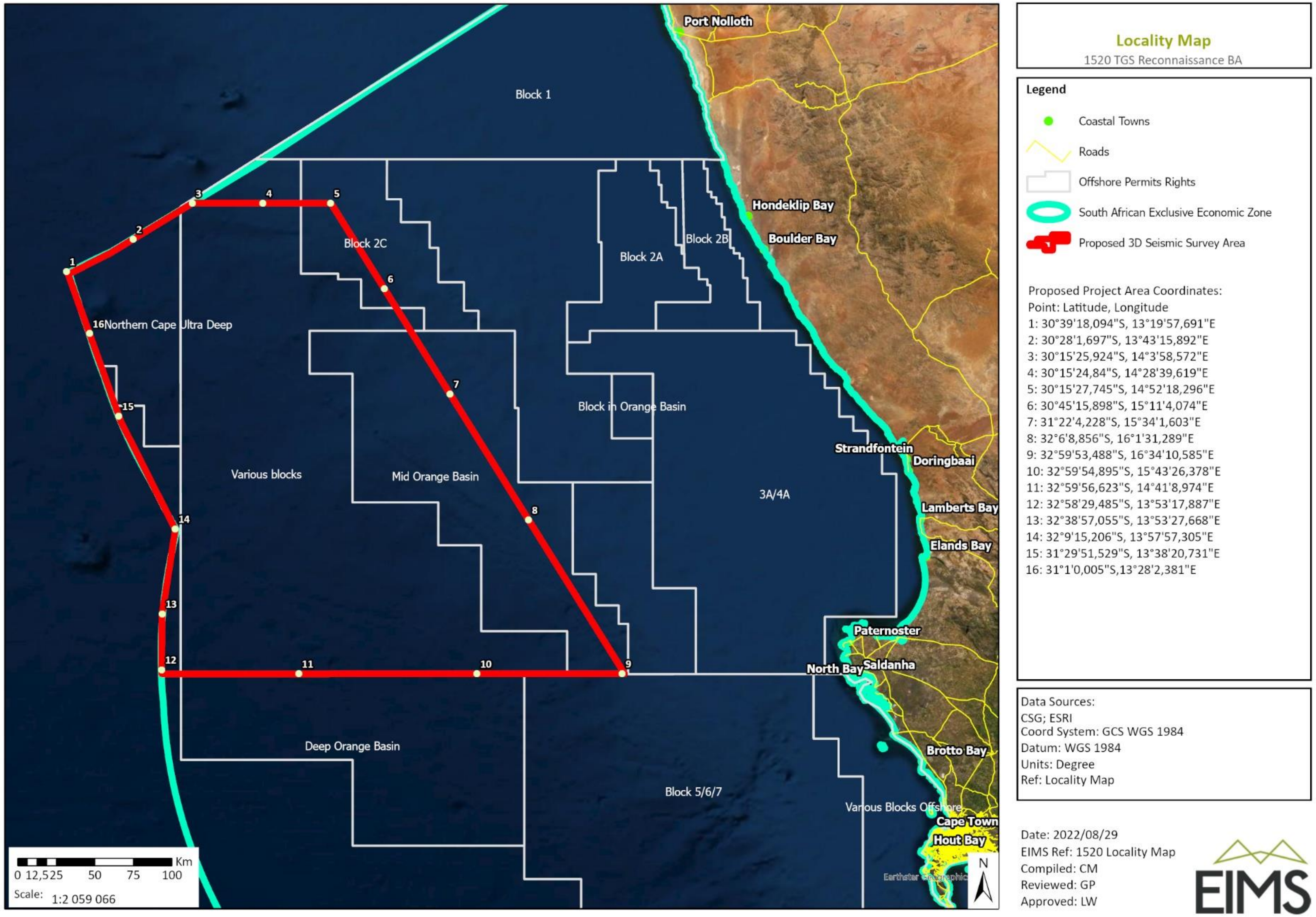


Figure 1: Locality map.

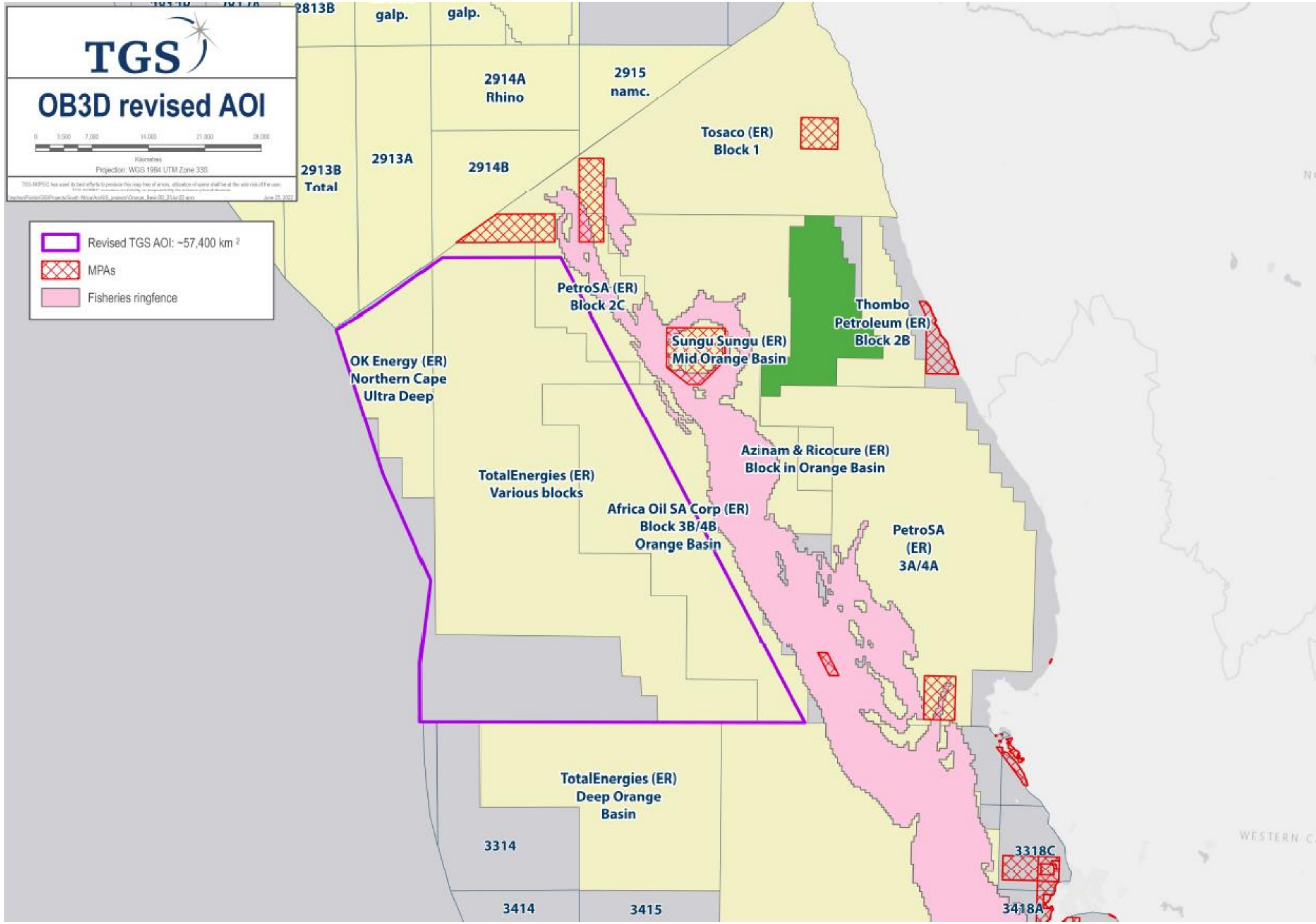


Figure 2: Application Area showing the various blocks and rights holders.

3 DESCRIPTION OF THE PROPOSED 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 high-level, 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 kerosene, 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.

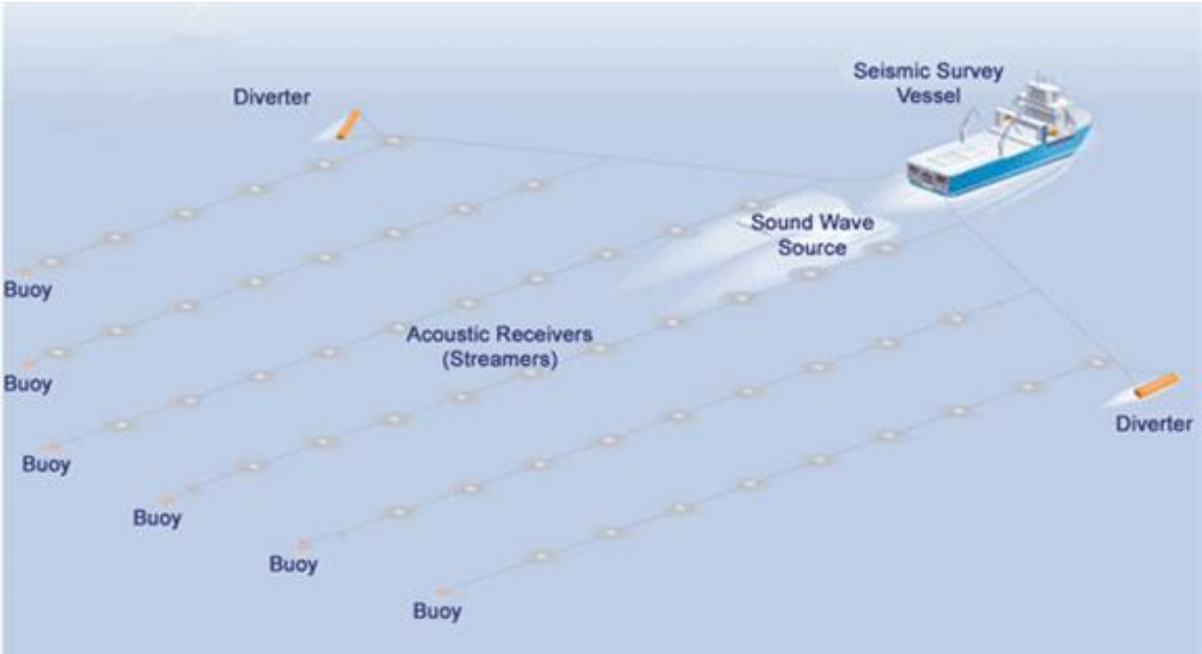


Figure 3: Example of seismic survey vessel and associated equipment (FishSAFE, 2021).

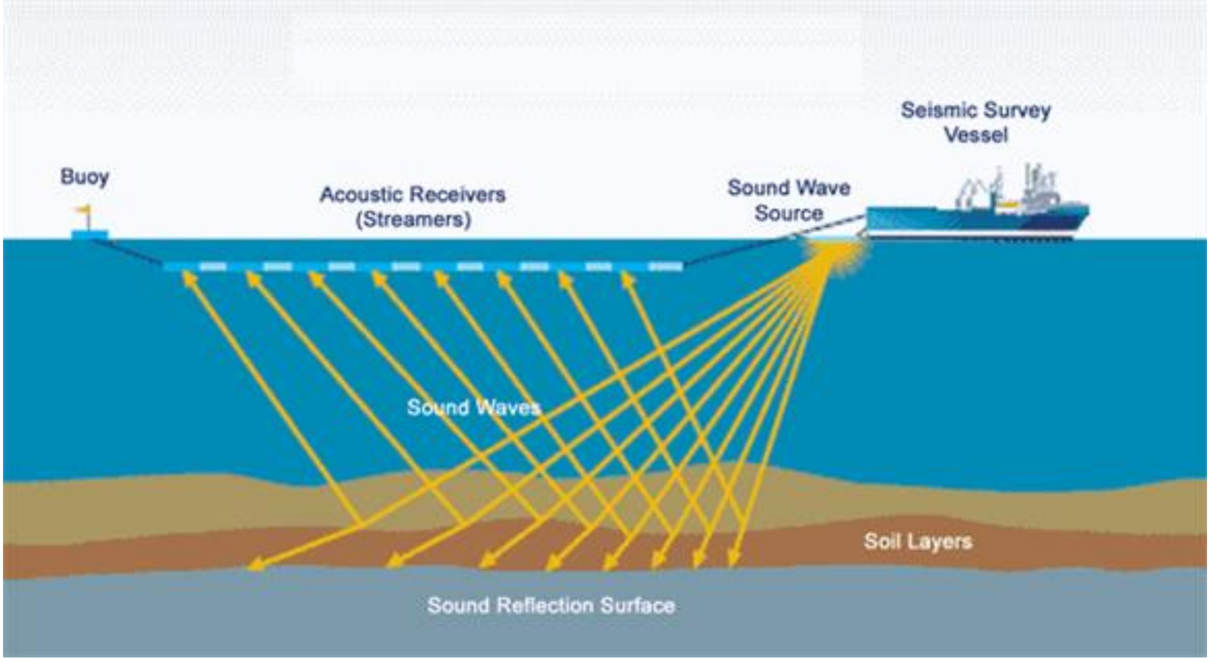


Figure 4: Example demonstration of seismic survey activities (Fish SAFE, 2021).

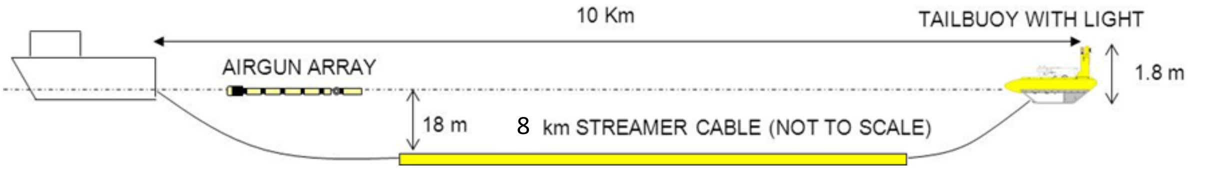


Figure 5: Schematic diagram showing side-view of the seismic source array and hydrophone cable ("streamer")

While acquiring the seismic data, the survey vessel would travel along transects of a prescribed grid within the Application 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, which would be approximately 8 000 m long and 2 000 m wide. The streamers would be towed at a depth of 8 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. The sound source would be towed behind the vessel at a depth of between 5 – 25 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 – 20 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 used 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: 12/1/040) dated 15 December 2021 from PASA (and the subsequent extension letters dated 10 February 2022 and 19 May 2022, TGS must apply 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 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 heritage, 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.

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 Application Area. The proposed 3D Application Area lies well offshore of these MPAs. Critical biodiversity areas (CBAs) within the Reconnaissance Permit and 3D Application Areas include both CBA1: natural and CBA2: natural areas.

4.6 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.

Legislation / Guidelines	Description
	The Small Scale Fishers Policy was gazetted in May 2019 under the Marine Living Resources Act.
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.

Legislation / Guidelines	Description
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 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.

4.7 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:

4.7.1 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.

4.7.2 NATIONAL DEVELOPMENT PLAN 2030

The 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 mentions of the need to act responsibly to mitigate the effects of climate change. Diversification of the energy 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".

4.7.3 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 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.

4.7.4 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.

4.7.5 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 COP 21 in Paris, 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 within the energy sector and increased reliance on alternative energy sources is therefore anticipated."

4.7.6 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.

4.8 INTERNATIONAL LEGISLATION

4.8.1 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.

4.8.2 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.

4.8.3 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. Based on the initial information review undertaken, TGS has designed a 3D seismic survey to specifically target the area highlighted in Figure 1.

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 co-disposal facility.

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; and • Acoustic (Noise) Technical Report The conclusions of these studies are included in this report.
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 Application Area. The proposed 3D Application Area lies well offshore of these MPAs. CBAs within the Application Area include both CBA1: natural and CBA2: natural areas. It is recommended that 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 be assessed to verify the findings of the predictive impact assessment. 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. It is anticipated that this can be achieved through the implementation of the mitigation measures in the Social Impact Assessment.
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.

Ref No.	Question	Answer
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.
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 Sections 11.4.5 and 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 and 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?	

Ref No.	Question	Answer
1.10	Describe the linkages and dependencies between human wellbeing, livelihoods and ecosystem services applicable to the area in question and how the development's ecological impacts will result in socio-economic impacts (e.g. on livelihoods, loss of heritage site, opportunity costs, etc.)?	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.
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, 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 Application 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

Ref No.	Question	Answer
		to extract economic development opportunities. The impact of the seismic survey activities 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 3.
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 TGS 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 2.
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:	

Ref No.	Question	Answer
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.
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.

Ref No.	Question	Answer
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.
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 Sections 11.4.5 and 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 120 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.

Ref No.	Question	Answer
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 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.)?	Refer to the impact assessment in Section 9 of this report.
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

Ref No.	Question	Answer
2.13.3	Ensure participation by vulnerable and disadvantaged persons,	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.
2.13.4	Promote community wellbeing and empowerment through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means,	
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,
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).	

Ref No.	Question	Answer
2.16.3	The distance from where labourers will have to travel.	should local labour be required during the possible 3D seismic survey, then travel will be from suitable ports.
2.16.4	The location of jobs opportunities versus the location of impacts.	
2.16.5	The opportunity costs in terms of job creation.	
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 as 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.

Ref No.	Question	Answer
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

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, l*et al*one 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. While it is acknowledged that the risks mentioned would need assessment, such assessment falls outside of the scope of the current application and would need to be assessed in detail during subsequent Scoping and EIA processes, should exploration drilling or production be proposed. 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 (USCUSA, 2015). 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 200MtCO2/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 57MtCO2/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 6MtCO2/yr.

According to the 2019 IRP 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 considered to be 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

The application area has been selected by TGS due to the high likelihood of containing significant hydrocarbon reserves. The application 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. 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. CBAs within the Application Areas include both CBA1: natural and CBA2: natural areas (see Figure 91). 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 – as is the case for this assessment), 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 Ecological Support Areas (ESAs). The CBA areas are not considered no-go areas for the purposes of seismic survey activities and TGS 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 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) are located within the Application Area. No no-go areas within the Application 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 124 below.

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 (2013) 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. TGS 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.

Refer to the detailed mitigation measures included in the EMPr (Appendix 5) 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 SCHEDULING ALTERNATIVES

Based on the findings of the Acoustics, Marine Ecology and Fisheries recommendations, it is recommended that the survey window of January – May be utilised in order to:

- Avoid sensitive areas and periods for some marine fauna: Movement of migratory cetaceans (particularly baleen whales) from their southern feeding grounds into low latitude waters (June/July and late October/November), and their aggregation on the summer feeding grounds between St Helena Bay and Dassen Island from late October to late December and ensure that migration paths are not blocked by seismic operations;
- Avoid periods of peak fishing activity during June and July in order to reduce the probability of disruption to the large pelagic longline fishing sector and tuna pole line fishing sector.

6.5 NO GO ALTERNATIVE

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 Application 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 has been 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. The I&AP database includes amongst others, adjacent landowners, rights holders, communities, regulatory authorities and other special interest groups.

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
- Iziko Museums of South Africa
- Japan Marine Supplies & Services
- Jayfish cc
- Kernel Marine (Pty) Ltd
- Khulani Fishing (Pty) Ltd
- Kobush

- 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
- EarthLife 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 Fas Industries
- Ingwe Emnyama Fishing Enterprises (Pty) Ltd
- IRASA Khoisan
- Irvin & Johnson Limited
- 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 Navy Hydrographic Office
- 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
- West Coast National Park

- Isinda Tient (Pty) Ltd
- World Wildlife Fund

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

- 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 16 August 2022 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), and 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;
- Details of initial round of public meetings; and
- Relevant EIMS contact person for the project.

7.1.2.3 SITE NOTICE PLACEMENT

A1 Correx site notices in English, Afrikaans and IsiXhosa were placed at 100 onshore locations adjacent to the application area during the week of 16-20 August 2022. The on-site notices included the following information:

- Project name;
- Applicant name;
- Project location;
- Map of proposed project area;
- Project description;
- Legislative requirements;
- Details of initial round of public meetings; 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. 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

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

- KFM (English);
- Radio NFM (English and Afrikaans);

- Radio Namakwaland (English and Afrikaans); and
- Radio West Coast (English and isiXhosa).

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.

This BA report is being made available for public review from 21 October 2022 to 21 November 2022. Hard copies of the report are 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 is also available for review and download at www.eims.co.za. Data free access to the report download was also available to those I&APs who required such. The executive summary has also been made available in English, Afrikaans and isiXhosa.

7.1.4 PUBLIC MEETINGS

A series of initial public meetings were held between from 29 August 2022 to 3 September 2022 at the following venues:

- Hout Bay: Hout Bay Public Library (Monday, 29 August 2022 at 16:00 – 18:00);
- Cape Town: Life Church (Tuesday, 30 August 2022 at 16:00 – 18:00);
- Saldanha: Hoedjies Bay Hotel (Wednesday, 31 August 2022 at 16:00 – 18:00);
- Lamberts Bay: Community Hall (Thursday, 1 September 2022 at 16:00 – 18:00);
- Hondeklip Bay: Eric Baker Hall (Friday, 2 September 2022 at 16:00 – 18:00); and
- Port Nolloth: Port Nolloth Country Club (Saturday, 3 September 2022 at 10:00 – 12:00).

The aim of the first round of public meetings was to ensure as many concerns and issues were captured prior to release of the draft BA report. This was done in order to ensure that the BA report addresses as many of the potential concerns from the public and affected stakeholders as possible. A second round of public meetings is scheduled for during the review period of this draft BA report.

Figure 6: Protest held outside the venue of the initial Port Nolloth Public Meeting on 3 September 2022.

Figure 7: Public Meeting held in Hondeklip Bay on 2 September 2022.

Figure 8: Public Meeting held in Lamberts Bay on 1 September 2022.

7.1.5 FOCUS GROUP MEETINGS

In addition to the above, a number of focus group meetings and other interviews were undertaken by the Social and Heritage Specialists as part of their assessments. Please refer to the Social and Heritage Specialist Reports in Appendix 3 for further details.

7.2 PUBLIC PARTICIPATION PROGRESS

Comments raised to date have been addressed in a transparent manner and included in the Public Participation Report (Appendix 2). A high-level summary of the key comments and concerns raised to date are presented below.

- I&AP registrations and deregistration;
- Notification/information document requests;
- Notification of I&APs registered on the previous Searcher application database;
- 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 as a “tick box exercise”;
- Impact on indigenous cultural heritage, historical connection to the sea;
- Overlap between the Searcher and TGS application areas;
- Lessons learnt from the Searcher and Shell court cases;
- EIMS’ independence if the applicant pays for the services rendered;
- Free Prior and Informed Consent in public participation processes;
- Alternative technologies to seismic surveys;
- Requests for mapping data;
- Objections to the proposed TGS Seismic Survey;
- Cumulative impacts;
- Need and desirability of seismic surveys;
- EIA process related comments;
- 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;
- Impact on livelihoods of the coastal communities; and
- The need for an Strategic Environmental Assessment (SEA).

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.

8 ENVIRONMENTAL BASELINE ASSESSMENT

8.1 LOCATION

The Application Area is located between approximately 120 km offshore of St Helena Bay, extending north along the western coastline to approximately 230 km offshore of Hondeklip Bay over a number of petroleum licence blocks. The locality of the proposed Application 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 3.

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) (Figure 9). 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[1] 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 (Sink *et al*. 2019). The three shelf zones characterising the West Coast are recognised following both abiotic (de Wet 2013) and biotic (Karenyi *et al*. 2016) 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 (Birch & Rogers 1973; Dingle *et al*. 1983; de Wet 2013). At its southwestern edge, the continental slope drops down steeply from -350 to -1 500 m over a distance of less than 60 km (de Wet 2013) creating precipitous cliffs at least 150 m high (Birch & Rogers 1973). 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 (Dingle 1973; Siesser *et al*. 1974). The top of this feature has been estimated to cover some 1 450 km^2 (Sink *et al*. 2012).

Tripp Seamount, a geological feature ~25 km to the north of the Reconnaissance Permit area, 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 Reconnaissance Permit Area include the Cape Canyon and Cape Point Valley, which lie ~95 km and ~250 km to the southeast of the southern boundary of the Reconnaissance Permit Area (Simpson & Forder 1968; Dingle 1986; Wigley 2004; Wigley & Compton 2006). 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 (Wigley 2004; Wigley & Compton 2006). 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 (Simpson & Forder 1968; Dingle *et al*. 1987). 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 (Dingle 1970), where the topography of the distal end is rugged and complex (Dingle *et al*. 1987). 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

[1]As per the 2019 National Biodiversity Assessment inshore is defined as the area influenced by wave energy and light, with the fair-weather wave base at a depth ranging between -30 to -50 m used to determine the outer limits of this zone in South Africa. Offshore areas are those that extend beyond this zone.

in turn power feeding grounds for cetaceans and seabirds (Filander *et al*. 2018; www.environment.gov.za/dearesearchteamreturnfromdeepseaexpedition).

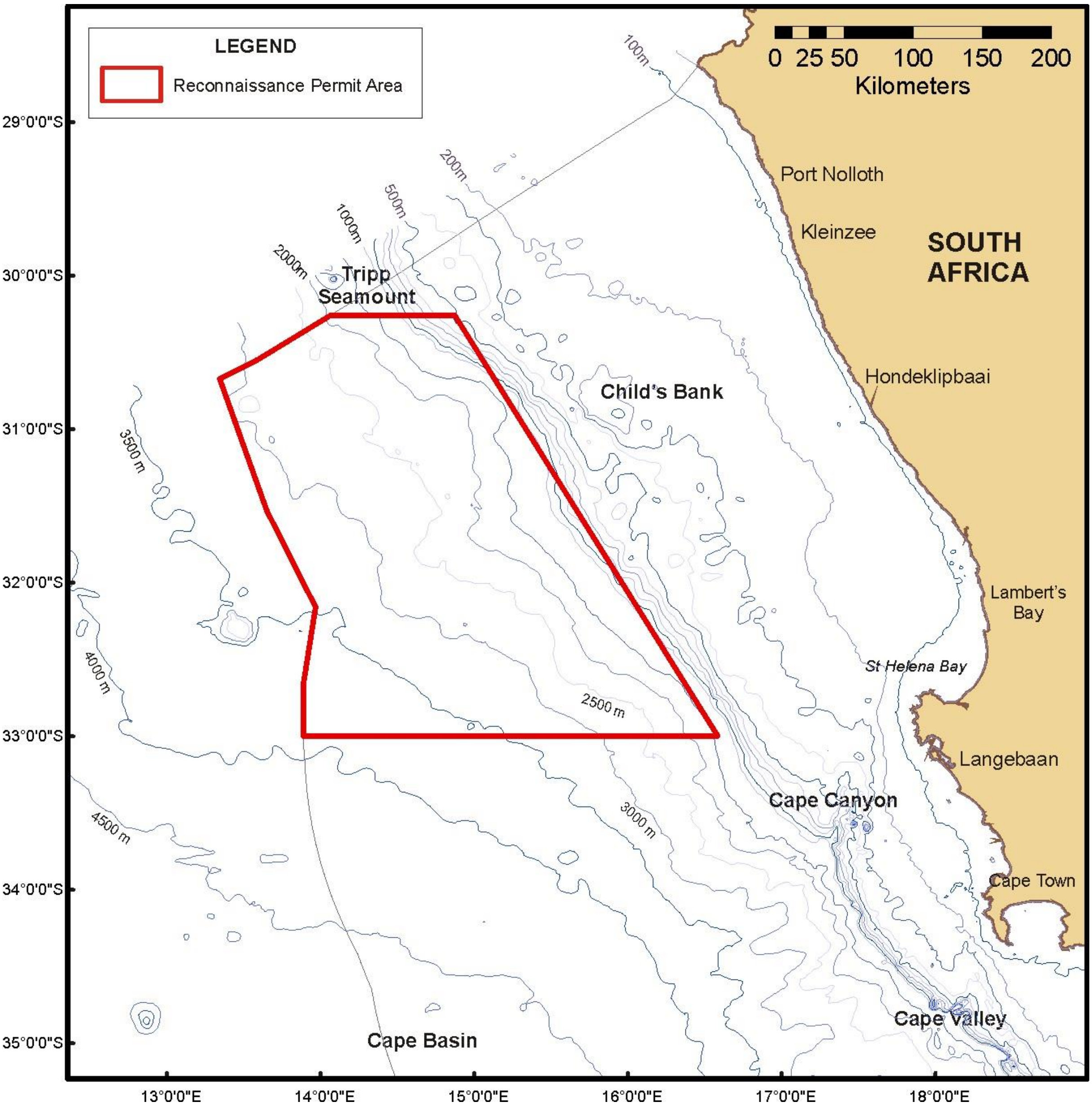


Figure 9: Map indicating location of the Reconnaissance Permit Area in relation to bathymetric features off the West Coast.

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 (www.marineprotectedareas.org.za/canyons).

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 10). 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 Reconnaissance Permit Area.

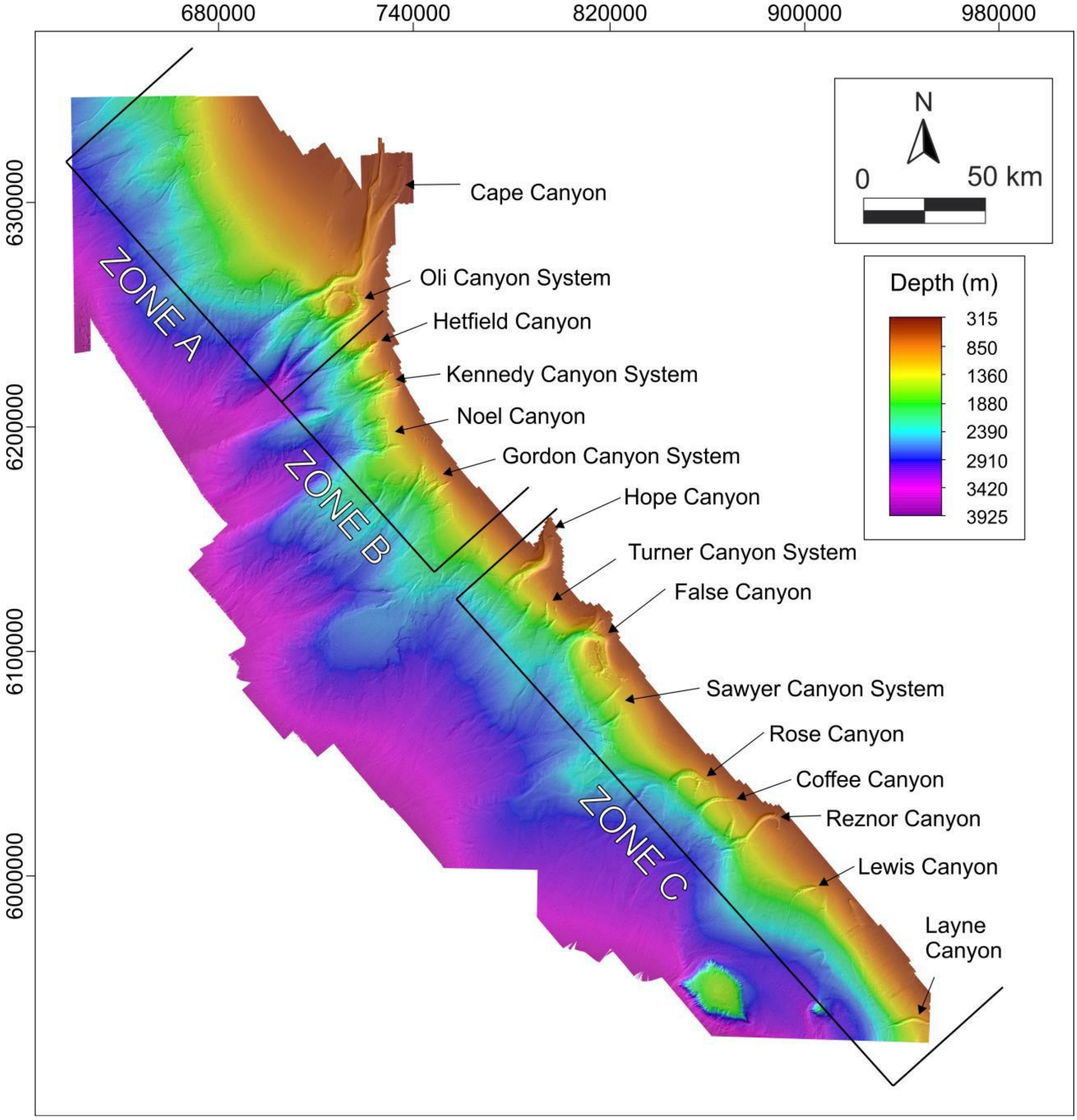


Figure 10: Submarine canyon domains of the southwestern Cape continental margin identified by Palan (2017).

8.2.2 COASTAL AND INNER-SHELF GEOLOGY AND SEABED GEOMORPHOLOGY

Figure 11 below 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 (Dingle 1973; Dingle *et al*. 1987; Birch *et al*. 1976; Rogers 1977; Rogers & Bremner 1991). 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 (Birch *et al*. 1976). Further offshore and within the Reconnaissance Permit 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.

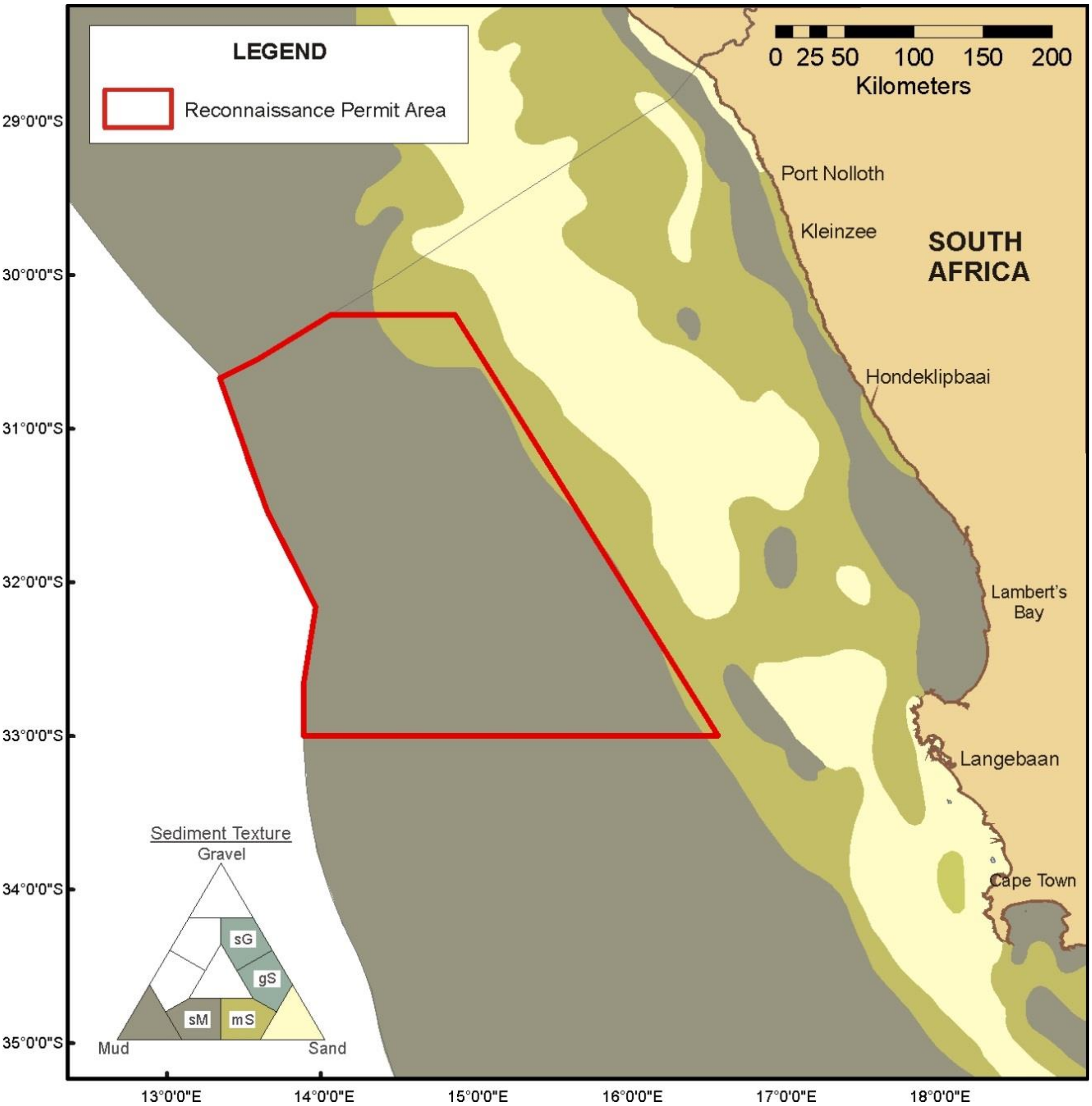


Figure 11: The Reconnaissance Permit Area in relation to sediment distribution on the continental shelf of the South African West Coast (Adapted from Rogers 1977). Based on information in Holness *et al*. (2014) and Sink *et al*. (2019), the mud/sandy mud sediments have been extended to the edge of the EEZ beyond that shown in Rogers (1977).

The benthic habitat types of the West Coast were classified and mapped in detail through the 2011 National Biodiversity Assessment (NBA) (Sink *et al*. 2012a). These were refined in the 2018 NBA (Sink *et al*. 2019) to provide substratum types (Figure 12 below).

In the Reconnaissance Permit Area the water depth ranges from ~500 m to nearly 4 000 m. The Southeast Atlantic Unclassified Slopes and Southeast Atlantic Unclassified Abyss substrata dominate across the area. The shelf inshore of the Reconnaissance Permit Area boasts a diversity of substrata (Sink *et al*. 2019).

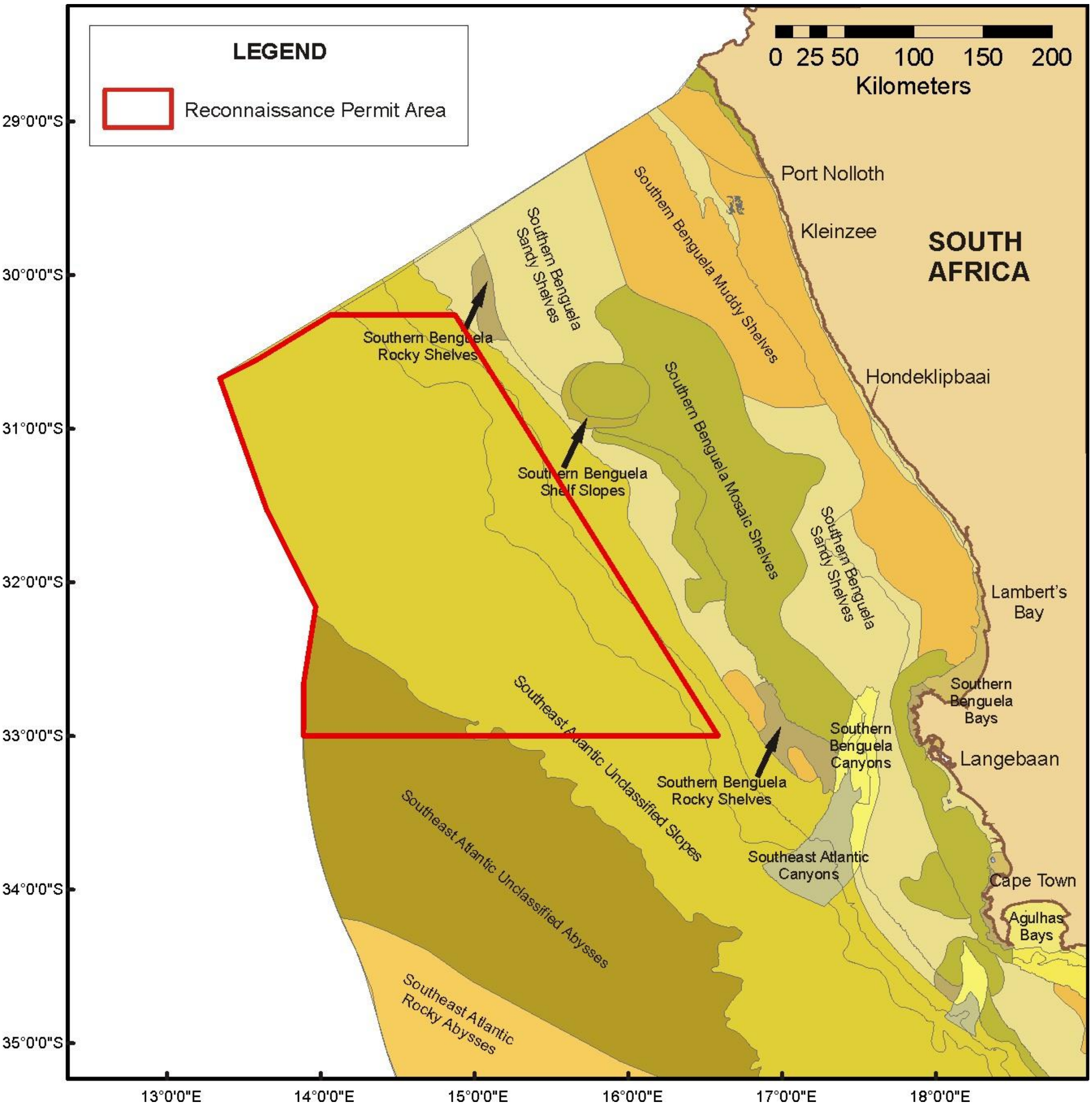


Figure 12: The Reconnaissance Permit Area in relation to the distribution of seabed substratum types along the West Coast (adapted from Sink *et al*. 2019).

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 3.

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 (PRDW 2013), with a total of 226 gales (winds exceeding 18 m/s or 35 kts) being recorded over the period (CSIR 2006). Virtually all winds in summer come from the south to south-southeast (Figure 13). 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.

Winter remains dominated by southerly to south-easterly winds, but the closer proximity of the winter cold-front systems results in a significant south-westerly to north-westerly component (Figure 13). This ‘reversal’ from the summer condition results in cessation of upwelling, movement of warmer mid-Atlantic water shore-wards and breakdown of the strong thermoclines which typically develop in summer. There are also more calms in winter, occurring about 3% of the time, and wind speeds generally do not reach the maximum speeds of summer. However, the westerly winds blow in synchrony with the prevailing south-westerly swell direction, resulting in heavier swell conditions in winter.

During autumn and winter, catabatic, or easterly ‘berg’ winds can also occur. These powerful offshore winds can exceed 50 km/h, producing sandstorms that considerably reduce visibility at sea and on land. Although they occur intermittently for about a week at a time, they have a strong effect on the coastal temperatures, which often exceed 30°C during ‘berg’ wind periods (Shannon & O’Toole 1998). The winds also play a significant role in sediment input into the coastal marine environment with transport of the sediments up to 150 km offshore.

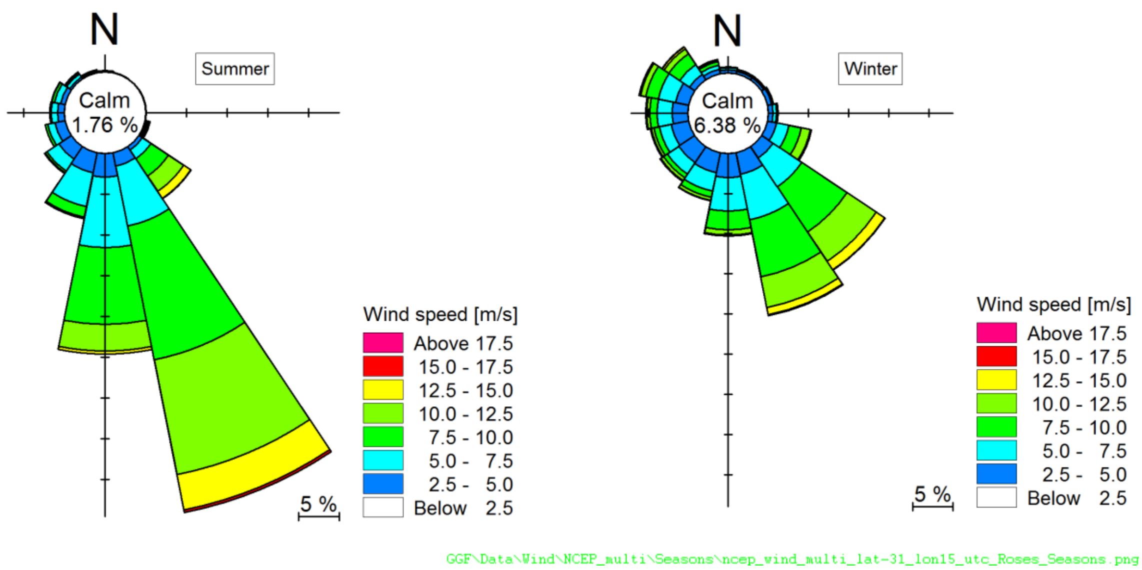


Figure 13: Wind Speed vs. Wind Direction for NCEP hind cast data at location 15°E, 31°S (From PRDW 2013).

8.3.2 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 (PRDW 2013). 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 (PRDW 2013). 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 (Shillington *et al*. 1990; Nelson & Hutchings

1983) (Figure 14b). 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 (Nelson 1989; PRDW 2013). 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 (Taunton-Clark 1985) (Figure 14a). Upwelling in these cells is seasonal, with maximum upwelling occurring between September and March. Both the Reconnaissance Permit area and the 3D Application Area are located offshore of these upwelling events.

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 (Figure 14). 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 Reconnaissance Permit Area lies offshore of 15°E on the outer edge of these features.

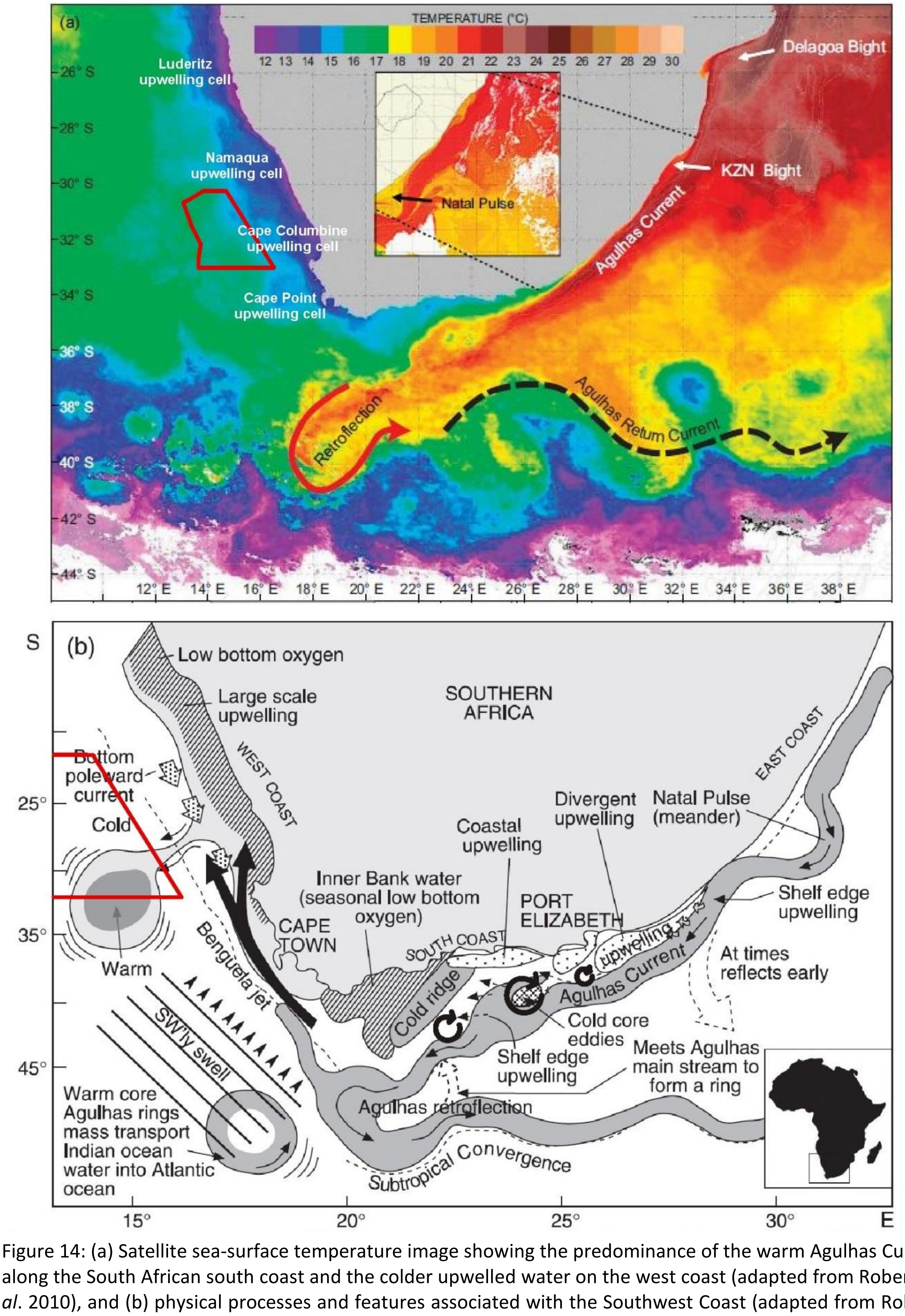


Figure 14: (a) Satellite sea-surface temperature image showing the predominance of the warm Agulhas Current along the South African south coast and the colder upwelled water on the west coast (adapted from Roberts *et al*. 2010), and (b) physical processes and features associated with the Southwest Coast (adapted from Roberts 2005) in relation to the Reconnaissance Permit Area (red polygon).

8.3.3 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 (McLachlan 1980). 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 15). The peak wave energy periods fall in the range 9.7 – 15.5 seconds.

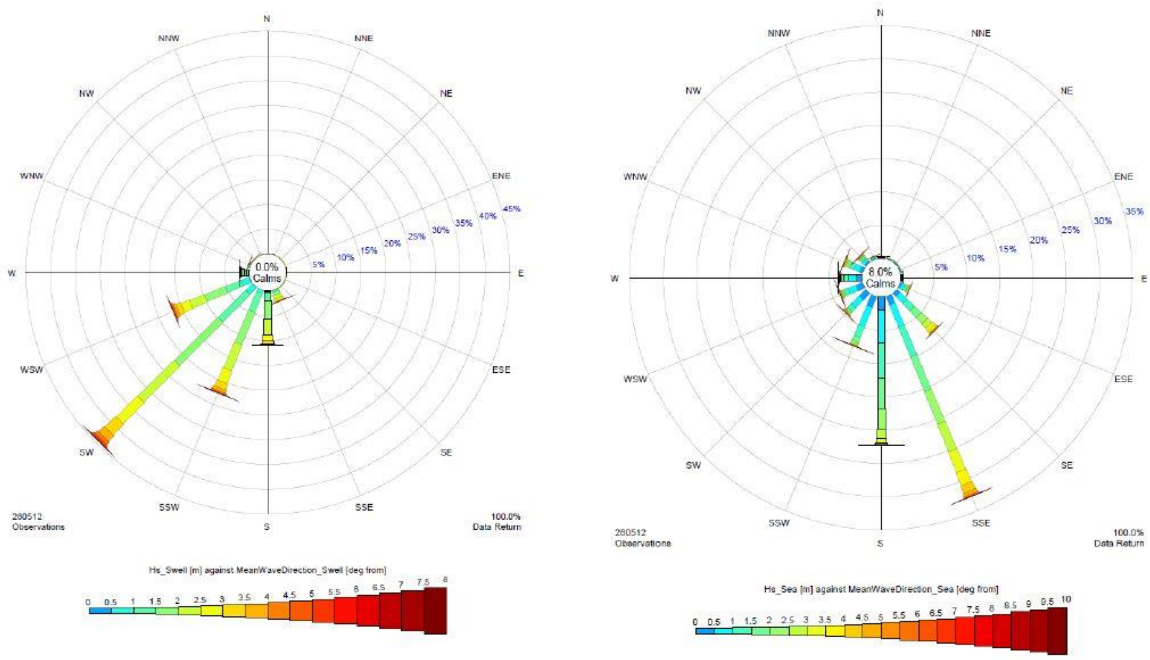


Figure 15: Annual rose plots of significant wave height partitions of swell (left) and wind-sea (right) for GROW1012 hind cast data at location 15°E, 31°S.

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 (CSIR 1996). 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.

8.3.4 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 (Nelson & Hutchings 1983). Salinities range between 34.5‰ and 35.5‰ (Shannon 1985).

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. South and east of Cape Agulhas, the Agulhas retroflection area is a global “hot spot” in terms of temperature variability and water movements.

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 (Bailey *et al*. 1985; Chapman & Shannon 1985).

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 (Chapman & Shannon 1985). This is mediated by nutrient regeneration from biogenic material in the sediments (Bailey *et al*. 1985). 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.

8.3.5 UPWELLING AND PLANKTON PRODUCTION

The cold, upwelled water is rich in inorganic nutrients, the major contributors being various forms of nitrates, phosphates and silicates (Chapman & Shannon 1985). 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 Reconnaissance Permit Area is located on the western edge of these 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 (see Figure 14). The Application Area is located well offshore of these upwelling events.

8.3.6 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 (Shannon *et al*. 2003). 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) (see Shannon & Pillar 1985; Pitcher 1998). 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 Reconnaissance Permit Area, but would not be expected in the Application Area.

8.3.7 LOW OXYGEN EVENTS

The continental shelf waters of the Benguela system are characterised by low oxygen concentrations with <40% saturation occurring frequently (e.g. Visser 1969; Bailey *et al*. 1985). The low oxygen concentrations are attributed to nutrient remineralisation in the bottom waters of the system (Chapman & Shannon 1985). 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 (see Figure 12), 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 (Chapman & Shannon 1985; Bailey 1991; Shannon & O'Toole 1998; Bailey 1999; Fossing *et al*. 2000). 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 (Newman & Pollock 1974; Matthews & Pitcher 1996; Pitcher 1998; Cockcroft *et al*. 2000). 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 most recent walkout occurred in early March 2022 at Elands Bay, when some 500 tons of rocklobster were reported stranded on the beach. 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.

8.3.8 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/yr (Rogers 1979). '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 (Shannon & Anderson 1982; Zoutendyk 1992, 1995; Shannon & O'Toole 1998; Lane & Carter 1999). 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 (Bricelj & Malouf 1984; Berg & Newell 1986; Fegley *et al*. 1992). 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 (Zoutendyk 1995). 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 (Zoutendyk 1995) to peak values of 7 400 mg/ℓ immediately upstream of the river mouth during the 1988 Orange River flood (Bremner *et al*. 1990).

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 equator-wards. 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 (Shillington *et al*. 1990; Rogers & Bremner 1991).

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 (Smith & Mocke 2002).

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 (see also Drake *et al*. 1985; Ward 1985). 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 (Lane & Carter 1999).

Offshore of the continental shelf, the oceanic waters are typically clear as they are beyond the influence of aeolian and riverine inputs. The waters in the Reconnaissance Permit Area are thus expected to be comparatively clear.

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 3.

Biogeographically, the study area falls into the cold temperate Namaqua Bioregion, which extends from Sylvia Hill, north of Lüderitz in Namibia to Cape Columbine (Emanuel *et al*. 1992; Lombard *et al*. 2004). The Reconnaissance Permit Area falls into the Southeast Atlantic Deep Ocean Ecoregion (Sink *et al*. 2019) (Figure 16). 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.

The Southeast Atlantic Oceanic Ecoregion extends from the shelf edge of the Southern Benguela onto the slope and into the abyssal plain of the Cape Basin, which comprises a relatively monotonous plain, interrupted by sporadic seamounts. This deep ocean region extends into Namibia and is bounded in the north by the prominent Walvis Ridge. In the south it is separated from the Southwest Indian Deep Ocean by the Agulhas Ridge, a transverse ridge that forms part of the Agulhas Falklands Fracture Zone and acts as a divide between the Cape Basin and the Agulhas Basin. The biodiversity patterns in the deep ocean ecosystems are not well understood (Sink *et al*. 2019).

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, deepwater 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 exploration activities.

8.4.1 DEMERSAL COMMUNITIES

8.4.1.1 **BENTHIC INVERTEBRATE MACROFAUNA**

The seabed communities in the Reconnaissance Permit 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 deep-sea slope, respectively. The benthic habitats of South Africa were mapped as part of the 2018 National Biodiversity Assessment (Sink *et al.* 2019) to develop assessments of the ecosystem threat status and ecosystem protection level. The benthic ecosystem types were subsequently mapped (Figure 17) and assigned an ecosystem threat status based on their level of protection (Figure 18). The Reconnaissance Permit 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.

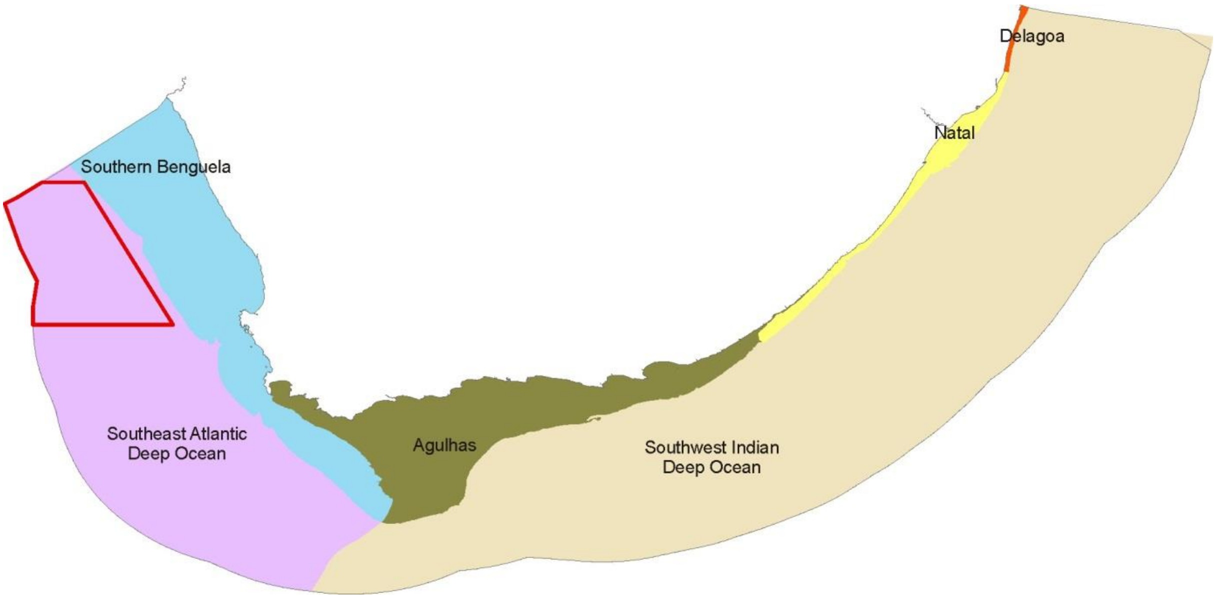


Figure 16: The Reconnaissance Permit Area (red polygon) in relation to the inshore and offshore ecoregions of the South African coast (adapted from Sink *et al*. 2019).

The benthic biota of unconsolidated marine sediments constitutes 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 (Christie & Moldan 1977; Moldan 1978; Jackson & McGibbon 1991; Field *et al*. 1996; Field & Parkins 1997; Parkins & Field 1998; Pulfrich & Penney 1999; Goosen *et al*. 2000; Savage *et al*. 2001; Steffani & Pulfrich 2004; 2007; Steffani 2007a; 2007b; Atkinson 2009; Steffani 2009a, 2009b, 2010a, 2010b, 2010c; Atkinson *et al*. 2011; Steffani 2012a, 2012b, 2014; Karenyi 2014; Steffani *et al*. 2015; Biccard & Clark 2016; Biccard *et al*. 2016; Duna *et al*. 2016; Karenyi *et al*. 2016; Biccard *et al*. 2017, 2018; Gihwala *et al*. 2018; Biccard *et al*.2019; Giwhala *et al*. 2019). These studies, however, concentrated on the 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.

To date very few areas on the continental slope off the West Coast have been biologically surveyed (Sink *et al*. 2019; Harris *et al*. 2022). Although sediment distribution studies (Rogers & Bremner 1991) suggest that the outer shelf is characterised by unconsolidated sediments (see Figure 11), recent surveys conducted between 180 m and 480 m depth offshore of the Northern Cape coast revealed high proportions of hard ground rather than unconsolidated sediment, although this requires further verification (Karenyi unpublished data).

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 (Sink *et al*. 2019). There is no quantitative data describing bathyal ecosystems in South Africa and hence limited understanding of ecosystem functioning and sensitivity (Anderson & Hulley 2000; Harris *et al*. 2022). 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 Reconnaissance Permit Area. However, as these communities would receive the sound in the far field only, no detrimental effects to the communities or to individual benthic species are expected. The description below for areas on the continental shelf, offshore of the Northern Cape coast is drawn from recent surveys by Karenyi (2014), Duna *et al*. (2016), Mostert *et al*. (2016), and Giwhala *et al*. (2018, 2019).

Three macro-infauna communities have been identified on the inner- (0-30 m depth) and mid-shelf (30-150 m depth, Karenyi *et al*. 2016). 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 (e.g. Kenny *et al*. 1998; Kendall & Widdicombe 1999; van Dalfsen *et al*. 2000; Zajac *et al*. 2000; Parry *et al*. 2003), with evidence of mass mortalities and substantial recruitments recorded on the South African West Coast (Steffani & Pulfrich 2004).

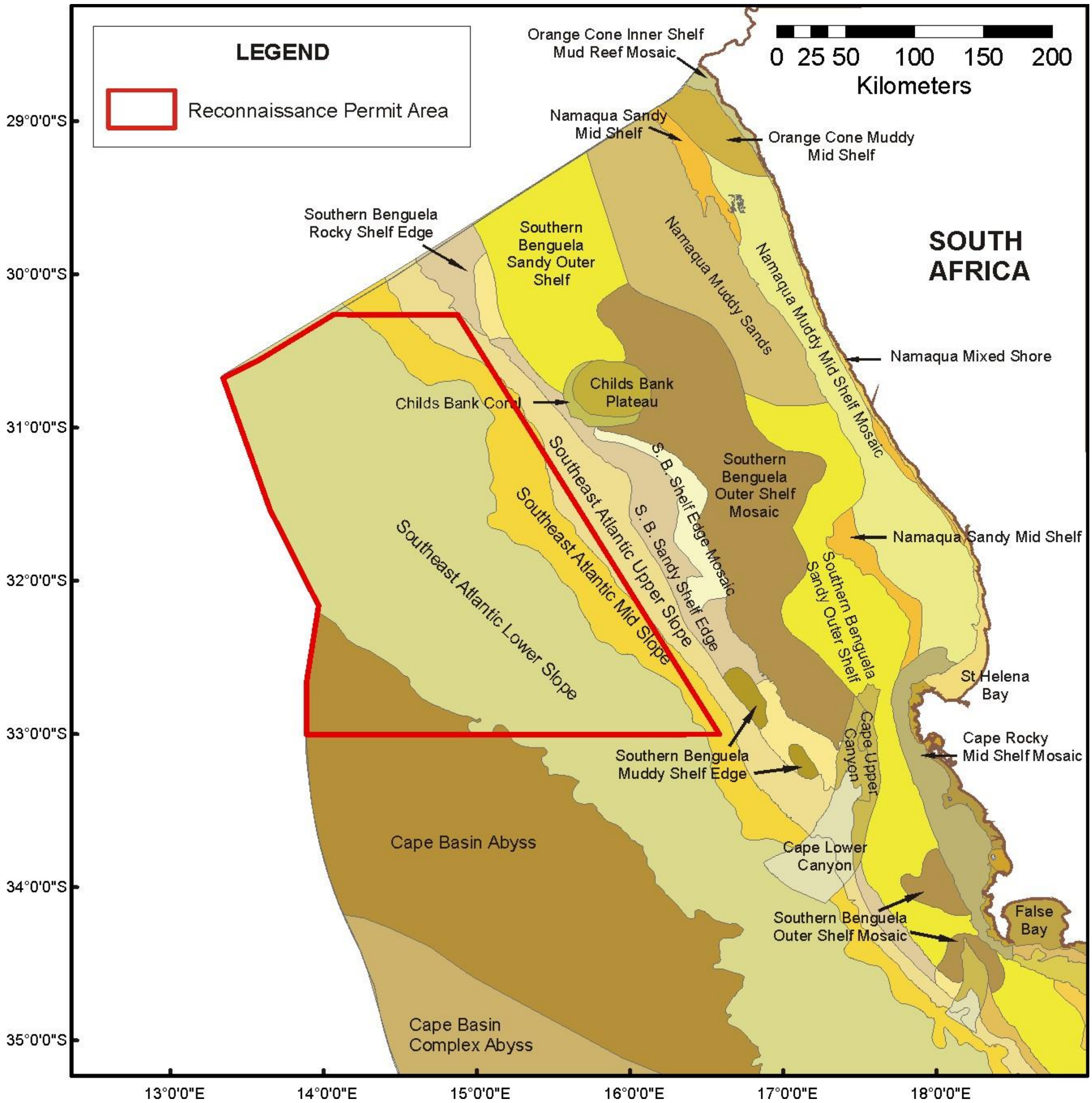


Figure 17: The Reconnaissance Permit Area (red polygon) in relation to the distribution of ecosystem types along the West Coast (adapted from Sink *et al*. 2019). Only those ecosystem types within the immediate vicinity of the Reconnaissance Permit Area are labelled.

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 (Sink *et al*. 2019), rated the South Atlantic bathyal and abyssal unconsolidated habitat types that characterise depths beyond 500 m, as being of ‘Least concern’ (Figure 18), 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 South African Exclusive Economic Zone (EEZ).

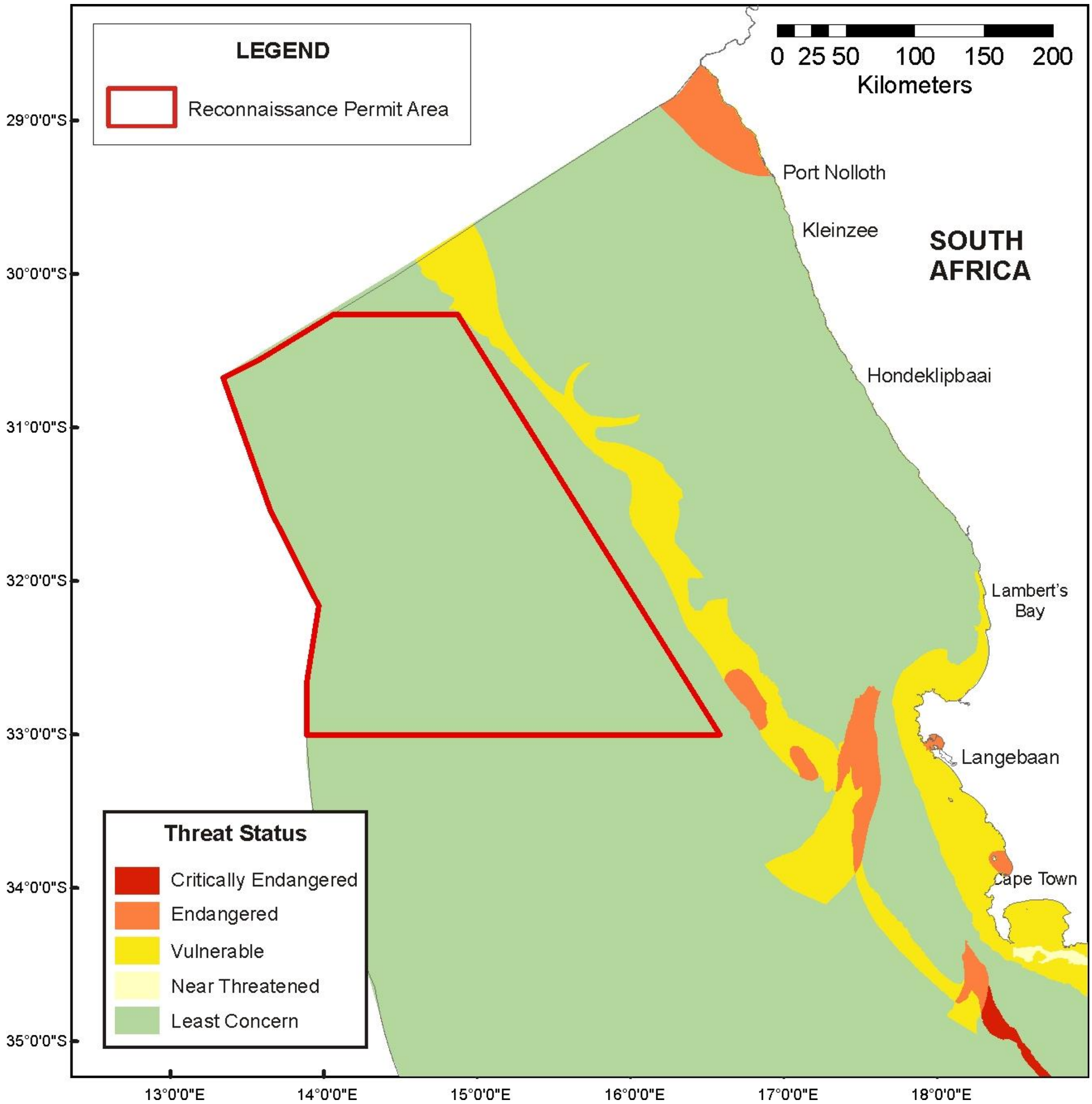


Figure 18: The Reconnaissance Permit Area (red polygon) in relation to the ecosystem threat status for coastal and offshore benthic and pelagic habitat types on the South African West Coast (adapted from Sink *et al*. 2019).

Karenyi *et al*. (2016) found that off Namaqualand, species richness generally increased 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 (Christie 1974, 1976; Steffani & Pulfrich 2004a, 2004b; 2007; Steffani 2007a; 2007b) and elsewhere in the world (e.g. Gray 1981; Ellingsen 2002; Bergen *et al*. 2001; Post *et al*. 2006). However, studies have shown that shear bed stress - a measure of the impact of current velocity on sediment – oxygen concentration (Post *et al*. 2006; Currie *et al*. 2009; Zettler *et al*. 2009, 2013), productivity (Escaravage *et al*. 2009), organic carbon and seafloor temperature (Day *et al*. 1971) 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 (Monteiro & van der Plas 2006; Pulfrich *et al*. 2006). 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.

The invertebrate macrofauna are important in the marine benthic environment as they influence major ecological processes (e.g. remineralisation and flux of organic matter deposited on the sea floor, pollutant metabolism, sediment stability) and serve as important food source for commercially valuable fish species and other higher order consumers. As a result of their comparatively limited mobility and permanence over seasons, these animals provide an indication of historical environmental conditions and provide useful indices with which to measure environmental impacts (Gray 1974; Warwick 1993; Salas *et al*. 2006).

Also associated with soft-bottom substrates are demersal communities that comprise epifauna and bottom-dwelling vertebrate species, many of which are dependent on the invertebrate benthic macrofauna as a food source. According to Lange (2012) the continental shelf on the West Coast between depths of 100 m and 250 m, contained a single epifaunal community characterised by the hermit crabs *Sympagurus dimorphus* and *Parapaguris pilosimanus*, the prawn *Funchalia woodwardi* and the sea urchin *Brisaster capensis*. Atkinson (2009) also reported numerous species of urchins and burrowing anemones beyond 300 m depth off the West Coast.

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 (Benthic Solutions Ltd 2019) as part of the Environmental Baseline Survey for Total E&P Namibia's Block 2913B just to the north of the Reconnaissance Permit 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 Reconnaissance Permit Area.

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 19. A wide diversity of macroinvertebrates has been recorded inshore of the 1 000 m depth contour, and the reader is referred to the comprehensive field guide compiled by Atkinson & Sink (2018).

The 2018 National Biodiversity Assessment for the marine environment (Sink *et al*. 2019) 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 (Breeze *et al*. 1997; MacIssac *et al*. 2001). 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 (Hovland *et al*. 2002). 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 Reconnaissance Permit Area (see Figure 9). Nonetheless, our understanding of the invertebrate fauna of the sub-photic zone is relatively poor (Gibbons *et al*. 1999) and the conservation status of the majority of invertebrates in this bioregion is not known.

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 (Roel 1987). Details on demersal fish communities beyond the shelf break and in the Reconnaissance Permit Area are, however, lacking (see Harris *et al*. 2022). Changes in fish communities occur both latitudinally (Shine 2006, 2008; Yemane *et al.* 2015) and with increasing depth (Roel 1987; Smale *et al.* 1993; Macpherson & Gordoa 1992; Bianchi *et al.* 2001; Atkinson 2009; Yemane *et al.* 2015), with the most substantial change in species composition occurring in the shelf break region between 300 m and 400 m depth (Roel 1987; Atkinson 2009). 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) (Howard *et al.* 2007) and with the eastward shifts observed in small pelagic fish species and rock lobster populations (Coetzee *et al.* 2008, Cockcroft *et al.* 2008).

The diversity and distribution of demersal cartilaginous fishes on the West Coast is discussed by Compagno *et al*. (1991). 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. Details on demersal cartilaginous species beyond the shelf break and in the Reconnaissance Permit Area are lacking, however.

There is limited information about bathyal fish communities in South Africa. South Africa defines its bathyal zone as extending from 500 m to 3 500 m, recognising an upper slope (500-1 000 m), mid slope (1 000-1 800 m) and lower slope (1 800-3 500 m). Typical upper slope fishes (200-2 000 m) include rattails (Macrouridae), greeneyes (*Chlorophthalmus* species), notacanthids, halosaurs, chimaeras, skates, bythitids such as *Cataetyx* spp. and morids (deepsea cods) (Smith & Heemstra 2003). Rattails, bythitids, liparidids (snail fishes) and notacanthids (*Polyacanthonotus* species and halosaurs) are characteristic of the lower bathyal (see also Iwamoto & Anderson 1994; Jones 2014).

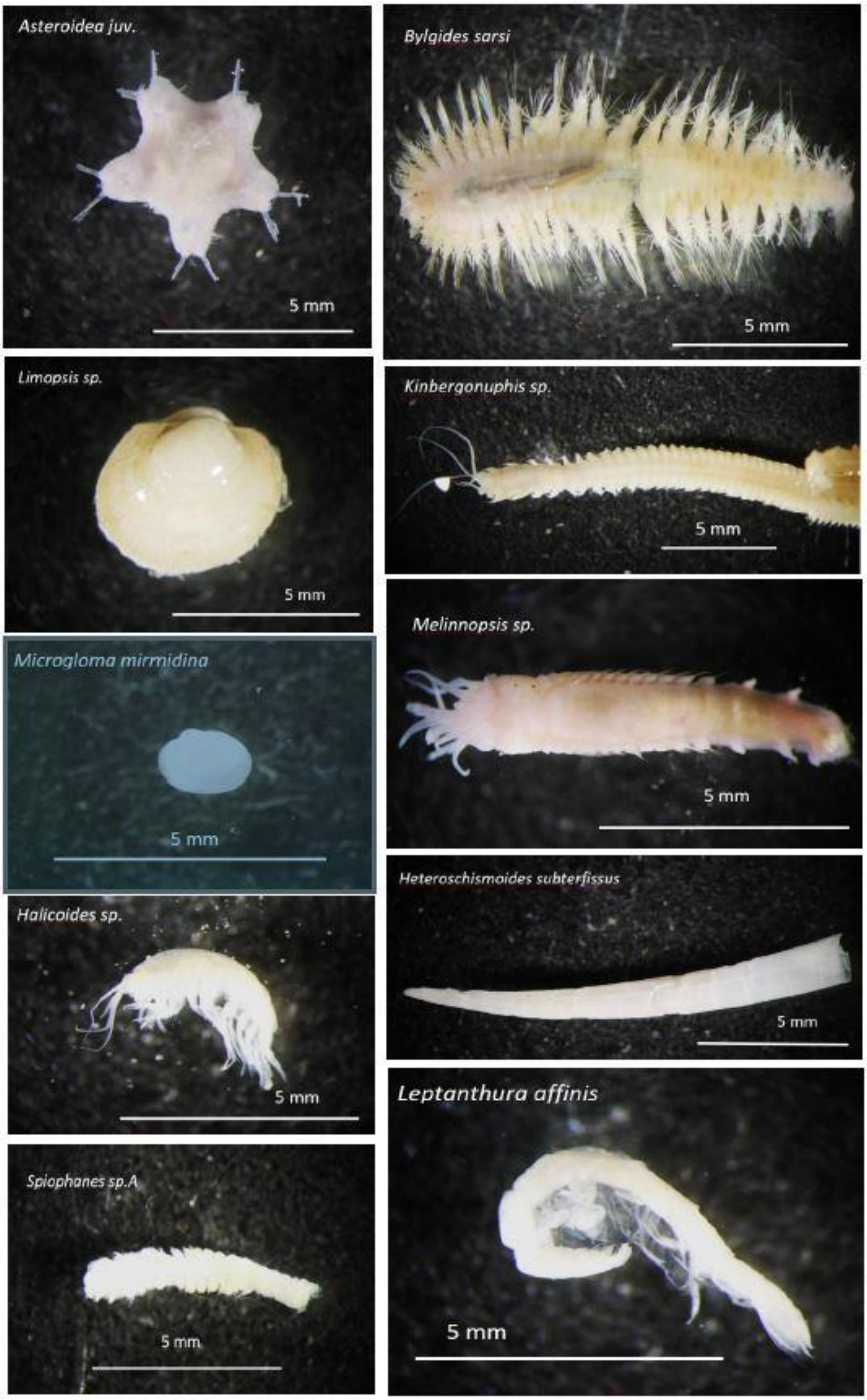


Figure 19: Examples of macroinvertebrates recorded in Block 2913B to the north of the Reconnaissance Permit Area (Source Benthic Solutions Ltd 2019).

Table 7: Demersal cartilaginous species found on the continental shelf along the West Coast, with approximate depth range at which the species occurs (Compagno *et al*. 1991) and their IUCN conservation status. The National Assessment is provided in parentheses where available.

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 quadrispinosa*	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

Common Name	Scientific name	Depth Range (m)	IUCN Conservation Status
Izak catshark	*Holohalaelurus regani*	100-500	LC
Yellowspotted catshark	*Scyliorhinus capensis*	150-500	NT
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	*Cruriraja parcomaculata*	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	*Dipturus pullopunctatus*	15-460	LC
Rough-belly skate	*Raja springeri*	85-500	LC
Yellowspot skate	*Raja wallacei*	70-500	VU
Roughskin skate	*Dipturus spinacidermis*	1 000-1 350	EN
Biscuit skate	*Raja clavata*	25-500	NT
Munchkin skate	*Rajella caudaspinosa*	300-520	LC
Bigthorn skate	*Raja confundens*	100-800	LC
Ghost skate	*Rajella dissimilis*	420-1 005	LC
Leopard skate	*Rajella leopardus*	300-1 000	LC
Smoothback skate	*Rajella ravidula*	500-1 000	LC
Spearnose skate	*Rostroraja alba*	75-260	EN
St Joseph	*Callorhinchus capensis*	30-380	LC (LC)
Cape chimaera	*Chimaera notafricana*	680-1 000	LC

Common Name	Scientific name	Depth Range (m)	IUCN Conservation Status
Brown chimaera	*Chimaera carophila*	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

8.4.2 SEAMOUNT AND SUBMARINE CANYON 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 (Clark *et al*. 1999), 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 (Koslow 1996).

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 (Hui 1985; Haney *et al*. 1995). Seamounts thus serve as feeding grounds, spawning and nursery grounds and possibly navigational markers for a large number of species (SPRFMA 2007; Derville *et al*. 2020).

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 (Rogers 1994). 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 (reviewed in Rogers 2004). There is also associated mobile benthic fauna that includes echinoderms (sea urchins and sea cucumbers) and crustaceans (crabs and lobsters) (reviewed by Rogers 1994; Kenyon *et al*. 2003). 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 (Rogers *et al*. 2008). 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 (FAO 2008).

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 (Birch & Rogers 1973). 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 (Kopaska-Merkel & Haywick 2001; Kenyon *et al*. 2003, Wheeler *et al*. 2005, Colman *et al*. 2005). Tripp Seamount situated at about 29°40'S, lies ~30 km north of the northern boundary of the Application 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 (Kensley 1980, 1981) and exploratory deepwater trawl fishing (Hampton 2003), 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 (Rogers 1986) 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 (Sink & Samaai, 2009) 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 (Bergstad *et al*. 2019), 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. 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 (Figure 20). 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.

The concept of a 'Vulnerable Marine Ecosystem' (VME) 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 (Parker *et al*. 2009; Auster *et al*. 2011; Hansen *et al*. 2013).

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 (Buhl-Mortensen *et al*. 2010; Hogg *et al*. 2010; Barrio Froján *et al*. 2012; Beazley *et al*. 2013, 2015). 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 (Bett & Rice 1992; Raes & Vanreusel 2005; Beazley *et al*. 2013; Ashford *et al*. 2019).

VMEs are also thought to contribute toward the long-term viability of a stock through providing an important source of habitat for commercial species (Pham *et al*. 2015; Ashford *et al*. 2019). 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 (Husebø & Nøttestad *et al*. 2002; Krieger & Wing, 2002; Tissot *et al*., 2006; Baillon *et al*. 2012; Pham *et al*. 2015). 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 (Krieger & Wing, 2002; Husebø & Nøttestad *et al*. 2002; Buhl-Mortensen *et al*, 2010; Hogg *et al*., 2010; Auster *et al*. 2011).

Figure 20: Deep water benthic macrofauna from various depths in the Cape Canyon (Source: www.environment.gov.za/dearesearchteamreturnfromdeepseaexpedition).

VME frameworks are typically elevated from the seabed, increasing turbulence and raising supply of suspended particles to suspension feeders (Krieger & Wing 2002; Buhl-Mortensen & Mortensen 2005; Buhl-Mortensen *et al*. 2010). Poriferans and cold-water corals have further been shown to provide a strong link between pelagic and benthic food webs (Pile & Young 2006; Cathalot *et al*. 2015). VMEs are increasingly being recognised as providers of important ecosystem services due to associated increased biodiversity and levels of ecosystem functioning (Ashford *et al*. 2019).

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 (De Beers Marine, unpublished data) (Figure 21), and in 190-527 m depth on Child's Bank (Sink *et al*. 2019) 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 (Atkinson & Sink 2018; Sink *et al*. 2019).

As sampling beyond 1 000 m depth has not taken place (Atkinson & Sink 2018) it is not known whether similar communities may be expected in the Reconnaissance Permit Area. Should they occur, however, they would receive the sound in the far field only and no detrimental effects to the communities or to individual benthic species are expected. The distribution of known and potential Vulnerable Marine Ecosystem habitat based on potential VME features, DFFE and SAEON trawl survey data, and many visual surveys indicating the presence of indicator taxa were mapped by Harris *et al*. 2022 (Figure 22). Some sites need more research to determine their status. The location of the Reconnaissance Permit 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.

Figure 21: Gorgonians and bryozoans communities recorded on deep-water reefs (100-120 m) off the southern African West Coast (Photos: De Beers Marine).

Table 8: Table of Potential VME species from the continental shelf and shelf edge on the West Coast (Atkinson & Sink 2018)

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

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+) (Hovland & Thomsen 1997), 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 (Hovland *et al*. 1998, Duncan & Roberts 2001, Hall-Spencer *et al*. 2002, Roberts & Gage 2003). 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 Reconnaissance Permit Area by Palan (2017).

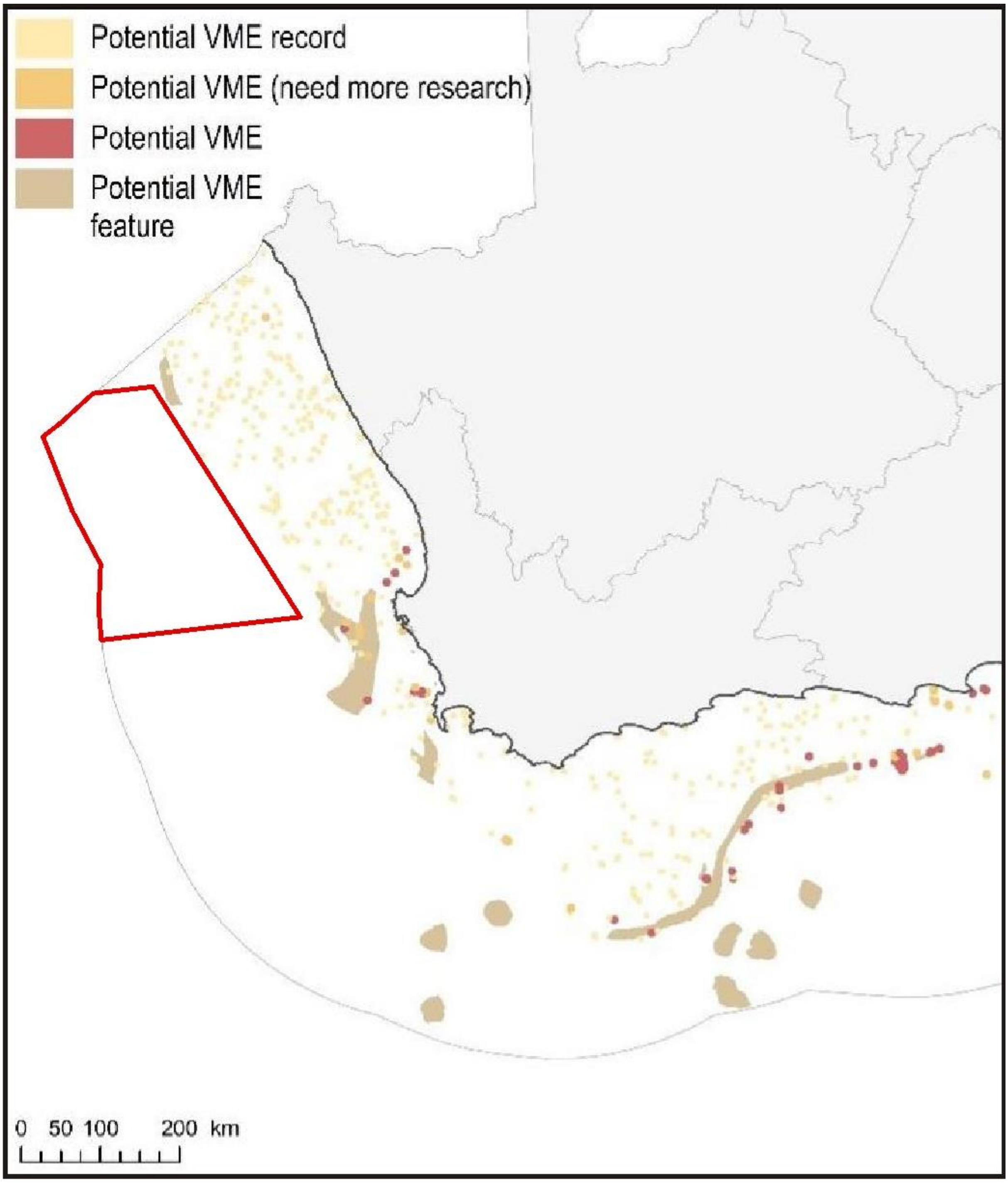


Figure 22: The Reconnaissance Permit Area (red polygon) in relation to the distribution of known and potential Vulnerable Marine Ecosystem habitat (adapted from Harris *et al*. 2022).

8.4.3 PELAGIC COMMUNITIES

In contrast to demersal and benthic biota 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.

8.4.3.1 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 23).

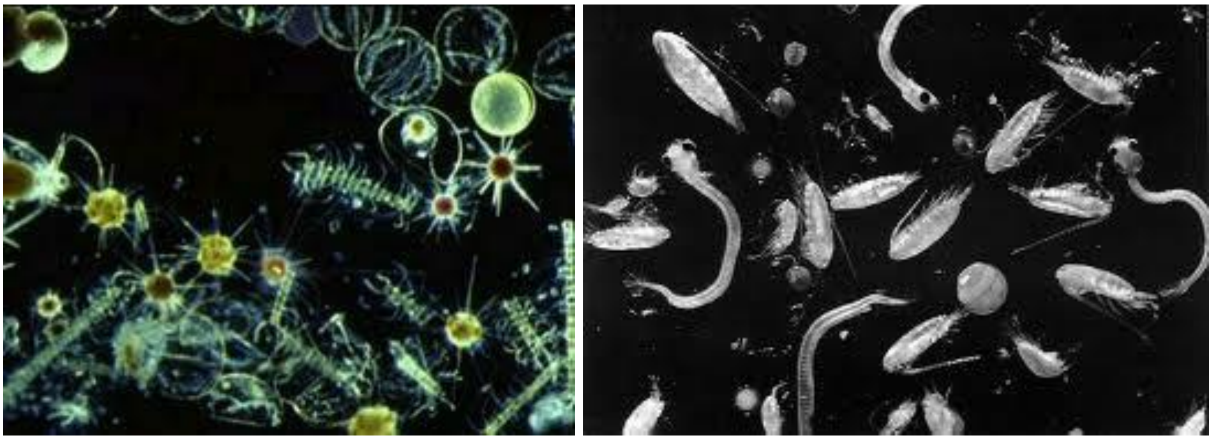


Figure 23: Phytoplankton (left, photo: hymagazine.com) and zooplankton (right, photo: mysciencebox.org) is associated with upwelling cells.

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 (Shannon & Field 1985; Mitchell-Innes & Walker 1991; Walker & Peterson 1991). 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* (Shannon & Pillar 1985). 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 (see Shannon & Pillar, 1986). 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. They are unlikely to occur in the offshore regions of the Application Area.

The mesozooplankton (≥200 µm) is dominated by copepods, which are overall the most dominant and diverse group in southern African zooplankton. Important species are *Centropages 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 (Pillar *et al.* 1991).

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 (Pillar 1986). 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 (Brown 1984; Brown & Henry 1985), 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 subsequent to 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 (Crawford *et al*. 1987; Hutchings 1994; Hutchings *et al*. 2002) (see Figure 24, Figure 25, Figure 26, and Figure 27), 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 25 and Figure 26 highlight 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 (Strømme *et al*. 2015). Snoek spawn along the shelf break (150-400 m) of the western Agulhas Bank and the West Coast between June and October (Griffiths 2002).
- 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 27, 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 27, 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 Reconnaissance Permit Area or indicative 3D acquisition area with the northward egg and larval drift of commercially important species, and the return migration of recruits (Figure 24). In the offshore oceanic waters of the Application Area, ichthyoplankton abundance is, therefore, expected to be low.

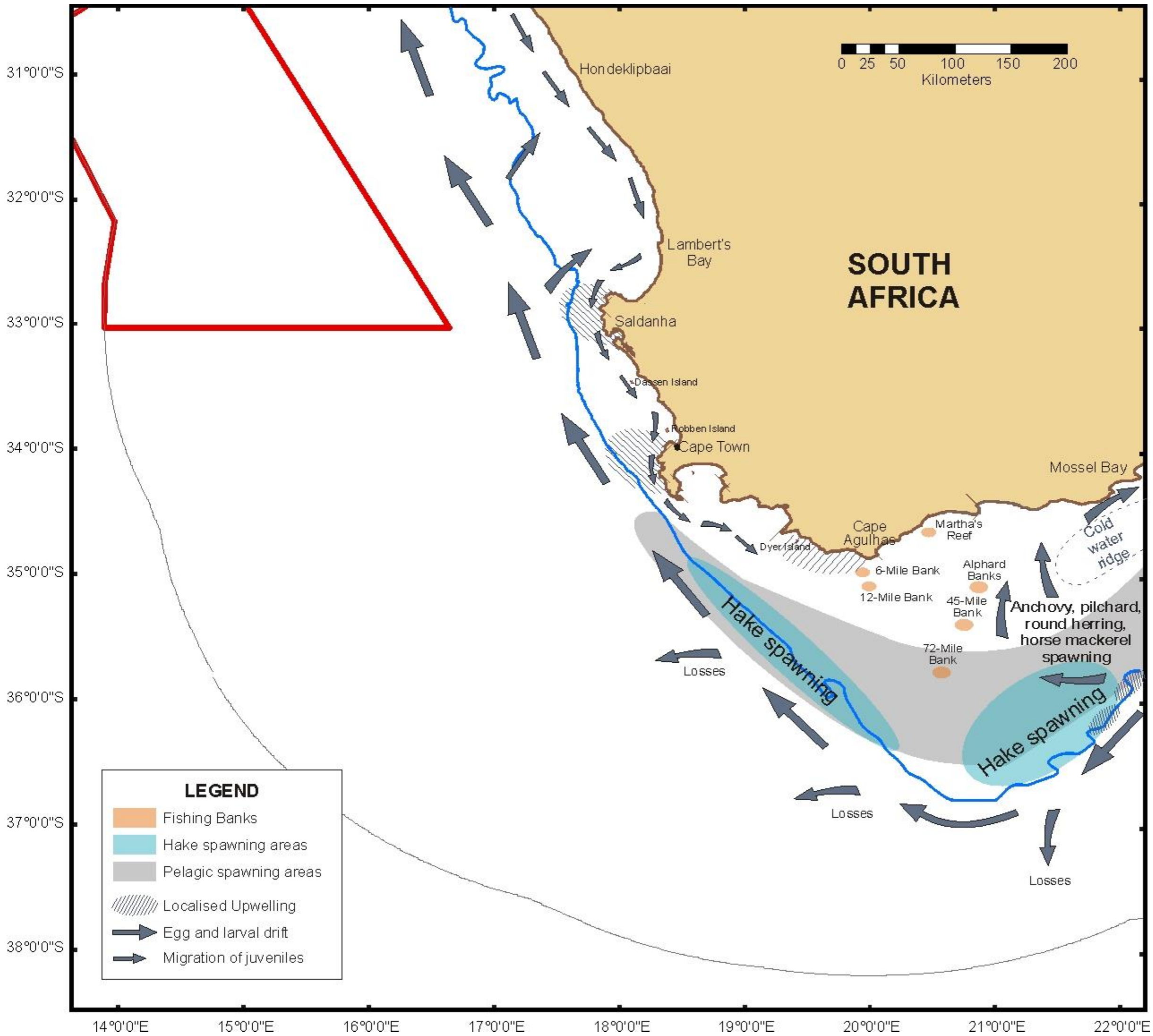


Figure 24: The Reconnaissance Permit Area (red polygon) in relation to major spawning, recruitment and nursery areas in the southern Benguela region (adapted from Crawford *et al*. 1987; Hutchings 1994; Hutchings *et al*. 2002).

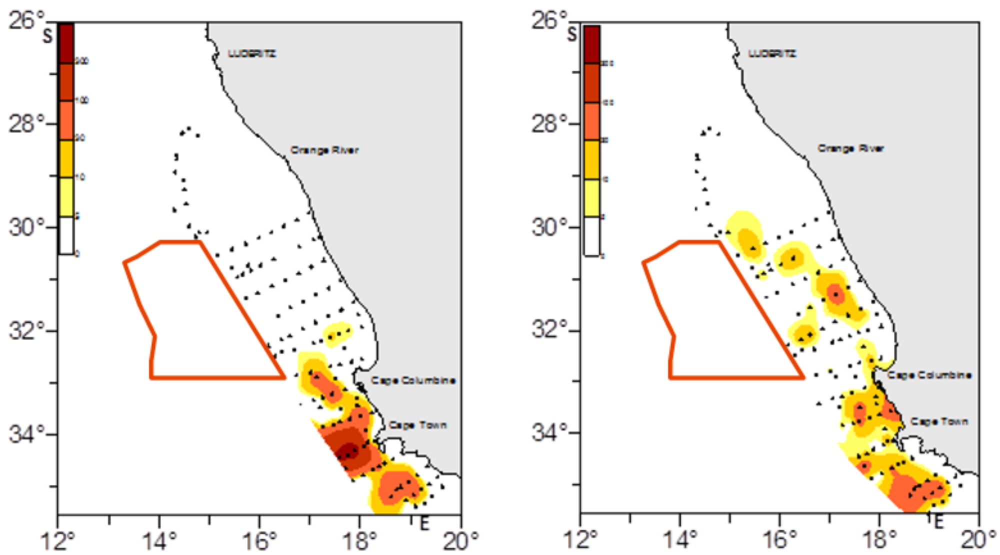


Figure 25: Distribution of hake eggs (left) and larvae (right) off the West Coast of South Africa between September and October 2005 (adapted from Stenevik *et al*. 2008) in relation to the Reconnaissance Permit Area (red polygon).

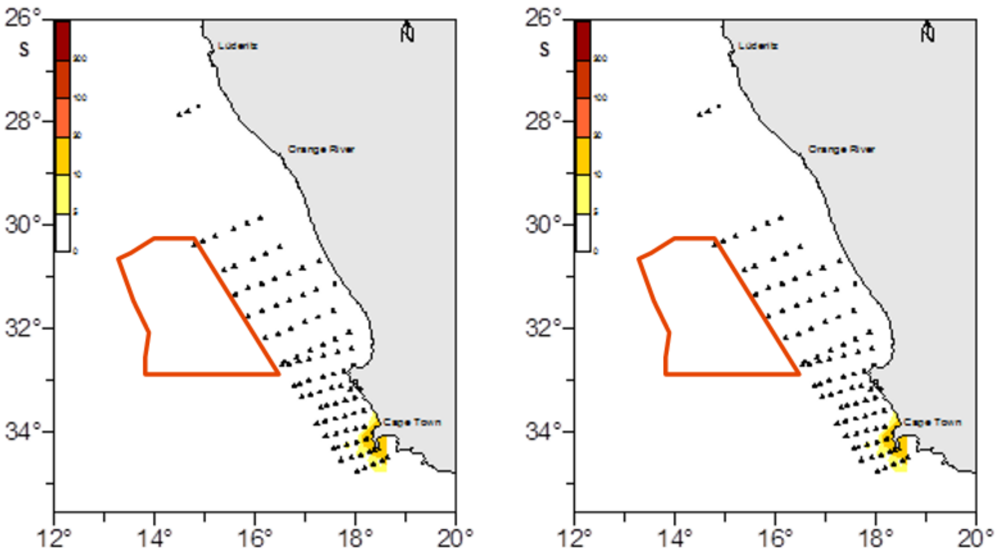


Figure 26: Distribution of hake eggs (left) and larvae (right) off the West Coast of South Africa between March and April 2007 (adapted from Stenevik *et al*. 2008) in relation to the Reconnaissance Permit Area (red polygon).

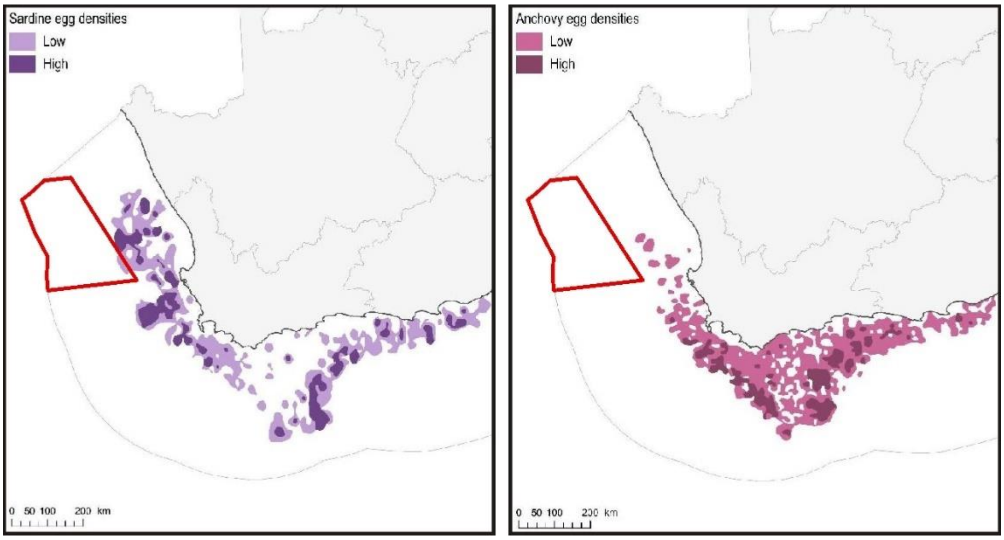


Figure 27: Distribution of sardine (left) and anchovy (right) spawning areas, as measured by egg densities, in relation to the Reconnaissance Permit Area (red polygon) (adapted from Harris *et al*. 2022).

8.4.3.2 CEPHALOPODS

Fourteen species of cephalopds have been recorded in the southern Benguela, the majority of which are sepiods/cuttlefish (Lipinski 1992; Augustyn *et al.* 1995). 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 (Augustyn *et al.* 1995). 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 28, top) while the giant squid is usually found near continental and island slopes all around the world's oceans (Figure 28, 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.

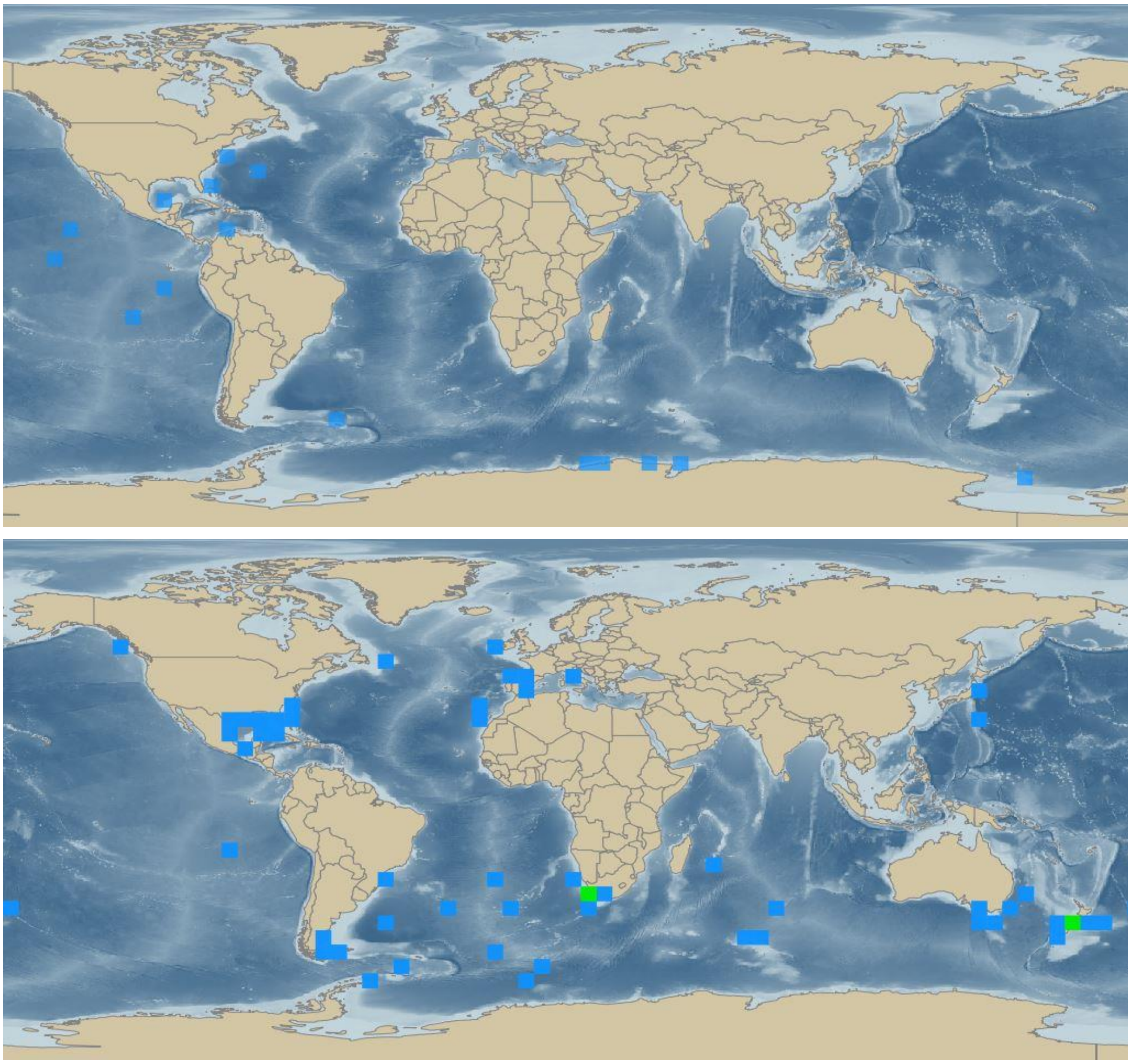


Figure 28: Distribution of the colossal squid (top) and the giant squid (bottom). Blue squares <5 records, green squares 5-10 records (Source: http://iobis.org).

8.4.3.3 **PELAGIC FISH**

Small pelagic species include the sardine/pilchard (*Sadinops ocellatus*) (Figure 29, left), anchovy (*Engraulis capensis*), chub mackerel (*Scomber japonicus*), horse mackerel (*Trachurus capensis*) (Figure 29, right) and round herring (*Etrumeus whiteheadi*). These species typically occur in mixed shoals of various sizes (Crawford *et al.* 1987), and generally occur within the 200 m contour and thus likely to only be encountered in southeastern inshore portion of the project area. 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 (Shannon & Pillar 1986) (see Figure 24). 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 29: Cape fur seal preying on a shoal of pilchards (left). School of horse mackerel (right) (photos: www.underwatervideo.co.za; www.delivery.superstock.com).

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 (Sink *et al.* 2019). 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 (Griffiths 2002). Initially postulated to be a single stock that undergoes a seasonal longshore migration from southern Angola through Namibia to the South African West Coast (Crawford & De Villiers 1985; Crawford *et al.* 1987), Benguela snoek are now recognised as two separate sub-populations separated by the Lüderitz upwelling cell (Griffiths 2003). 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 (Griffiths 2002) (Figure 30). 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 (Payne & Crawford 1989). The distribution of snoek and chub mackerel therefore lies well inshore of the Reconnaissance Permit Area.

The fish most likely to be encountered on the shelf, beyond the shelf break and in the offshore waters of the Application Areas 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.

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 31, right), yellowfin *T. albacares*, bigeye *T. obesus*, and skipjack *Katsuwonus pelamis tunas*, as well as the Atlantic blue marlin *Makaira nigricans* (Figure 31, left), the white marlin *Tetrapturus albidus* and the broadbill swordfish *Xiphias gladius* (Payne & Crawford 1989). The distribution of these species is 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 (Shannon *et al.* 1989; Penney *et al.* 1992). Seasonal association with Child's Bank and Tripp Seamount occurs between October and June, with commercial catches often peaking in March and April (www.fao.org/fi/fcp/en/NAM/body.htm; see CapMarine 2022 – Fisheries Specialist Study in Appendix 3).

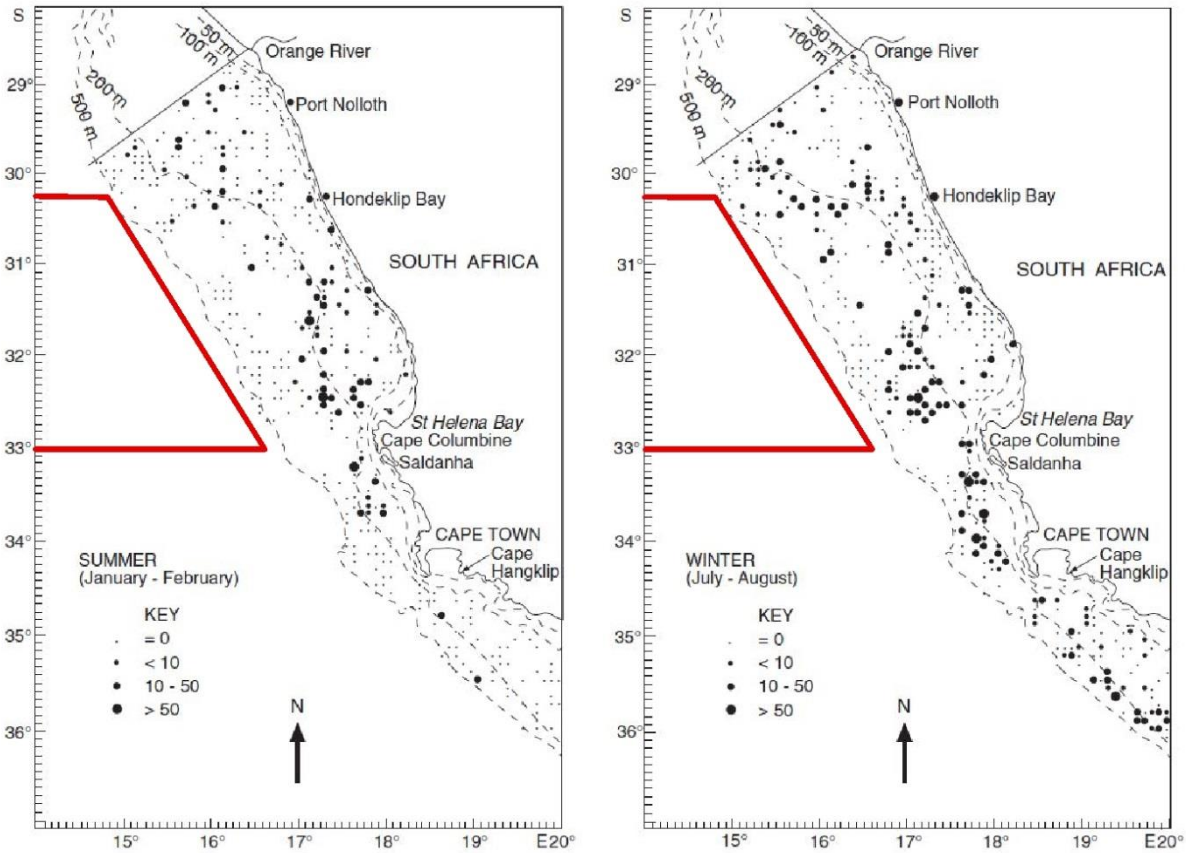


Figure 30: Mean number of snoek per demersal trawl per grid block (5 × 5 Nm) by season for (A) the west coast (July 1985–Jan 1991) and (B) the south coast in relation to the Reconnaissance Permit Area (red polygon) (adapted from Griffiths 2002).

Table 9: Some of the more important large migratory pelagic fish likely to occur in the offshore regions of the West Coast (TOPS list under NEMBA, Act 10 of 2004; Sink *et al*. 2019; www.iucnredlist.org;). The National and Global IUCN Conservation Status are also provided.

Common Name	Species	National Assessment	IUCN Conservation Status
Tunas			
Southern Bluefin Tuna	*Thunnus maccoyii*	Not Assessed	Endangered
Bigeye Tuna	*Thunnus obesus*	Vulnerable	Vulnerable
Longfin Tuna/Albacore	*Thunnus alalunga*	Near Threatened	Least concern
Yellowfin Tuna	*Thunnus albacares*	Near Threatened	Least concern
Frigate Tuna	*Auxis thazard*	Not Assessed	Least concern
Eastern Little Tuna	*Euthynnus affinis*	Least concern	Least concern
Skipjack Tuna	*Katsuwonus pelamis*	Least concern	Least concern
Atlantic Bonito	*Sarda sarda*	Not Assessed	Least concern
Billfish			

Common Name	Species	National Assessment	IUCN Conservation Status
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
Swordfish	*Xiphias gladius*	Data deficient	Least concern
Pelagic Sharks			
Oceanic Whitetip Shark	*Carcharhinus longimanus*	Not Assessed	Vulnerable
Dusky Shark	*Carcharhinus obscurus*	Data deficient	Vulnerable
Bronze Whaler Shark	*Carcharhinus brachyurus*	Data deficient	Near Threatened
Great White Shark	*Carcharodon carcharias*	Least concern	Vulnerable
Shortfin Mako	*Isurus oxyrinchus*	Vulnerable	Endangered
Longfin Mako	*Isurus paucus*	Not Assessed	Vulnerable
Whale Shark	*Rhincodon typus*	Not Assessed	Endangered
Blue Shark	*Prionace glauca*	Least concern	Near Threatened

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. The recapture of a juvenile blue shark off Uruguay, which had been tagged off the Cape of Good Hope, supports the hypothesis of a single blue shark stock in the South Atlantic (Hazin 2000; Montealegre-Quijano & Vooren 2010) and Indian Oceans (da Silva *et al*. 2010). Using the Benguela drift in a north-westerly direction, it is likely that juveniles from the parturition off the south-western Cape would migrate through the project area *en route* to South America (da Silva *et al.* 2010).

The shortfin mako inhabits offshore temperate and tropical seas worldwide. It can be found from the surface to depths of 500 m, and as one of the few endothermic sharks is seldom found in waters <16 °C (Compagno 2001; Loefer *et al.* 2005). As the fastest species of shark, shortfin makos have been recorded to reach speeds of 40 km/h with burst of up to 74 km/h, and can jump to a height of 9 m (http://www.elasmo-research.org/education/shark_profiles/ i_oxyrinchus.htm). Most makos caught by longliners off South Africa are immature, with reports of juveniles and sub-adults sharks occurring near the edge of the Agulhas Bank and off the South Coast between June and November (Groeneveld *et al.* 2014), whereas larger and reproductively mature sharks were more common in the inshore environment along the East Coast (Foulis 2013).

Figure 31: Large migratory pelagic fish such as blue marlin (left) and longfin tuna (right) occur in offshore waters (photos: www.samathatours.com; www.osfimages.com).

Whale sharks are regarded as a broad ranging species typically occurring in offshore epipelagic areas with sea surface temperatures of 18–32°C (Eckert & Stewart 2001). 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 (Rowat 2007). 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 (KZN) in the Greater St. Lucia Wetland Park (Cliff *et al*. 2007). Satellite tagging has revealed that individuals may travel distances of tens of 1 000s of kms (Eckert & Stewart 2001; Rowat & Gore 2007; Brunnschweiler *et al*. 2009). On the West Coast their summer and winter distributions are centred around the Orange River mouth and between Cape Columbine and Cape Point (Harris *et al*. 2022). The likelihood of an encounter in the offshore waters of the Reconnaissance Permit Area is relatively low.

The whale shark and shortfin mako are listed in Appendix II (species in which trade must be controlled in order to avoid utilization incompatible with their survival) of CITES (Convention on International Trade in Endangered Species) and Appendix I and/or II of the Bonn Convention for the Conservation of Migratory Species (CMS). The whale shark is also listed as 'vulnerable' in the List of Marine Threatened or Protected Species (TOPS) as part of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA).

8.4.3.4 **TURTLES**

Three species of turtle occur along the West Coast, namely the Leatherback (*Dermochelys coriacea*) (Figure 32, left), and occasionally the Loggerhead (*Caretta caretta*) (Figure 32, 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.

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) (Lambardi *et al.* 2008, Elwen & Leeney 2011; SASTN 2011[2]). 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 (Lambardi *et al.* 2008) (Figure 33).

[2] SASTN Meeting – Second meeting of the South Atlantic Sea Turtle Network, Swakopmund, Namibia, 24-30 July 2011.

Figure 32: Leatherback (left) and loggerhead turtles (right) occur along the West Coast of Southern Africa (Photos: Ketos Ecology 2009; www.aquaworld-crete.com).

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 (Hays *et al*. 2004). 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 (Hughes & Nel 2014) 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.

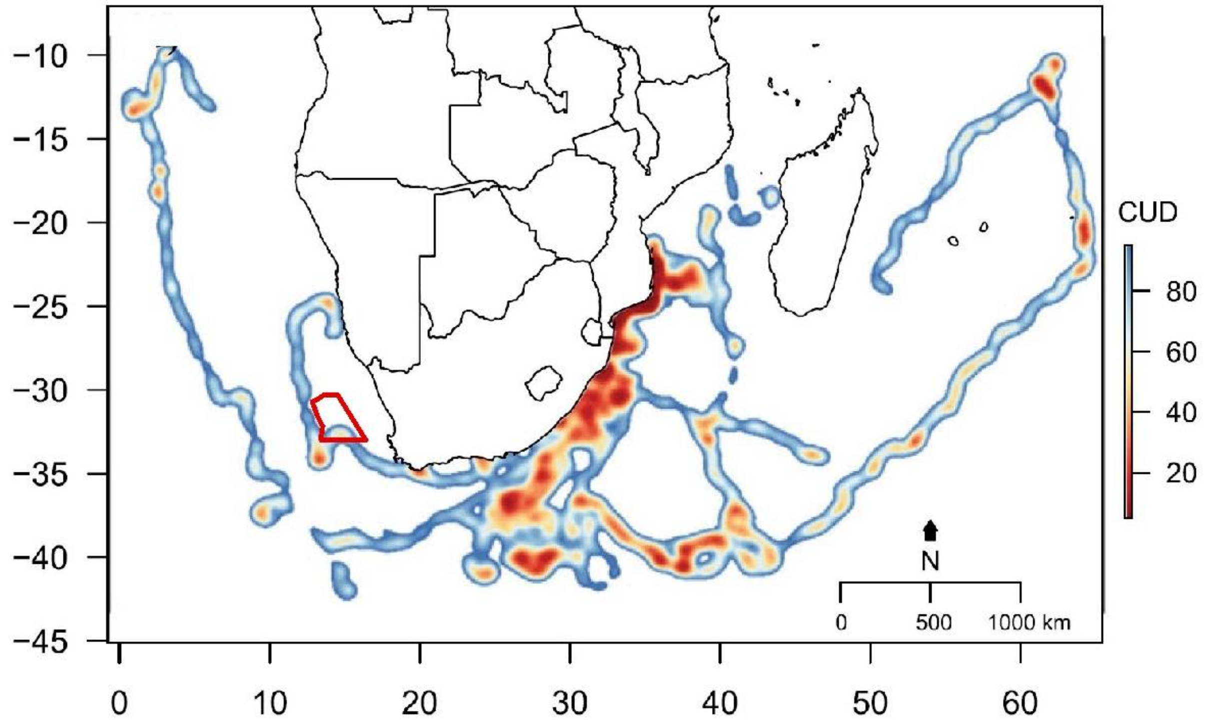


Figure 33: The Reconnaissance Permit Area (red polygon) in relation to the migration corridors of leatherback turtles in the south-western Indian Ocean. Relative use (CUD, cumulative utilization distribution) of corridors is shown through intensity of shading: light, low use; dark, high use (adapted from Harris *et al*. 2018).

8.4.3.5 **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. 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), with highest population levels during their non-breeding season (winter). Pintado petrels and Prion spp. show the most marked variation here. Pelagic seabird species are therefore likely to be relatively frequently encountered in the offshore waters of the Reconnaissance Permit Area.

Fifteen species of seabirds breed in southern Africa; Cape Gannet (Figure 34, left), African Penguin (Figure 34, right), four species of Cormorant, White Pelican, three Gull and four Tern species (Table 12). The breeding areas are distributed around the coast with islands being especially important. The closest breeding islands to the Reconnaissance Permit Area are Bird Island in Lambert's Bay, the Saldanha Bay Islands and Dassen Island, which lie approximately 192 km,126 km and 150 km to the east and south east of the eastern and southern boundary of the Reconnaissance Permit 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 (Dundee 2006; Ludynia 2007; Grémillet *et al*. 2008; Crawford *et al*. 2011), and African Penguins have also been recorded as far as 60 km offshore. The Application Area lies well offshore of the aggregate core home ranges of Cape Gannet and African Penguin (Figure 35) (BirdLife South Africa 2022). Aggregate core home ranges and foraging areas for Cape Cormorant and Bank Cormorant similarly lie well inshore of the Reconnaissance Permit Area (see Harris *et al*. 2022). There is, however, overlap of the foraging areas of Wandering Albatross and Atlantic Yellow-nosed Albatross with the Reconnaissance Permit Area (Figure 35) (BirdLife South Africa 2022; Harris *et al*. 2022).

Figure 34: Cape Gannets Morus capensis (left) (Photo: NACOMA) and African Penguins Spheniscus demersus (right) (Photo: Klaus Jost) breed primarily on the offshore Islands.

Table 11: Pelagic seabirds common in the southern Benguela region (Crawford *et al*. 1991; BirdLife 2021). IUCN Red List and Regional Assessment status are provided (Sink *et al*. 2019).

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 Albatross	*Thalassarche chlororhynchos*	Endangered	Endangered
Indian Yellow-nosed Albatross	*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 palpebrata*	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

Common Name	Species name	Global IUCN	Regional Assessment
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
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 vittata*	Least concern	Endangered

Table 12: Breeding resident seabirds present along the South-West Coast (adapted from CCA & CMS 2001). IUCN Red List and National Assessment status are provided (Sink *et al*. 2019). * denotes endemicity.

Common Name	Species name	Global IUCN	Regional Assessment
African Penguin*	*Spheniscus demersus*	Endangered	Endangered
African Black Oystercatcher*	*Haematopus moquini*	Near Threatened	Least Concern
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*	Least Concern	Vulnerable
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*	Least Concern	Vulnerable
Swift Tern	*Sterna bergii*	Least Concern	Least Concern
Roseate Tern	*Sterna dougallii*	Least Concern	Endangered
Damara Tern*	*Sterna balaenarum*	Vulnerable	Vulnerable

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 (Crawford *et al.* 2015). 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 (Sink *et al.* 2019). 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 (Crawford *et al.* 2015).

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 (Rollinson *et al*. 2017). 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 (Sink *et al*. 2019).

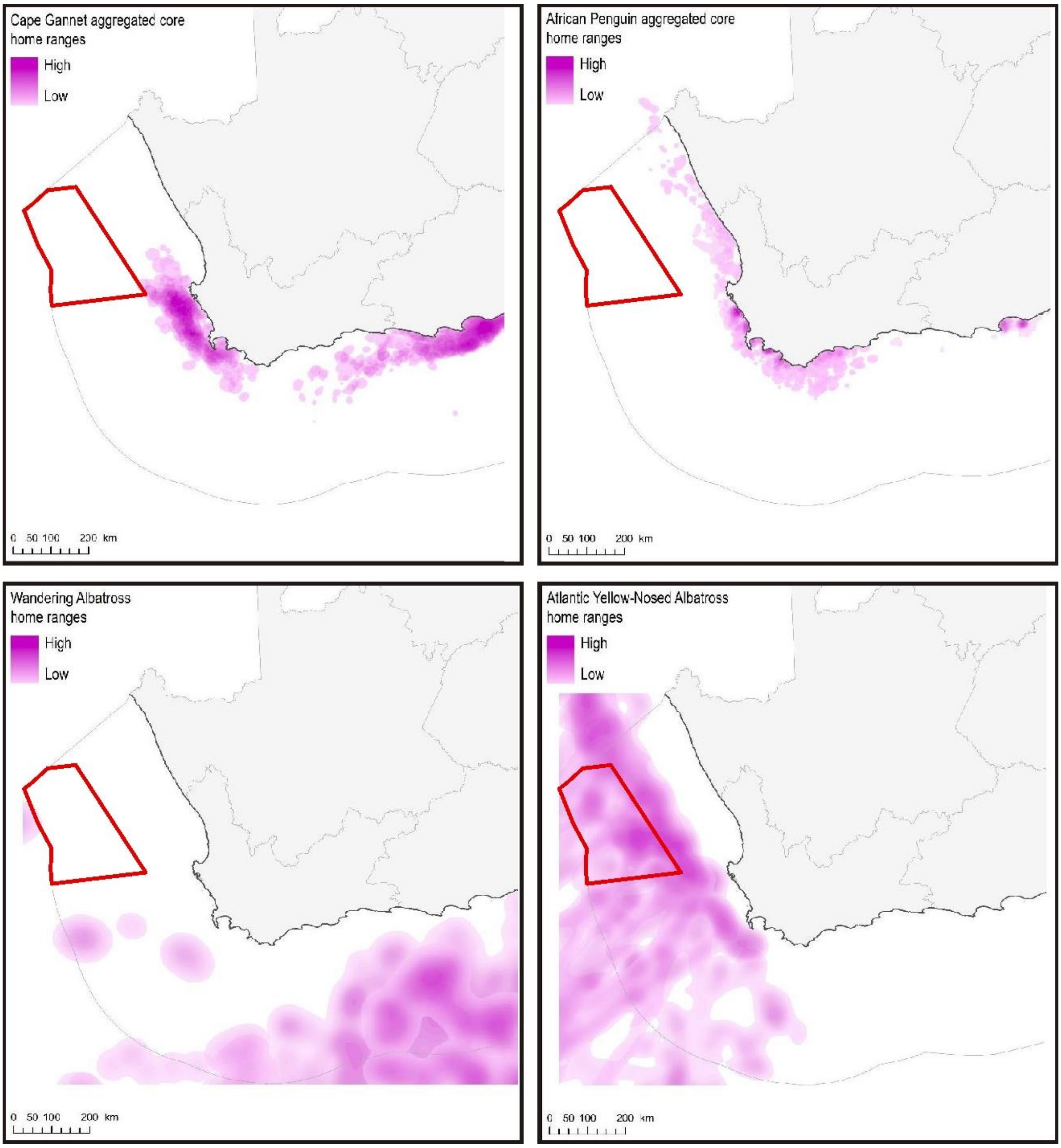


Figure 35: The Reconnaissance Permit Area (red polygon) in relation to aggregate core home ranges of Cape Gannet (top left), African Penguin (top right) for different colonies and life-history stages, and foraging areas of Wandering Albatross (bottom left) and Atlantic Yellow-nosed Albatross (bottom right). For foraging areas, darker shades are areas of higher use and where foraging areas from different colonies overlap (adapted from Harris *et al*. 2022).

8.4.3.6 **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 (Best *et al*. 2009; Elwen *et al*. 2011; Rosenbaum *et al*. 2014; Shabangu *et al*. 2019; Thomisch *et al*. 2019) 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 (Purdon *et al*. 2020). 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 3D acquisition area extends from the Namibian border to 32°27' offshore of St Helena Bay from roughly the 500 m isobath to nearly 4 000 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 (~32° S) and Cape Agulhas (~34° S, 20° E) 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 (Findlay *et al*. 1992). 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 (De Rock *et al*. 2019, SLR data). 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 36) (Harris *et al*. 2022).

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, based on all available data sources but mainly: Findlay et al. (1992), Best (2007), Weir (2011), De Rock et al. (2019), Purdon et al. (2020a, 2020b, 2020c), and unpublished records held by Sea Search and those held by SLR consulting and shared for this report (see also Figure 37, Figure 38, Figure 40). 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.

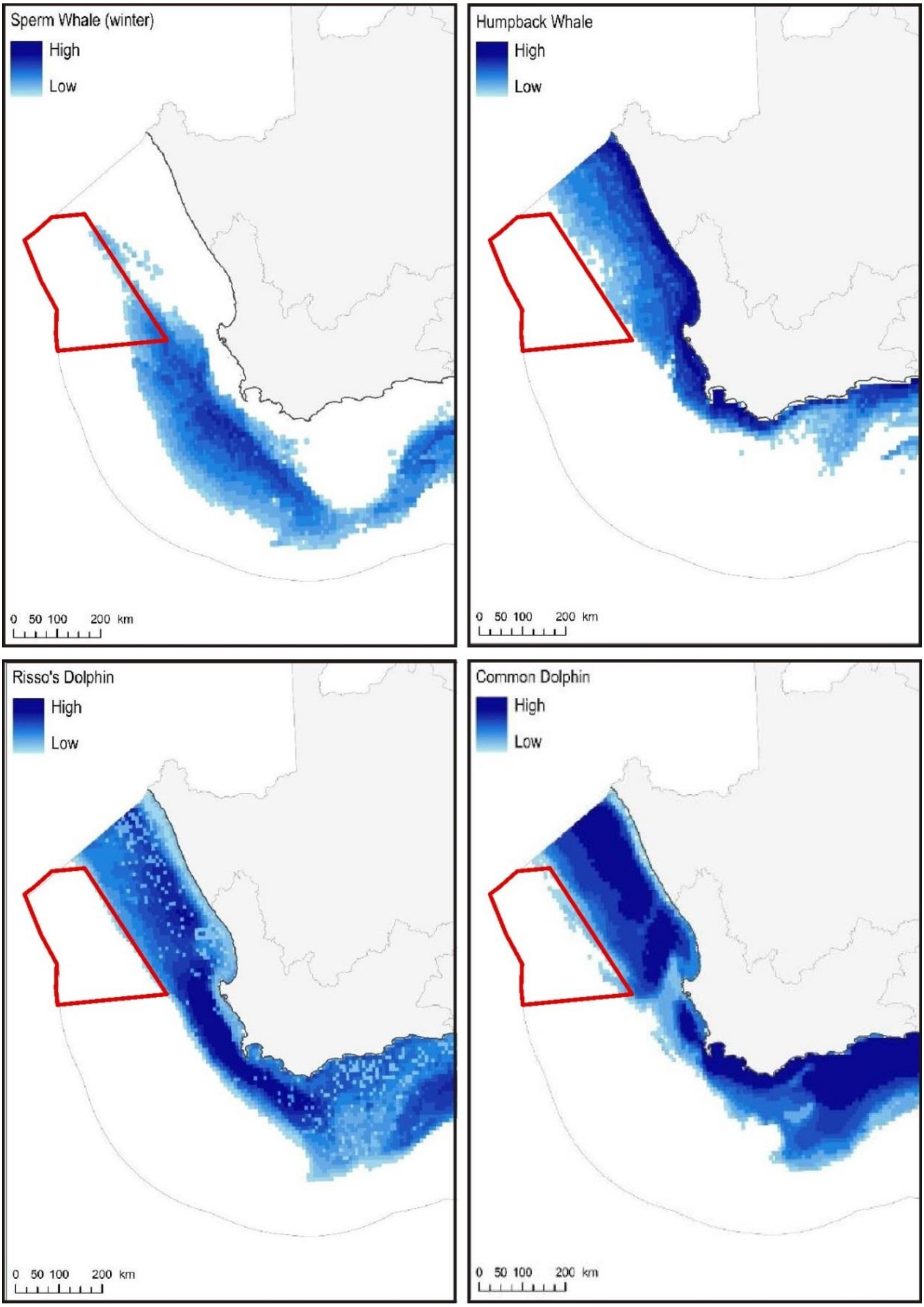


Figure 36: The Reconnaissance Permit Area (red polygon) in relation to the predicted distribution of Sperm whales (winter distribution)(left), humpback whale (middle) and Risso's dolphin (right) with darker shades of blue indicating highest likelihood of occurrence (adapted from Harris *et al*. 2022).

8.4.3.6.1 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 enroute 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.

Bryde's whales: Two genetically and morphologically distinct populations of Bryde's whales (Figure 39, left) live off the coast of southern Africa (Best 2001; Penry 2010). 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 area in January - March. The "inshore population" of Bryde's whale live mainly on the continental shelf and Agulhas Bank, and are unique amongst baleen whales in the region by being non-migratory. The inshore population has recently been recognised as its own (yet to be named) sub species (*Balaenoptera brydei edeni*, Penry *et al.* 2018) with a total population for this subspecies of likely fewer than 600 individuals. 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 (Best 2007). The offshore stock was subjected to heavy whaling in the mid-20th century (Best 2001) and there are no current data on population size or stock recovery therefrom and is currently listed as 'Data deficient' on the South African Red List. The inshore stock is regarded as extremely 'Vulnerable' and listed as such on the South African red list as it regularly suffers losses from entanglement in trap fisheries and has been subject to significant changes in its prey base due to losses and shifts in the sardine and small pelgic stocks around South Africa.

Sei whales: Almost all information is based on whaling records 1958-1963, most from shore-based catchers operating within a few hundred kilometres of Saldanha Bay. At this time the species was not well differentiated from Bryde's whales and records and catches of the two species intertwined. There is no current information on population recovery, abundance or much information on distribution patterns outside of the whaling catches and the species remains listed as 'Endangered' on the SA Red List. Sei whales feed at high latitudes (40-50˚S) during summer months and migrate north through South African waters to unknown breeding grounds further north (Best 2007). Their migration pattern thus shows a bimodal peak with numbers west of Saldanha Bay being 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 (Best & Lockyer 2002). A recent survey to Vema Seamount ~1 000 km west of Cape Town during Oct-Nov 2019, encountered a broadly spread feeding aggregation of over 30 sei and fin whales at around 200 m water depth (Elwen *et al.* in prep.). This poorly surveyed area (roughly 32˚S, 15˚E) is just to the NW of the historic whaling grounds suggesting this region remains an important feeding area for the species. This region lies well within the impact area of the proposed 3D seismic survey and caution is recommended to reduce impacts on this endangered and poorly known species.

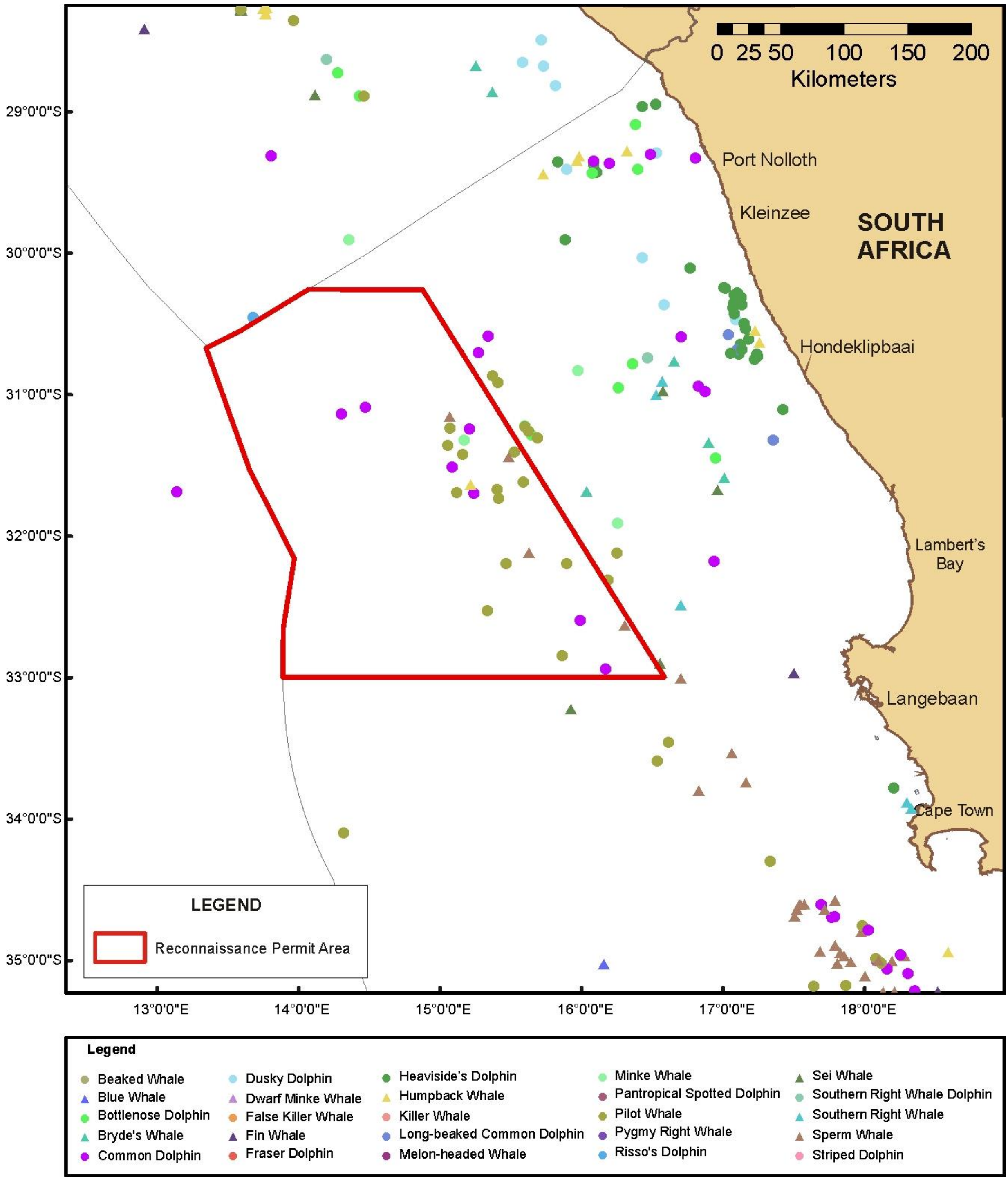


Figure 37: The Reconnaissance Permit Area (red polygon) in relation to the distribution and movement of cetaceans along the West Coast collated between 2001 and 2020 (SLR MMO database).

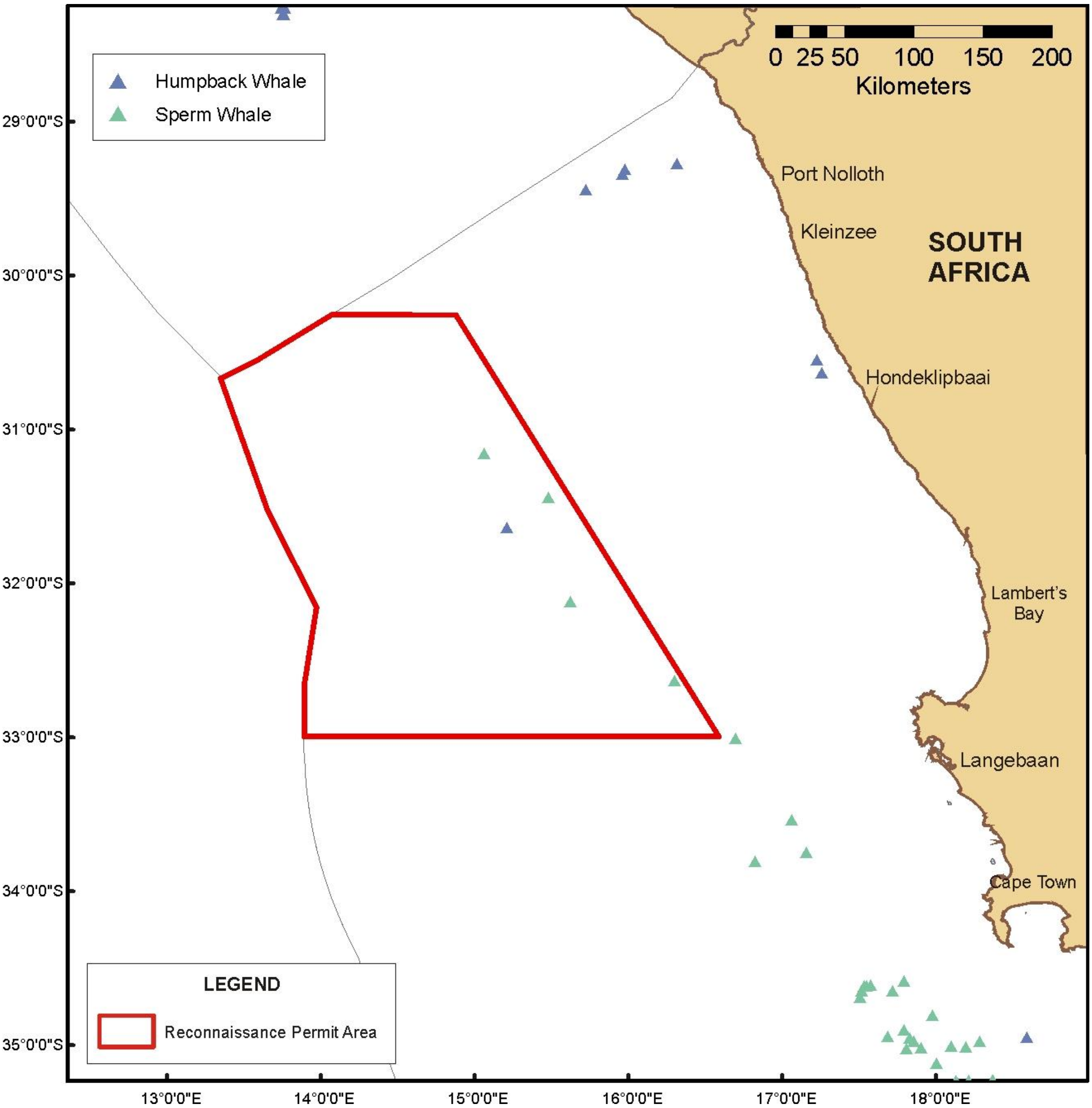


Figure 38: The Reconnaissance Permit Area (red polygon) in relation to the distribution and movement of Humpback whales and Sperm whales along the West Coast collated between 2001 and 2020 (SLR MMO database).

Figure 39: The Bryde's whale *Balaenoptera brydei* (left) and the Minke whale *Balaenoptera bonaerensis* (right) (Photos: www.dailymail.co.uk; www.marinebio.org).

Table 13: Cetaceans occurrence off the West Coast of South Africa, their seasonality, likely encounter frequency with proposed exploration activities and South African (Child *et al*. 2016) 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	Least Concern
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	Yes	Year round	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	Edge	Yes	Year round	Least Concern	Least Concern
Rough-toothed dolphin	*Steno bredanensis*	HF	No	Yes	Year round	Not Assessed	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	No	Yes	Year round	Least Concern	Least Concern
Risso's dolphin	*Grampus griseus*	HF	Yes (edge)	Yes	Year round	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	Yes	Year round	Data Deficient	Data Deficient
Sperm whale	*Physeter macrocephalus*	HF	Edge	Yes	Year round	Vulnerable	Vulnerable
Beaked whales							
Cuvier's	*Ziphius cavirostris*	HF	No	Yes	Year round	Data Deficient	Least Concern
Arnoux's	*Beradius arnouxii*	HF	No	Yes	Year round	Data Deficient	Data Deficient
Southern bottlenose	*Hyperoodon planifrons*	HF	No	Yes	Year round	Least Concern	Least Concern
Layard's	*Mesoplodon layardii*	HF	No	Yes	Year round	Data Deficient	Data Deficient
True's	*Mesoplodon mirus*	HF	No	Yes	Year round	Data Deficient	Data Deficient
Gray's	*Mesoplodon grayi*	HF	No	Yes	Year round	Data Deficient	Data Deficient
Blainville's	*Mesoplodon densirostris*	HF	No	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*	LF	Yes	Yes	MJ & ASO	Endangered	Endangered

Common Name	Species	Hearing Frequency	Shelf (<200 m)	Offshore (>200 m)	Seasonality	RSA Regional Assessment	IUCN Global Assessment
Bryde's (inshore)	*B brydei (subspp)*	LF	Yes	Edge	Year round	Vulnerable	Least Concern
Bryde's (offshore)	*B. brydei*	LF	Edge	Yes	Summer (JFM)	Data Deficient	Least Concern
Pygmy right	*Caperea marginata*	LF	Yes	?	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, ONDJFMA	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 (Best 2007 and other sources) and data from stranding events (NDP unpubl data).

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

Values of high (H), Medium (M) and Low (L) are relative within each row (species) and not comparable between species. For abundance / likely encounter rate within the broader project area, see Table 9.

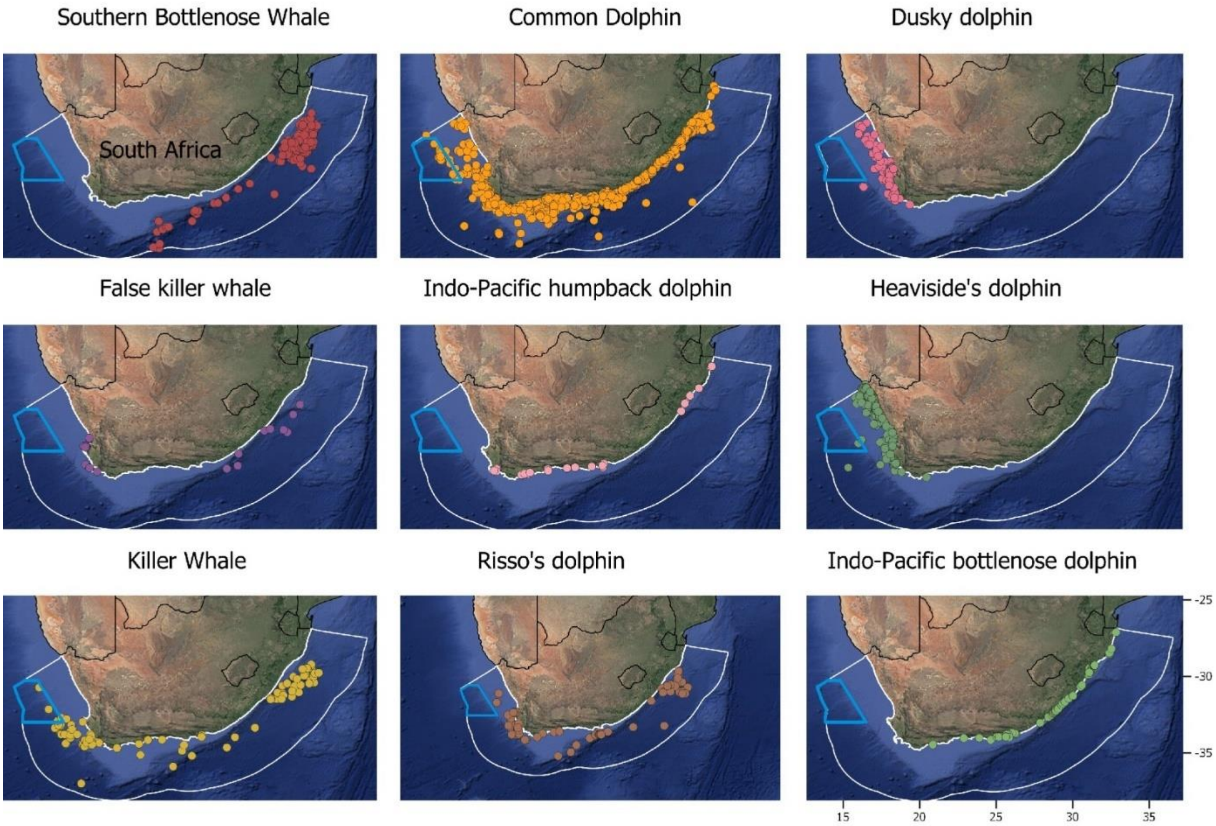


Figure 40: The Reconnaissance Permit area (cyan polygon) in relation to projections of predicted distributions for nine odontocete species off the West Coast of South Africa (adapted from: Purdon *et al*. 2020a).

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 (Best 2007). Some juvenile animals may feed year round in deeper waters off the shelf (Best 2007). Aggregations of up to eight animals have been seen on multiple occasions on the coast either side of Lüderitz in Apr-May of 2014 and January 2015 (Sea Search unpubl. Data), the occasional single whale has been reported during humpback whale research in November in the southern Benguela, and a feeding aggregation of ~30 animals was observed in November 2019 ~200 km west of St Helena Bay in ~2 000 m of water (see above). Current sightings records support the bimodal peak in presence observed from whaling data (but with some chance of year-round sightings) with animals apparently feeding in the nutrient rich Benguela during their southward migration as is observed extensively for humpback and right whales (see below) there clearly is a chance of encounters year round. There are no recent data on abundance or distribution of fin whales off western South Africa.

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 (Best 2007). Although there were only two confirmed sightings of the species in the area between 1973 and 2006 (Branch *et al.* 2007), evidence of blue whale presence off Namibia is increasing. Recent acoustic detections of blue whales in the Antarctic peak between December and January (Tomisch *et al.* 2016), off western South Africa (Shanbangu *et al.* 2019) and in northern Namibia between May and July (Thomisch 2017) supporting observed timing from whaling records. Several recent (2014-2015) sightings of blue whales during seismic surveys off the southern part of Namibia (water depth >1 000 m) confirm their existence in the area and occurrence in Autumn months. The chance of encountering the species in the Application Area is considered low but the species is 'Critically Endangered' so all precautions must be taken to avoid impact.

Minke whales: Two forms of minke whale (Figure 39, 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 (Best 2007). 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 (Thomisch *et al.* 2016), 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, although sightings have been reported (SLR data).

The **pygmy right whale** is the smallest of the baleen whales reaching only 6 m total length as an adult (Best 2007). 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 (Leeney *et al.* 2013). Its distribution off the west coast of South Africa is thus likely to be limited to the cooler shelf waters of the main Benguela upwelling areas.

The most abundant baleen whales in the Benguela are southern right whales and humpback whales (Figure 41a & b). Both species have long been known to feed in the Benguela Ecosystem and numbers since 2000 have grown substantially. The feeding peak in the Benguela is spring and early summer (October – February) and follows the 'traditional' South African breeding season (June – November) and its' associated migrations (Johnson *et al.* 2022). Some individual right whales are known to move directly from the south coast breeding area into the west coast feeding area where they remained for several months (Barendse *et al.* 2011; Mate *et al.* 2011). 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 (NDP unpubl. data).

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 (Rosenbaum *et al.* 2009; Barendse *et al.* 2010). Until recently it was believed that that these breeding grounds were functionally separate from those off east (Mozambique-Kenya-Madagascar), with only rare movements between them (Pomilla & Rosenbaum 2005) and movements to other continental breeding grounds being even more rare. Recent satellite tagging of animals between Plettenberg Bay and Port Alfred during the northward migration, showed them to turn around and end up feeding in the Southern Benguela (Seakamela *et al*. 2015) before heading offshore and southwards using the same route as whales tracked off Gabon and the West Coast of South Africa. Unexpected results such as this highlight the complexities of understanding whale movements and distribution patterns and the fact that descriptions of broad season peaks in no way captures the wide array of behaviours exhibited by these animals. Furthermore, three separate matches have been made between individuals off South Africa and Brazil by citizen scientist photo-identification (www.happywhale.com). This included whales from the Cape Town and Algoa Bay-Transkei areas. Analysis of humpback whale breeding song on Sub-Antarctic feeding grounds also suggests exchange of singing male whales from western and eastern South Atlantic populations (Darling & Sousa-Lima 2005; Schall *et al*. 2021; but see also Darling *et al*. 2019; Tyarks *et al*. 2021).

Figure 41: 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 (Photos: www.divephotoguide.com; www.aad.gov.au).

In southern African coastal waters, the northward migration stream is larger than the southward peak (Best & Allison 2010; Elwen *et al.* 2014), 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. 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 (Elwen *et al.* 2014; Rosenbaum *et al.* 2014). 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 (Barendse *et al.* 2010; Best & Allison 2010; Elwen *et al.* 2014). The only available abundance estimate put the number of animals in the West African breeding population (Gabon) to be in excess of 9 000 individuals in 2005 (IWC 2012) and it is likely to have increased substantially since this time at about 5% per annum (IWC 2012; see also Wilkinson 2021). The number of humpback whales feeding in the southern Benguela has increased substantially since estimates made in the early 2000s (Barendse *et al.* 2011). Since ~2011, 'supergroups' of up to 200 individual whales have been observed feeding within 10 km from shore (Findlay *et al.* 2017) with many hundred more passing through and whales are now seen in all months of the year around Cape Town. It has been suggested that the formation of these super-groups may be in response to anomalous oceanographic conditions in the Southern Benguela, which result in favourable food availability, thereby leading to these unique humpback whale feeding aggregations (Dey *et al.* 2021; see also Avila *et al.* 2019; Meynecke *et al.* 2020; Cade *et al.* 2021). Humpback whales are thus likely to be the most frequently encountered baleen whale in the project area (see Figure 29b), ranging from the coast out beyond the shelf, with year round presence but numbers peaking during the northward migration in June – 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.

In the first half of 2017 (when numbers are expected to be at their lowest) more than 10 humpback whales were reported stranded along the Namibian and South African west coasts. A similar event was recorded in late 2021-early 2022 when numerous strandings of young humpbacks were reported along the Western Cape Coast and in Namibia (Simon Elwen, Sea Search, pers. comm.). The cause of these deaths is not known, but a similar event off Brazil in 2010 (Siciliano *et al.* 2013) was linked to possible infectious disease or malnutrition. Unusual mortality events of humpback whales between 2016 and 2022 have similarly been reported along the US Atlantic Coast from Maine to Florida (https://www.fisheries.noaa.gov/national/marine-life-distress/2016-2022-humpback-whale-unusual-mortality-event-along-atlantic-coast). The West African population may be undergoing similar stresses in response to changes in their ecosystem (see for example Kershaw *et al.* 2021). It is not yet understood what may be driving these ecosystem changes and what the long-term effects to populations could potentially be.

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, 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 42).

Figure 42: 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).

8.4.3.6.2 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 (see Figure 40). Those in the region can range in size from 1.6-m long (Heaviside's dolphin) to 17 m (bull sperm whale).

Sperm whales: Most information about sperm whales in the southern African sub-region results from data collected during commercial whaling activities prior to 1985 when over 10 000 whales were taken, although passive acoustic monitoring (Shabangu & Andrew 2020) and sightings from MMOs are beginning to provide insights into current behaviour. 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 (Best 2007) (Figure 43, left). They are considered to be relatively abundant globally (Whitehead 2002), 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 (Best 2007). Analysis of recent passive acoustic monitoring data from the edge of the continental shelf (800 - 1 000 m water depth, roughly 80 km WSW of Cape Point) confirms year-round presence. Sperm whales have also been regularly identified by MMOs working in this area (SLR data). 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 43: Sperm whales *Physeter macrocephalus* (left) and killer whales *Orcinus orca* (right) are toothed whales likely to be encountered in offshore waters (Photos: www.onpoint.wbur.org; www.wikipedia.org).

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 occur worldwide in pelagic and shelf edge waters, with with few sighting records of live animals in their natural habitat (McAlpine 2018). Their abundance, population trends and seasonality in South African waters are unknown (Seakamela *et al*. 2021). 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, although their narrow-band high frequency echolocation clicks make them detectable and identifiable (at leas to the genus) using passive acoustic monitoring equipment. The majority of what is known about the distribution and ecology of Kogiid whales in the southern African subregion is derived mainly from stranding records (e.g. Ross 1979; Findlay *et al.* 1992; Plön 2004; Elwen *et al.* 2013, but see also Moura *et al*. 2016). *Kogia* species are most frequently occur in pelagic and shelf edge waters, are thus likely to occur in the Application 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 (Best 2007) 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 (*K. sima*) 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 (Seakamela *et al*. 2020, 2021). The cause of the strandings is unknown.

Killer whales: Killer whales 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 (Best *et al.* 2014). Killer whales (Figure 43) have a circum-global distribution being found in all oceans from the equator to the ice edge (Best 2007). Killer whales occur year-round in low densities off South Africa (Best *et al.* 2010, Elwen *et al.* in prep.), Namibia (Elwen & Leeney 2011) and in the Eastern Tropical Atlantic (Weir *et al.* 2010). 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 (Best *et al.* 2010; Sea Search unpublished data). 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 (Best 2007). 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 (Findlay *et al.* 1992). They usually occur in groups ranging in size from 1 - 100 animals (Best 2007). 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 (Best 2007).

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) (Mate *et al.* 2005; Findlay *et al.* 1992; Weir 2011; Seakamela *et al*. 2022). They are regularly seen associated with the shelf edge by 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 (Best 2007), it is likely that the majority of pilot whales encountered in the project area will be long-finned. There are many confirmed sightings of pilot whales along the shelf edge of South Africa and Namibia including within the Application Area since 2010 (de Rock *et al.* 2019; Sea Search unpublished data, SLR data). Observed group sizes range from 8-100 individuals (Seakamela *et al*. 2022). 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 (Seakamela *et al*. 2022).

Common dolphin: Two forms of common dolphins occur around southern Africa, a long-beaked and short-beaked form (Findlay *et al*. 1992; Best 2007), although they are currently considered part of a single global species (Cunha *et al*. 2015). 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 (Best 2007), 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 44, right) 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 (Findlay *et al*. 1992). A recent abundance estimate from southern Namibia calculated roughly ~3 500 dolphins in the ~400 km long Namibian Islands Marine Protected area (Martin *et al*. 2020), at a density of 0.16 dolphins/km^2 and similar density is expected to occur off the South African coast where they are regularly encountered in near shore waters between Cape Town and Lamberts Bay (Elwen *et al*. 2010; NDP unpubl. data) with group sizes of up to 800 having been reported. Dusky dolphins are resident year round in the Benguela.

Heaviside's dolphins: Heaviside's dolphins (Figure 44, left) 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 Lambert's Bay (Elwen *et al*. 2009) and ~1 600 in the ~400 km long Namibian Islands Marine Protected Area (Martin *et al*. 2020). This species occupies waters from the coast to at least 200 m depth, and may show a diurnal onshore-offshore movement pattern (Elwen *et al*. 2010a, 2010b), as they feed offshore at night. Heaviside's dolphins are resident year round but will only occur well inshore of the Reconnaissance Permit Area.

Figure 44: The dusky dolphin *Lagenorhynchus obscurus* (left) and endemic Heaviside's Dolphin *Cephalorhynchus heavisidii* (right) (Photos: Simon Elwen, Sea Search Research and Conservation).

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 (Ross 1984; Ross *et al.* 1987). 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 (Best 2007) 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 Reconnaissance Permit 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 (Best 2007; Purdon *et al.* 2020a, 2020b). 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 Reconnaissance Permit Area is possible (see Figure 36).

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 (see various species accounts in Best 2007). 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 (Tyack *et al.* 2011). 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 (MacLeod & D'Amico 2006; Best 2007). 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 (Cox *et al.* 2006; MacLeod & D'Amico 2006) and a seismic survey for hydrocarbons also running a multi-beam echo-sounder and sub bottom profiler (Southall *et al.* 2008; Cox *et al.* 2006; DeRuiter *et al.* 2013). 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 (Tyack *et al.* 2011), 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. 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.

8.4.3.6.3 SEALS

The Cape fur seal (*Arctocephalus pusillus pusillus*) (Figure 45) 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 (see Figure 89). The South African population, which includes the West Coast colonies, was estimated at ca. 725 000 individuals in 2020. This is about 40% of the total southern African population, which has previously been estimated at up to 2 million (Seakamela *et al*. 2022). 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)* (David 1989).

Figure 45: Colony of Cape fur seals *Arctocephalus pusillus pusillus* (Photo: Dirk Heinrich).

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 (Wickens 1994). The colony at Buchu Twins and Cliff Point, formerly non-breeding colonies, have also attained breeding status (M. Meyer, SFRI, pers. comm.). Non-breeding colonies and haul-out sites occur 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 Reconnaissance Permit Area.

Seals are highly mobile animals with a general foraging area covering the continental shelf up to 120 nautical miles offshore (Shaughnessy 1979), 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. Benthic feeding to depths of nearly 200 m for periods of up to 2 minutes has, however, also been recorded (Kirkman *et al*. 2015). Seals are unlikely to be encountered in the offshore waters of the Reconnaissance Permit Area (Figure 46).

The timing of the annual breeding cycle is very regular, occurring between November and January. Breeding success is highly dependent on the local abundance of food, territorial bulls and lactating females being most vulnerable to local fluctuations as they feed in the vicinity of the colonies prior to and after the pupping season (Oosthuizen 1991).

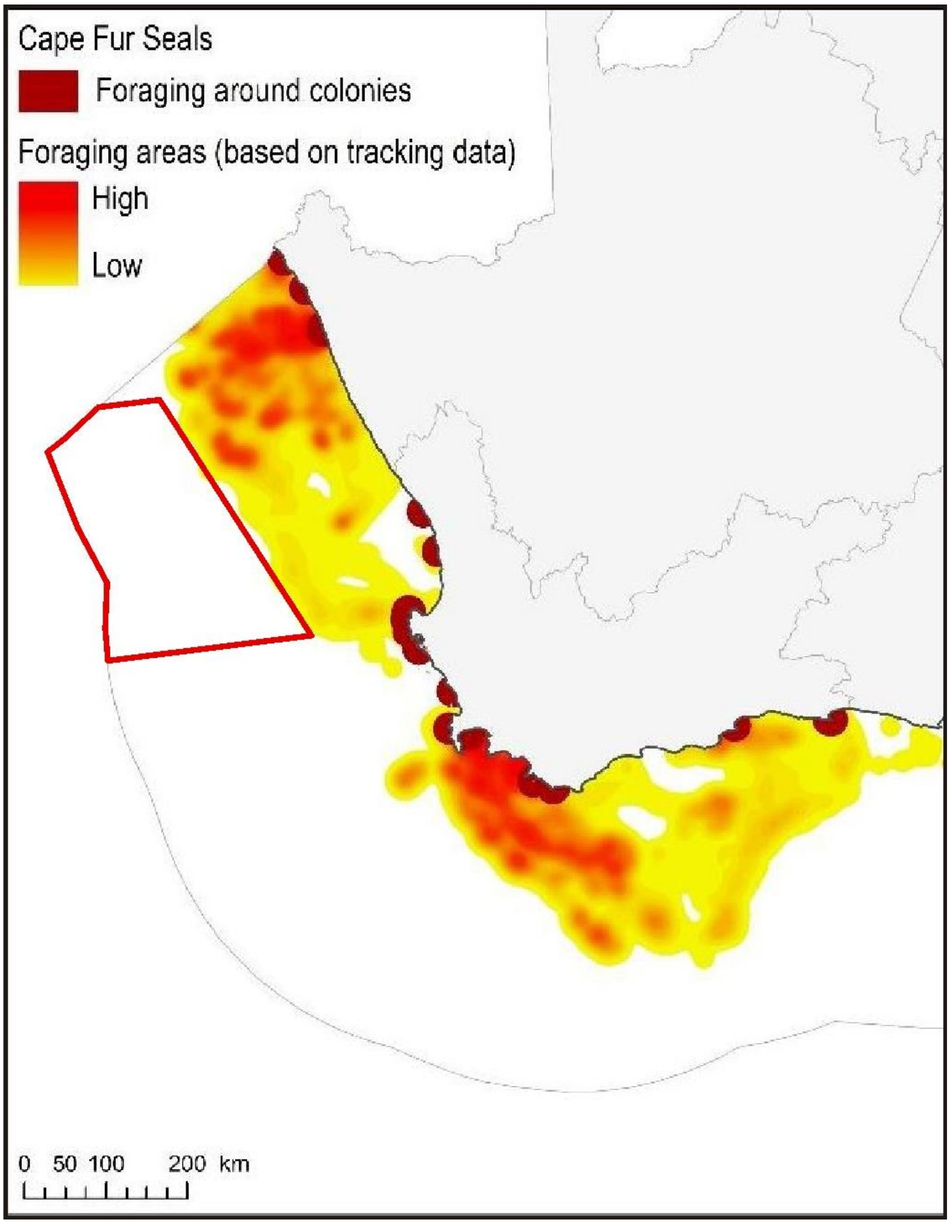


Figure 46: Reconnaissance Permit Area (red polygon) in relation to seal foraging areas on the West and South Coasts. Brown areas are generalised foraging areas around colonies, and areas in shades of red are foraging areas based on tracking data. Darker shades of red indicate areas of higher use.

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 Department of Fisheries, Forestry and Environment (DFFE) (e.g. Kirkman *et al*. 2013). 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 (Kirkman *et al*. 2013).

An unprecedented mortality event was recorded in South Africa between September and December 2021 at colonies around the West Coast Peninsula and north to Lambert's Bay and Elands Bay. Primarily pups and juveniles were affected. Post-mortem investigations revealed that seals died in a poor condition with reduced blubber reserves, and protein energy malnutrition was detected for aborted foetuses, for juveniles and subadults. Although no unusual environmental conditions were identified that may have triggered the die-off, or caused it indirectly (e.g. HABs), 2021 was a year of below average recruitment of anchovy and sardine, the main food source for seals. While a lack of food, as a result of possibly climate change and/or overfishing, has been predicted to be the cause of this mass mortality, the underlying causes of the mortality event remain uncertain (Seakamela *et al*. 2022).

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 3.

8.5.1 OVERVIEW OF FISHERIES SECTORS

South Africa has a coastline that spans two ecosystems over a distance of 3623 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, 1998 (No. 18 of 1998) (MLRA).

Approximately 22 different fisheries sectors currently operate within South African waters. Table 15 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 47. 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 stewarti*), 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, Doringbaai, 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 (DAFF, 2016). Small-scale fisheries operate in the nearshore environment. 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.

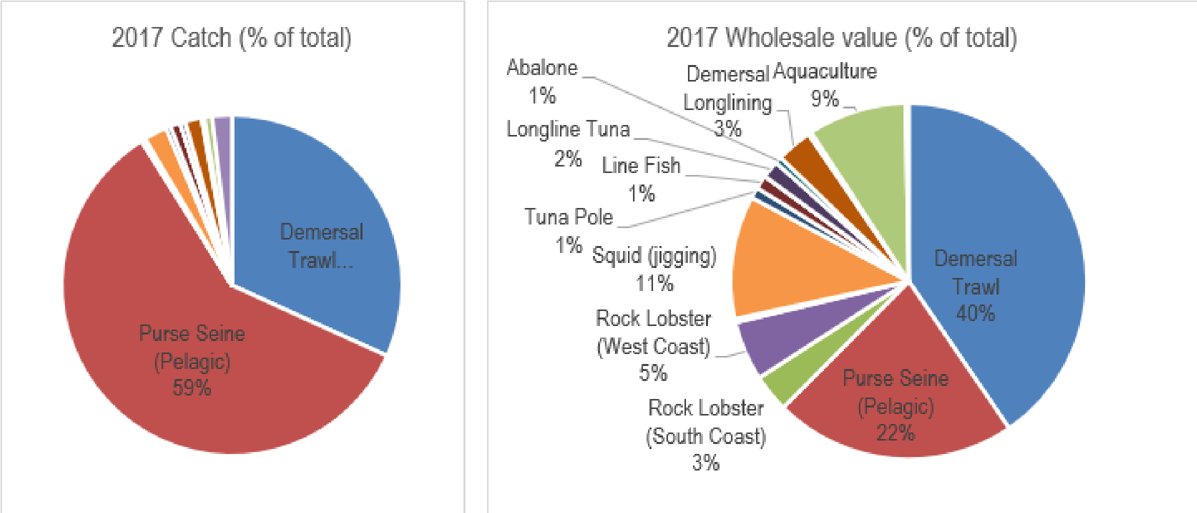


Figure 47: Pie chart showing percentage of landings by weight (left) and wholesale value (right) of each commercial fishery sector as a contribution to the total landings and value for all commercial fisheries sectors combined (2017). Source: DEFF, 2019.

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
Midwater trawl	34 (6)	19 555			
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
Linefish	422 (450)	4931	4931	122096	1.2
Longline shark demersal	4	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
Seaweeds	14 (N/a)	9877	6874	27095	0.3

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

Table16: South African offshore commercial fishing sectors, landings, number of rights holders, wholesale catch value and target species (DEFF, 2019).

Sector	Areas of Operation	Main Ports	Target Species
Small pelagic purse-seine	West Coast 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 Coast 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 Coast South Coast	Cape Town, Port Elizabeth	Adult horse mackerel (*Trachurus capensis*)
Demersal longline	West Coast South Coast	Cape Town, Saldanha, Mossel Bay, Port Elizabeth, Gansbaai	Shallow-water hake (*Merluccius capensis*)
Large pelagic longline	West Coast South Coast 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-line	West Coast South Coast	Cape Town, Saldanha	Albacore tuna (*T. alalunga*), yellowfin tuna
Linefish	West Coast South Coast 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*

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

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 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 (Hutchings *et al*., 2002).

Hake, sardines, anchovy and horse mackerel are mostly serial, broadcast spawners, producing large numbers of eggs sporadically that are widely dispersed in ocean currents (Hutchings *et al*., 2002). The principal commercial fish species undergo a critical migration pattern in the Agulhas and Benguela ecosystems. Adults spawn on the Agulhas Bank between the shelf-edge upwelling and the cold-water ridge, where copepod availability is highest (Crawford 1980; Hutchings 1994; Roel & Armstrong 1991; Hutchings *et al*. 2002). The spawn products are thought to move southwards from the central Agulhas Bank and then may drift northwards in the Benguela current across the shelf and up the west coast, or inshore and eastwards towards the south coast. 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, from October to March. In the southern Benguela system, juveniles shoal and then begin a southward migration down the west coast – it is at this stage that anchovy and sardine are targeted by the small pelagic purse seine fishery. Juveniles of demersal species such as hake are thought to move from a pelagic phase and to systematically migrate to the seafloor (a vertical migration) and then as they mature and grow in size, move offshore into deeper water where they are targeted by commercial fisheries (in hake this occurs in their third year of growth and is referred to as “recruiting” to the fishery).

Spawning of key species exploited by commercial fishery sectors off the West Coast are presented below (Hutchings *et al*. 2002):

- 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 (Johann Augustyn, SADSTIA and Dave Japp, CapMarine pers com.). 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 known to spawn on the western, central and eastern Agulhas Bank, from October to March with spawning peaking during October to January (van der Lingen and Huggett, 2003) and some shifts to the west coast in years when Agulhas Bank water intrudes strongly north of Cape Point (van der Lingen *et al*., 2001 in Hutchings *et al*., 2002).
- Genomic and transcriptomic analyses have shown that there are two stocks of sardine off South Africa; the Cool Temperate Sardine (CTS) off the west coast and Warm Temperate Sardine (WTS) off the south coast, with some mixing (in both directions) between the two (Teske *et al*. 2021). Sardines spawn on the western, central and eastern Agulhas Bank, and also off the west coast north of Cape Point. Sardine eggs are found throughout the year, but spawning occurs from August to February (spring-summer) for the CTS off the west coast, and from June to November (winter-spring) for WTS off the south coast. There is an intense seasonal movement of sardine eastwards (the "sardine run") that occurs in mid-winter and which is associated with westerly frontal systems driving fish inshore in counter currents. And whilst sardine eggs are found off the east coast from June to December (see Connell 2010 AJMS 32(2)), the KwaZulu-Natal sardine run is not the spawning migration of a third stock but a navigation error by CTS.
- 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 (Augustyn *et al*. 1994; Schön *et al*. 2002). 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 (Roberts 2005; Oosthuizen & Roberts 2009). The greatest concentration of their food (copepods) tends to be found further west in the cold-water ridge on the central Agulhas Bank (Roberts & van den Berg 2002). 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 (Olyott *et al*. 2007).
- Snoek spawning occurs offshore during winter-spring (June to October), 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 (Griffiths, 2002; refer to Figure 48).
- The inshore area of the Agulhas Bank, especially between the cool water ridge and the shore, serves as an important nursery area for numerous linefish species (e.g. elf *Pomatomus saltatrix*, leervis *Lichia amia*, geelbek *Atractoscion aequidens*, carpenter *Argyrozona argyrozona*) (Wallace *et al*. 1984; Smale *et al*. 1994). 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 (van der Elst 1976, 1981; Griffiths 1987; Garratt 1988; Beckley & van Ballegooyen 1992). 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 (van der Elst 1976, 1981; Garratt 1988). In the case of the carpenter, a high proportion of the reproductive output comes from the central Agulhas Bank and the Tsitsikamma Marine Protected Area (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 (van der Lingen *et al*. 2006).

Table 17 shows known spawning periods of key commercial species off the West Coast of South Africa.

Table 17: Table showing known spawning periods of key commercial species off the West Coast of South Africa.

Sector	**Spawning Intensity by Month (peak spawning = orange)**											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Cape hakes	Yellow	Yellow	Orange	Orange	Yellow	Yellow	Yellow	Yellow	Yellow	Orange	Orange	Yellow
Anchovy	Orange	Yellow	Yellow							Orange	Orange	Orange
Sardine	Yellow	Yellow						Yellow	Yellow	Yellow	Yellow	Yellow
Snoek						Yellow	Yellow	Yellow	Yellow	Yellow		

Refer to Figure 48 and Figure 49 for an overview of the main fish spawning grounds and nursery areas off the West and South Coasts of South Africa. Figure 50 shows the distribution of egg density of sardine and anchovy, and Figure 51 shows spawning ground and nursery areas of snoek and anchovy. Figure 48 shows the West Coast nursery area and the western/central Agulhas Bank spawning grounds. Light stippled area on the West Coast marks the main recruiting area for the small pelagic fishery and dark stippled area on the Agulhas Bank marks the main spawning grounds for small pelagic fish.

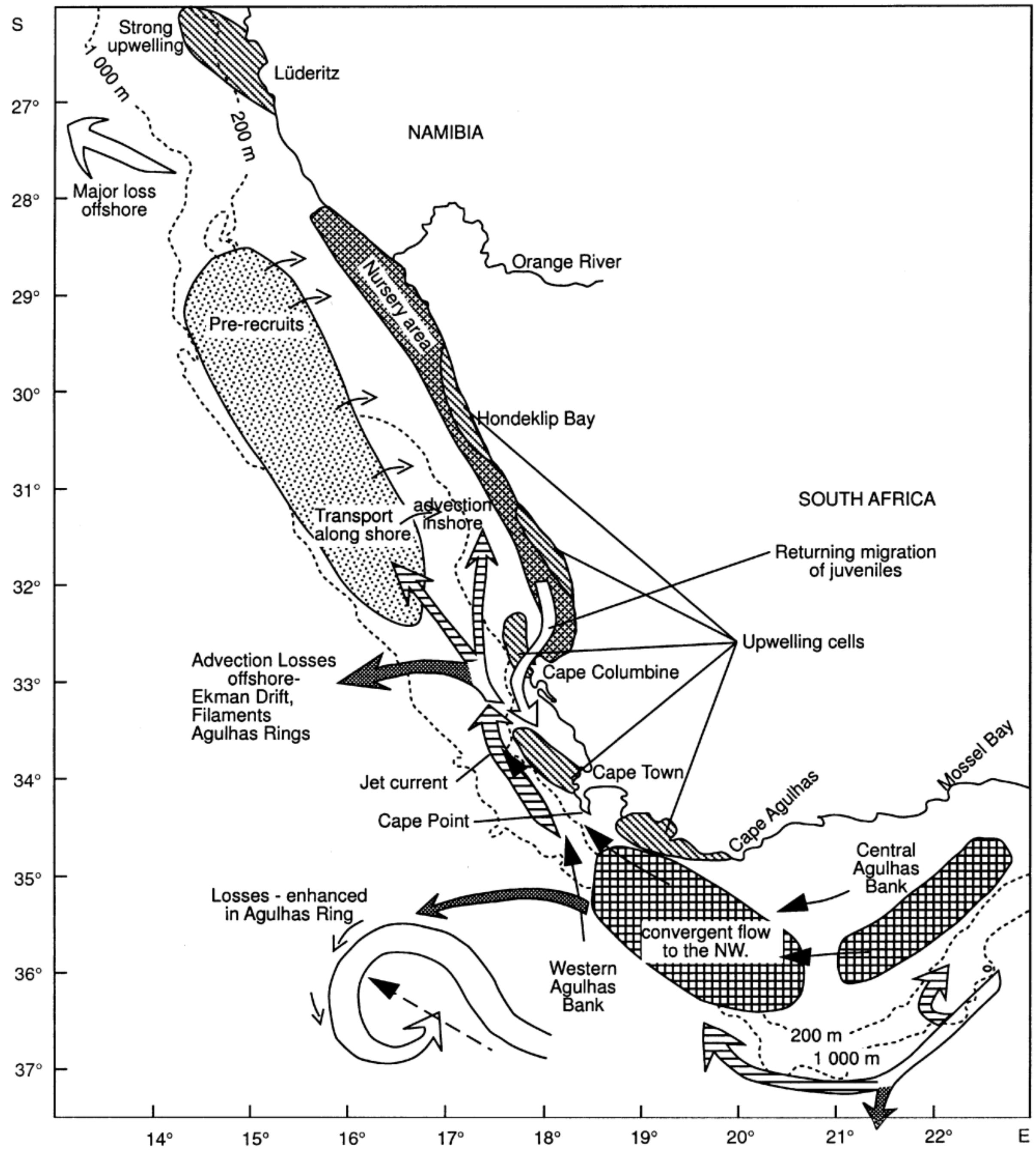


Figure 48: Generalised figure of the main fish recruiting process for species caught on the West Coast of South Africa (after Hutchings *et al*., 2002).

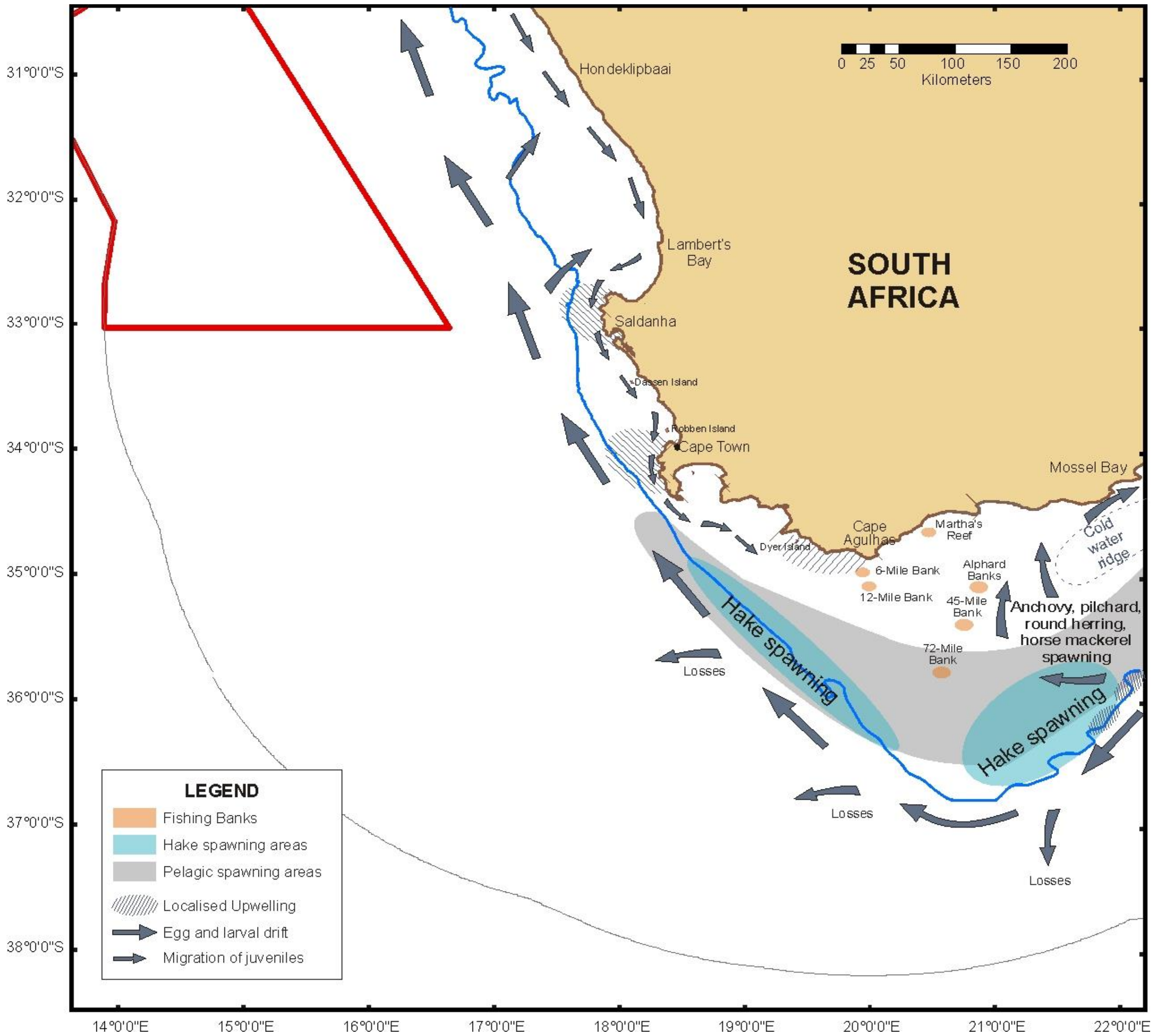


Figure 49: The Reconnaissance Permit area in relation to major spawning, recruitment and nursery areas in the southern Benguela region (adapted from Crawford *et al*. 1987, Hutchings 1994, and Hutchings *et al*., 2002, in Pisces 2022).

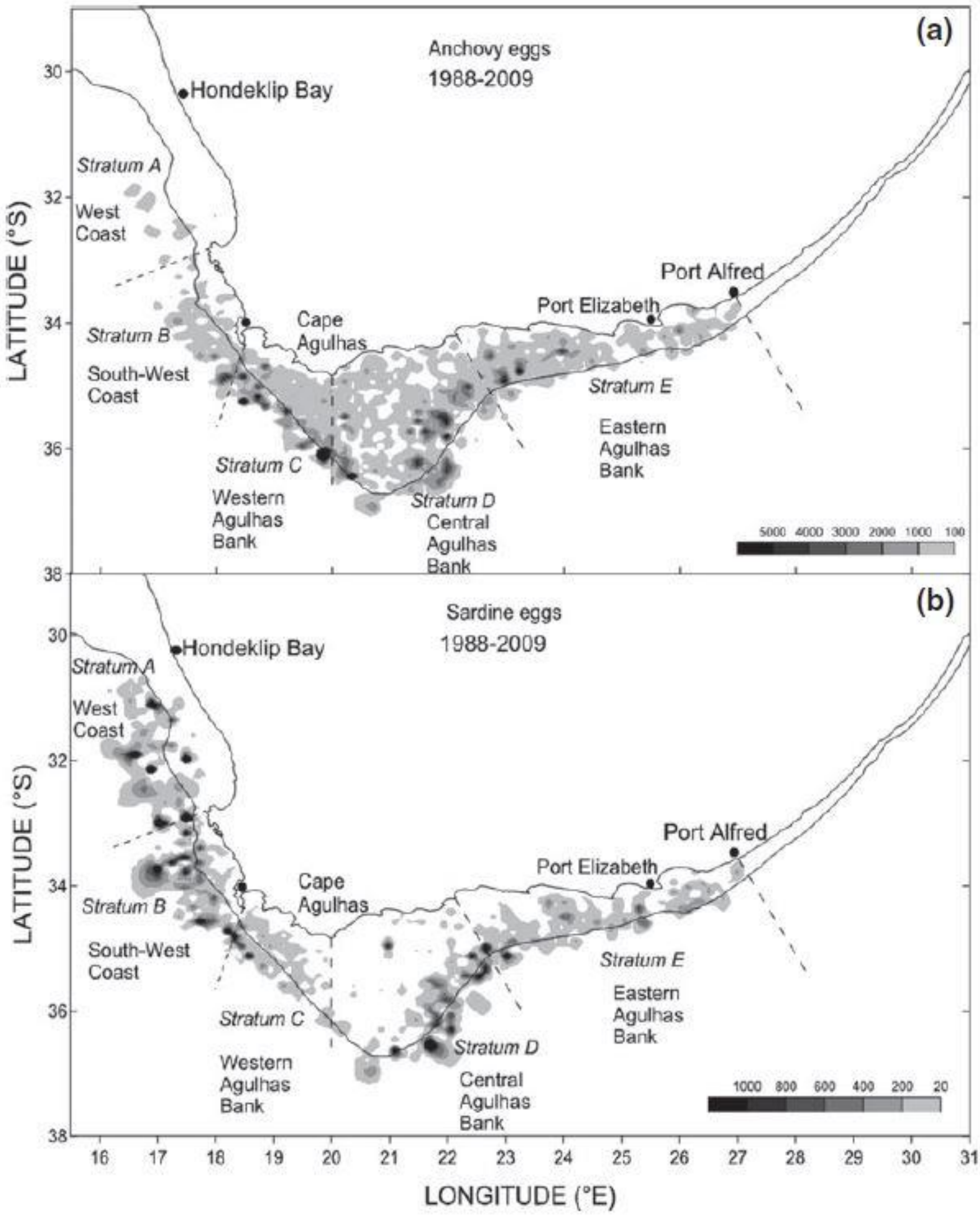


Figure 50: Composite distribution maps for eggs (eggs.m-2) of (a) anchovy and (b) sardine collected during spawner biomass surveys by DFFE over the period 1988-2009 (Mhlongo *et al*., 2015).

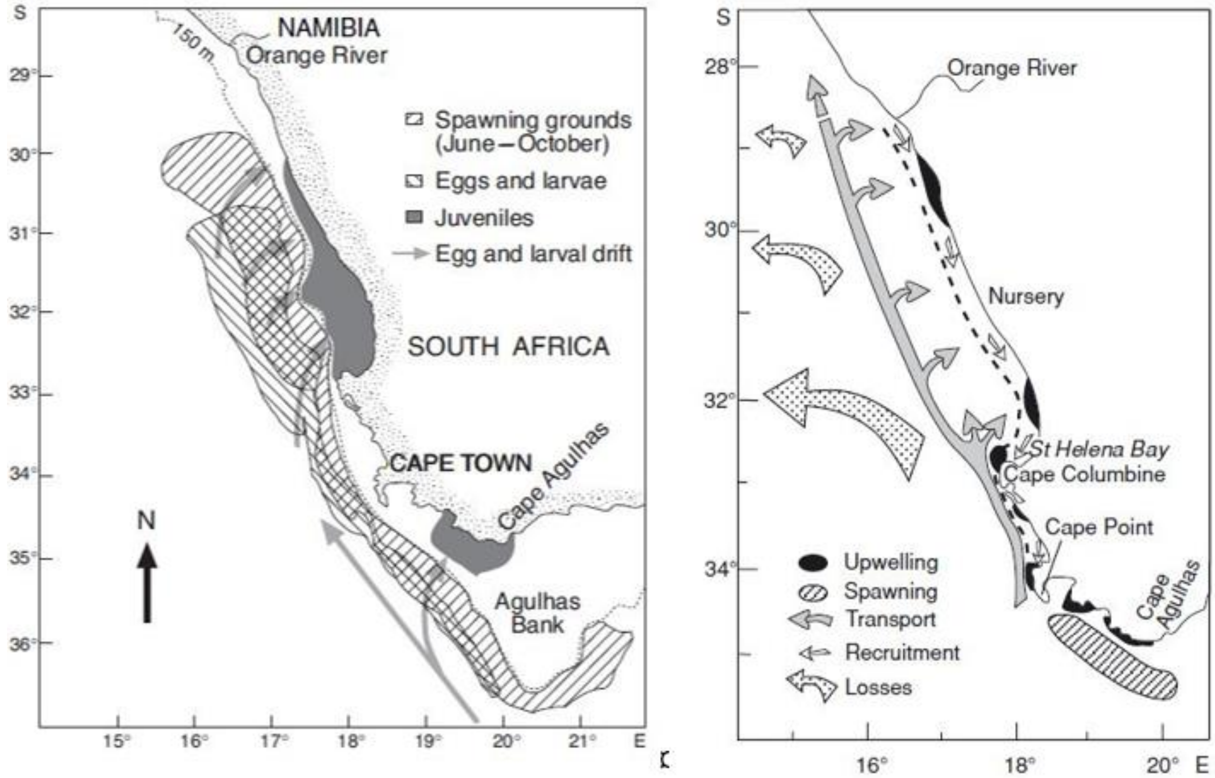


Figure 51: Conceptual model depicting the life history of snoek (left; Source: Griffiths, 2002) and anchovy (right; Hutchings *et al*., 1992) in the southern Benguela ecosystem, including spawning grounds, distribution and transport of eggs and larvae, and the nursery areas.

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 longline 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 (deep-sea) 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 2022 total allowable catch (TAC) for hake is set at 132 154 tons, of which 84% and 6% is allocated to the offshore and inshore trawl sectors, respectively (The remaining 10% is allocated to the hake demersal longline sector – refer to Section 8.5.3.3).

The annual TAC limits and landings of hake (both species) by the trawl and longline sectors is listed in Table 18. A time-series of total hake catch as well as hake catch by sector is shown in Figure 52.

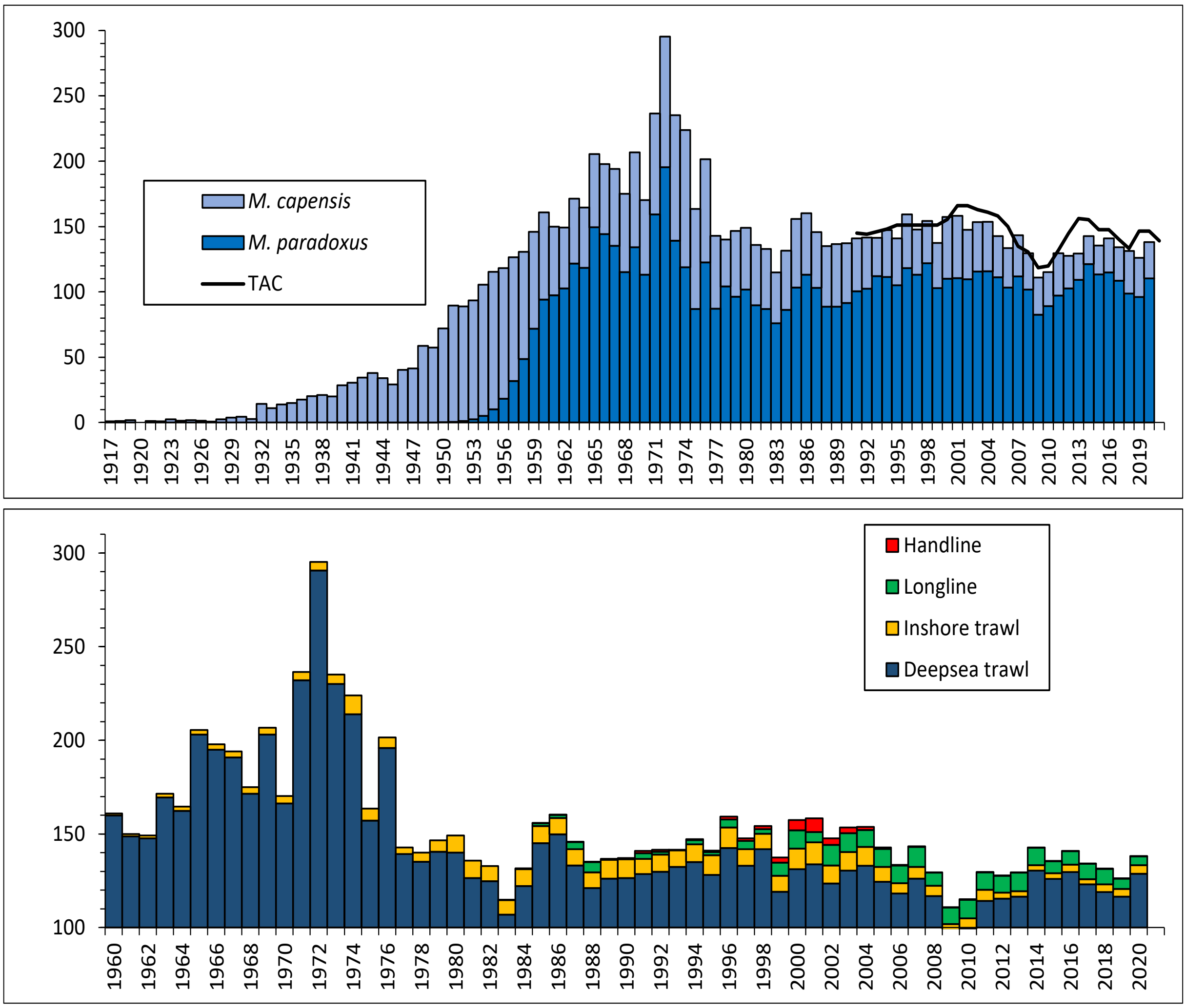


Figure 52: (top) Total catches ('000 tonnes) of Cape hakes split by species over the period 1917–2020 and the TAC set each year since the 1991. (bottom) Catches of Cape hakes per fishing sector for the period 1960–2020. Prior to 1960, all catches are attributed to the deep-sea trawl sector. Note that the vertical axis commences at 100 000 tonnes to better clarify the contributions by each sector. (Source DEFF, 2022)

Table 18: Annual total allowable catch (TAC) limits and catches (tons) of the two species of hake by the hake-directed fisheries on the West (WC) and South (SC) coasts (Adapted from DEFF, 2020[3]).

		M. paradoxus					*M. capensis*						TOTAL (both species)
Year	TAC	Offshore		Longline		TOTAL	Offshore		Inshore	Longline		TOTAL	
		WC	SC	WC	SC		WC	SC	SC	WC	SC		
2010	119831	69709	15457	2394	1527	89087	10186	4055	5472	3086	3024	26098	115185
2011	131780	76576	17904	2522	140	97142	15673	4086	6013	3521	3047	35525	129667
2012	144671	81411	16542	4358	306	102616	12928	4584	3223	2570	1737	25050	127666
2013	156075	74341	28859	6056	60	109316	8761	4475	2920	2606	1308	20071	129387
2014	155280	73252	41156	6879	8	121295	9671	6286	2965	2123	315	21361	142656

[3] FISHERIES/2021/OCT/SWG-DEM/21rev

		M. paradoxus					*M. capensis*						TOTAL (both species)
Year	TAC	Offshore		Longline		TOTAL	Offshore		Inshore	Longline		TOTAL	
		WC	SC	WC	SC		WC	SC	SC	WC	SC		
2015	147500	77521	31745	4001	18	113286	12727	4085	3077	2325	53	22217	135503
2016	147500	93173	18968	2806	1	114948	14744	2810	3973	4360	2	25889	140837
2017	140125	72326	30961	5288	25	108600	15273	4466	2812	2807	126	25488	134088
2018	133119	64252	29218	5156	89	98715	12689	12863	3983	2615	481	32655	131370
2019	146431	70608	22201	3177	20		14193	9454	4149	2160	179		
2020	146400	97093	10061	3220	3		18115	3500	4536	1293	177		
2021	139109												
2022	132154												

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 approximately 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. Fishing activity occurs year-round.

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 (see Figure 53). 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.

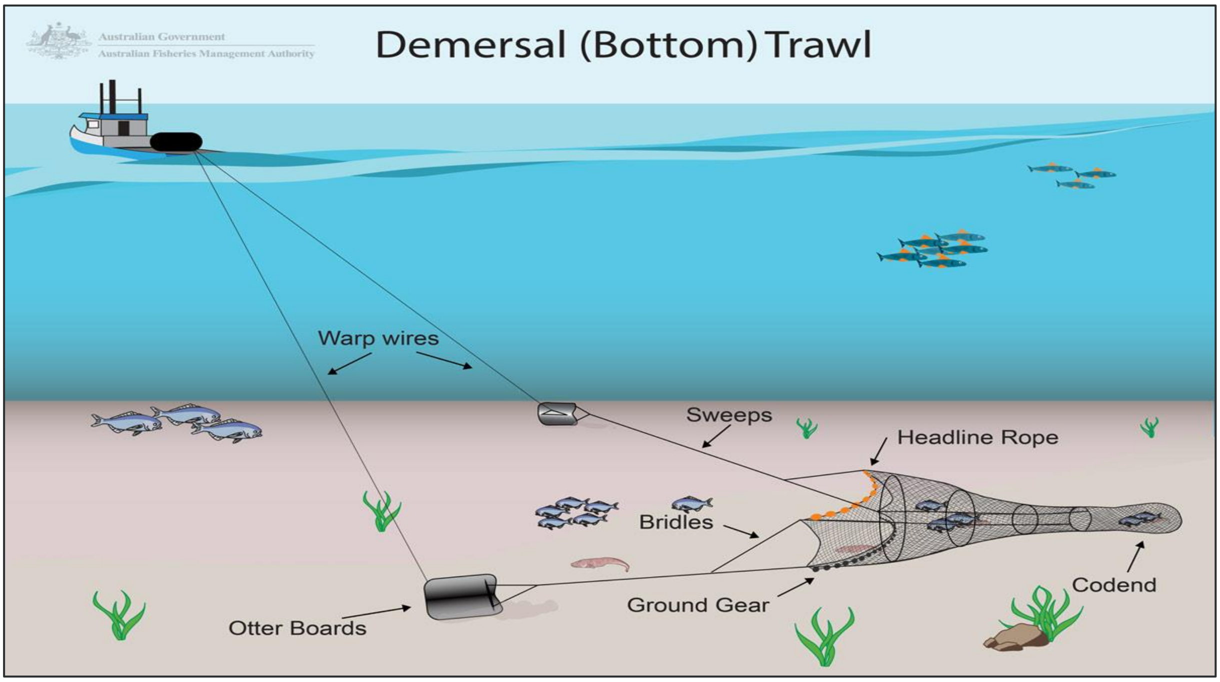


Figure 53: Typical gear configuration used by offshore demersal trawlers targeting hake (Source: www.afma.gov.au/fisheries-management/methods-and-gear/trawling).

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. Offshore trawlers operate along the west coast along the shelf break between approximately Hondeklipbaai and the southern tip of the Agulhas Bank between the 200 m and 750 m bathymetric contours, with sporadic trawls to a maximum depth of 900 m. The Reconnaissance Permit extends offshore of fishing grounds referred to as the "North Grounds" (Sink et. al, 2012). These grounds are characterised by sandy and muddy sand, with isolated patches of hard ground. The area has been trawled since the 1930's commencing on shallower grounds and with effort extending into deeper waters with the advancement of fishing technologies over time.

At it's closest point the demersal trawl footprint is situated approximately 5 km offshore of the area fished around the slopes of the submarine feature Childs Bank (referred to by the fishing industry as the "karbonkel") off Hondeklipbaai. The demersal trawl footprint is situated at least 10 km inshore of the eastern extent of the Reconnaissance Permit area towards the productive fishing grounds between Lamberts Bay and Saldanha Bay. Figure 54 shows the demersal trawling footprint and recent effort off the west coast of South Africa and in relation to the Reconnaissance Permit application area.

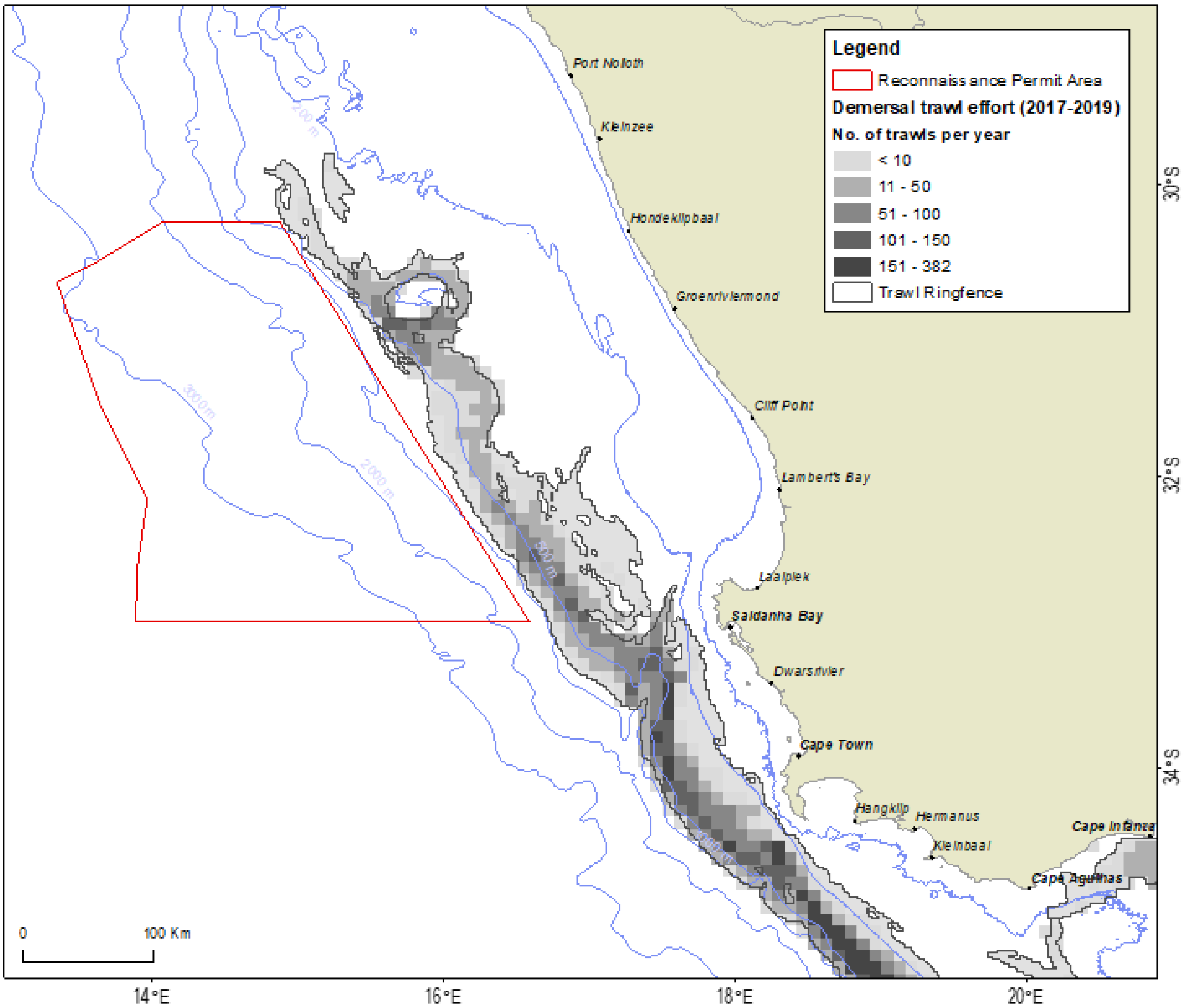


Figure 54: Overview of the trawl ringfence and the spatial distribution of fishing effort expended by the demersal trawl sector in relation the Reconnaissance Permit application area.

8.5.3.2 MIDWATER 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 (DEFF, 2020).

This sector comprises six vessels and 34 rights holders which landed a total catch of 19 555 in 2019. Refer to Figure 55 for the catches and TACs for the midwater trawl fishery between 1998 and 2018. The fleet is split between dual rights holders who fish horse mackerel on hake-directed trawlers and others that combine their allocation on a single large midwater trawl vessel (the MFV Desert Diamond). Dual rights holders fishing only occurs if horse mackerel availability is high when fishing for hake at which point that may switch from bottom trawl to midwater trawl. The amounts of horse mackerel caught by these vessels is a relatively small component of the horse mackerel TAC. Those horse mackerel rights holders that do not have hake rights or who do not have a suitable vessel to catch horse mackerel allow their share of the horse mackerel to be caught on a single large midwater trawler. This facilitates the economic use of a single large vessel that can more efficiently catch their horse mackerel allowing the vessels to fish year round. The area fished by this vessel is restricted largely (but not exclusively) to water deeper than 110 m or more than 20 nm from the coast and in an area east of Cape Point. The dual vessels may fish in a broader area, mostly on or near the hake fishing grounds.

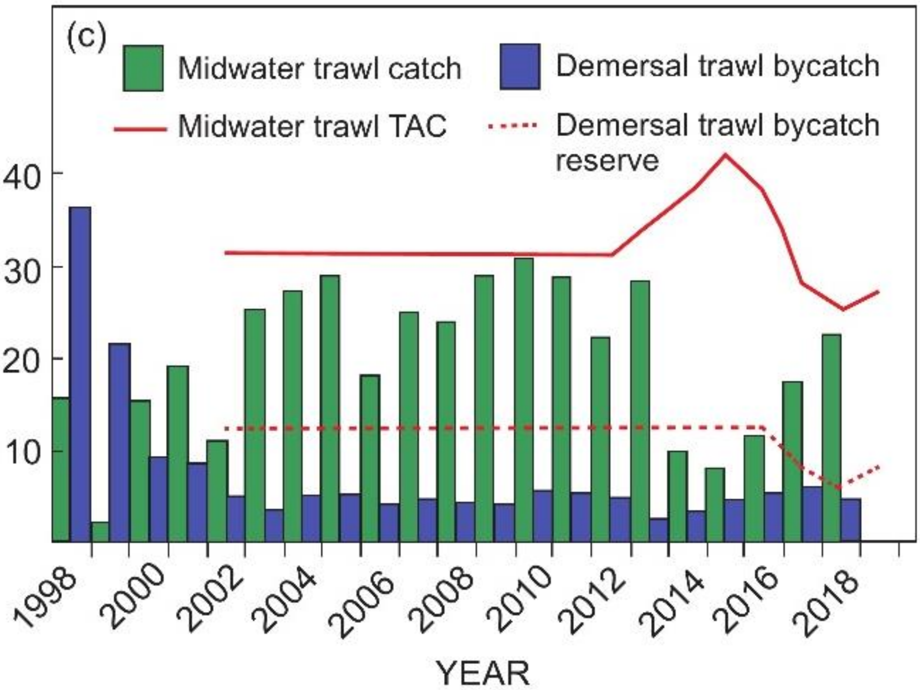


Figure 55: Trawl catches (tons, 1998 – 2018) split into the demersal and midwater trawl components. The midwater trawl TAC (solid line) and demersal trawl bycatch reserve (dashed line) are also shown (Source: DEFF, 2020).

Midwater trawl is defined in the Marine Living Resources Act (No. 18 of 1998) (MLRA) as any net which can be dragged by a fishing vessel along any depth between the seabed and the surface of the sea without continuously touching the bottom. In practice, midwater trawl gear does occasionally come into contact with the seafloor. Midwater trawling gear configuration is similar to that of demersal trawlers, except that the net is manoeuvred vertically through the water column (refer to Figure 56 for a schematic diagram of gear configuration). 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.

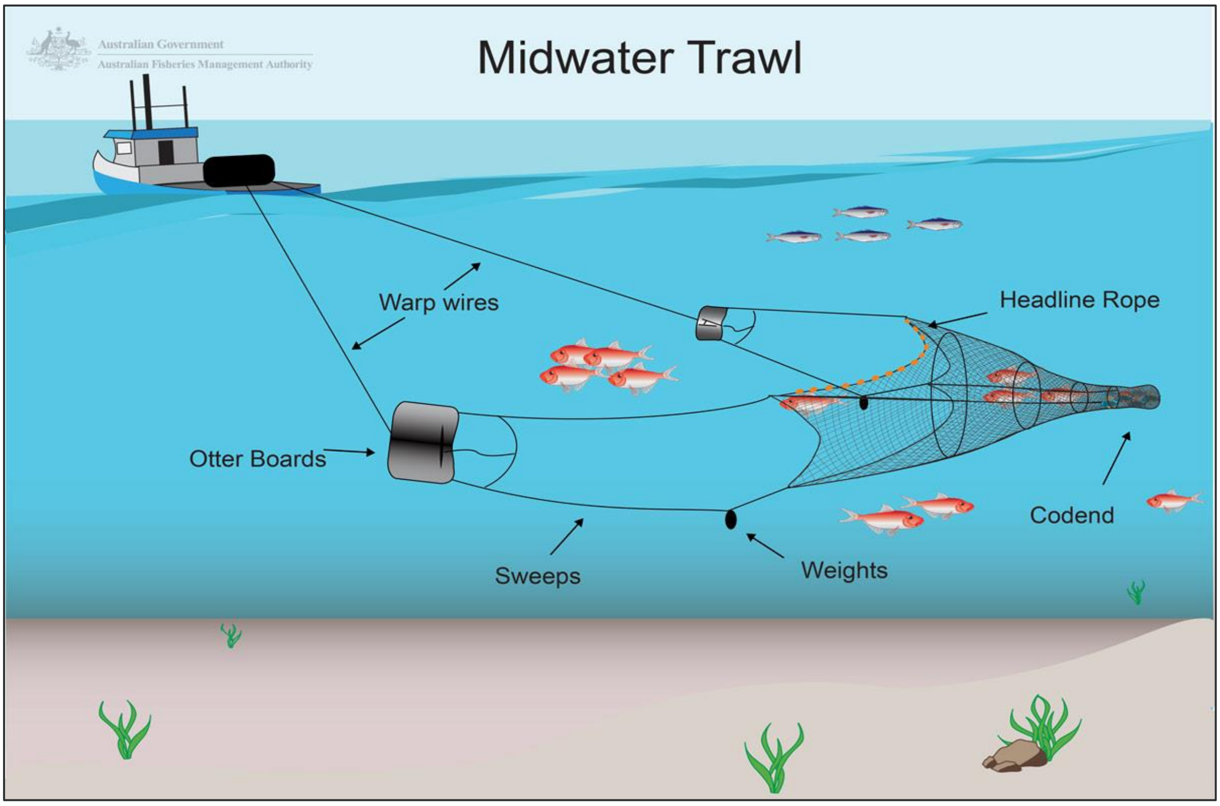


Figure 56: Schematic diagram showing the typical gear configuration of a midwater trawler. Source: www.afma.gov.au/fisheries-management/methods-and-gear/trawling

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. Since 2017, DFFE has permitted experimental fishing to take place westward of 20°E.

Figure 57 shows the spatial extent of midwater trawls undertaken between 2017 and 2019 in relation to the Reconnaissance Permit application 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 30 km from the closest fishing location and 150 km from the main fishing areas.

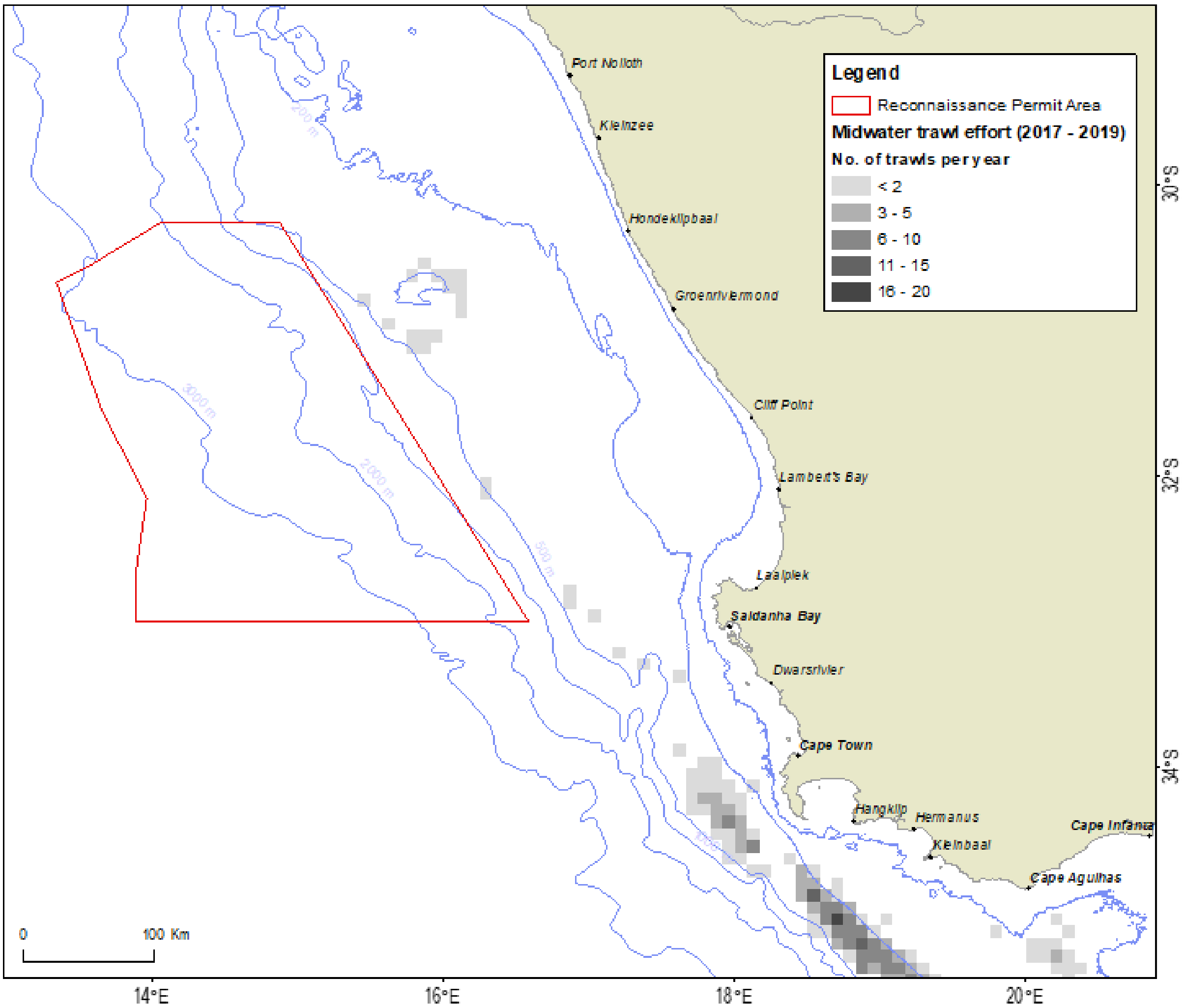


Figure 57: DFFE's catch reporting grid system and the spatial distribution of fishing effort expended by the midwater trawl sector in relation to the Reconnaissance Permit application area.

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, 8113 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 58.

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 more 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. Fishing activity within the area occurs year-round with slightly lower levels during winter.

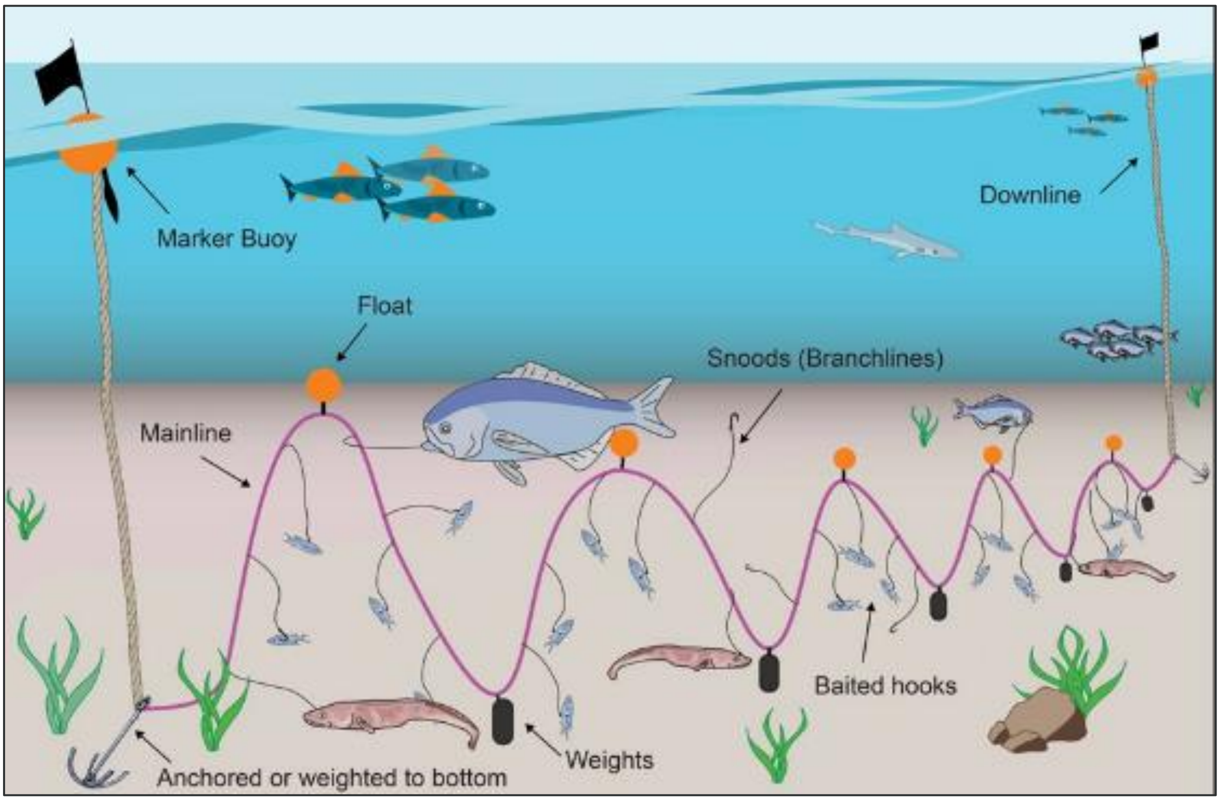


Figure 58: Typical configuration of demersal longline gear used in the South African hake-directed fishery.

Figure 59 shows the spatial distribution of demersal longline fishing areas in relation to the Reconnaissance Permit application area. Fishing effort takes place between the 100 m and 750 m bathymetric contours, but the majority of effort takes place within the depth range 200 m to 650 m. There is no overlap between demersal hake-directed longline grounds and the Reconnaissance Permit application area, which is situated approximately 12 km offshore of the closest fishing locations.

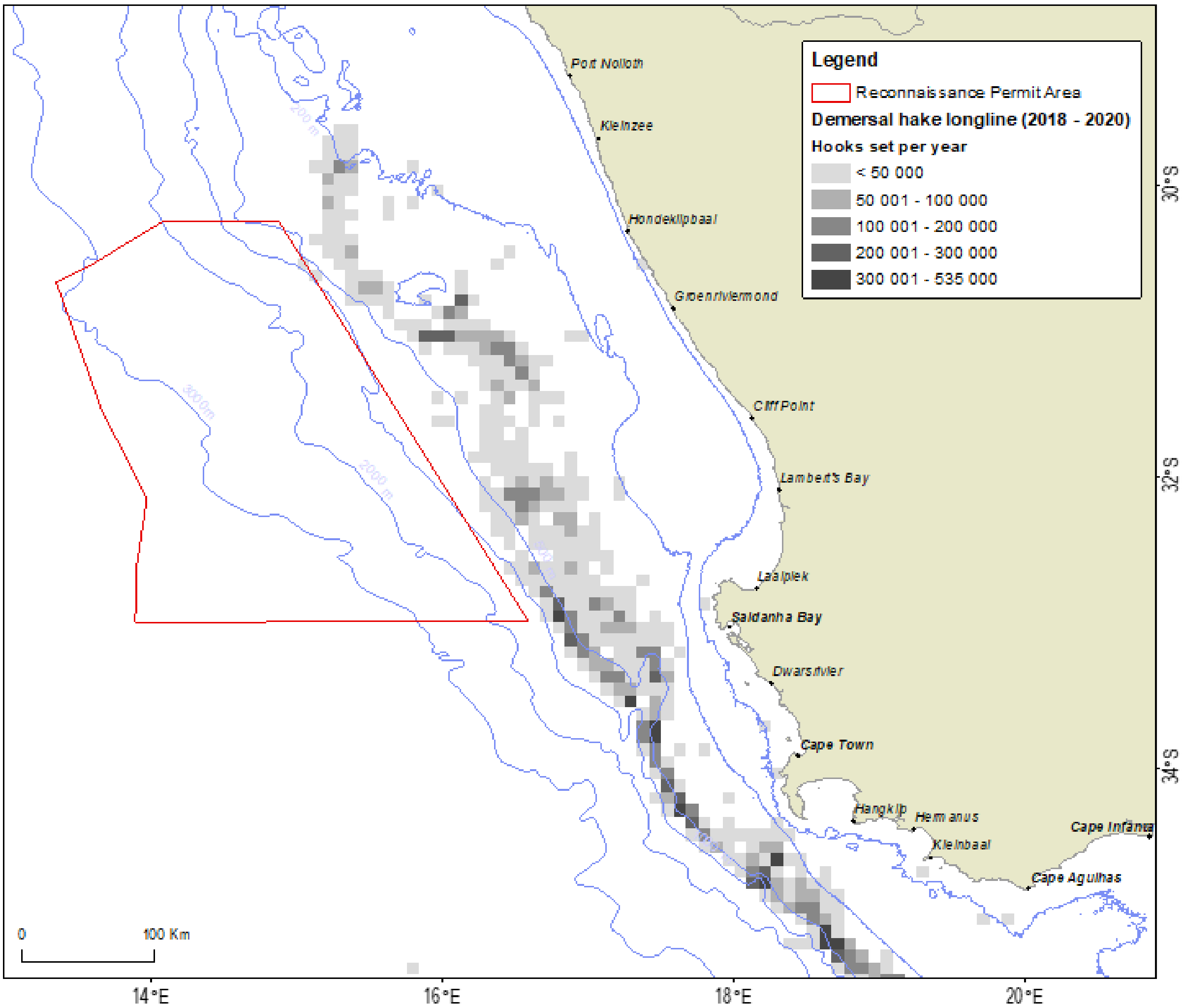


Figure 59: Spatial distribution of fishing effort expended by the hake-directed demersal longline sector in relation to the Reconnaissance Permit application area.

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. Table 19 lists 2018 landings of the main demersal shark and skate species caught by line.

Table 19: Total catches per FAO area of demersal shark (2018).

Species	Catch by FAO Area (kg)			Total
	1.6	2.1	2.2	
Soupfin shark	7	2017	365	2388
Smoothhound shark	6	4244	5340	9591
Bronze shark	6	384	0	390
St. Joseph shark	0	112	33	144
Skate	0	145	444	589
Total	19	6902	6183	13103

Figure 60 shows the spatial distribution of shark-directed demersal longline catch between 2017 and 2019 in relation to the Reconnaissance Permit application area. Recent fishing activity shows effort occurs East of Cape Point, inshore of the 100 m depth contour and at least 230 km SE of the Reconnaissance Permit area at closest point. There is no overlap of the demersal longline sector with the Reconnaissance Permit area.

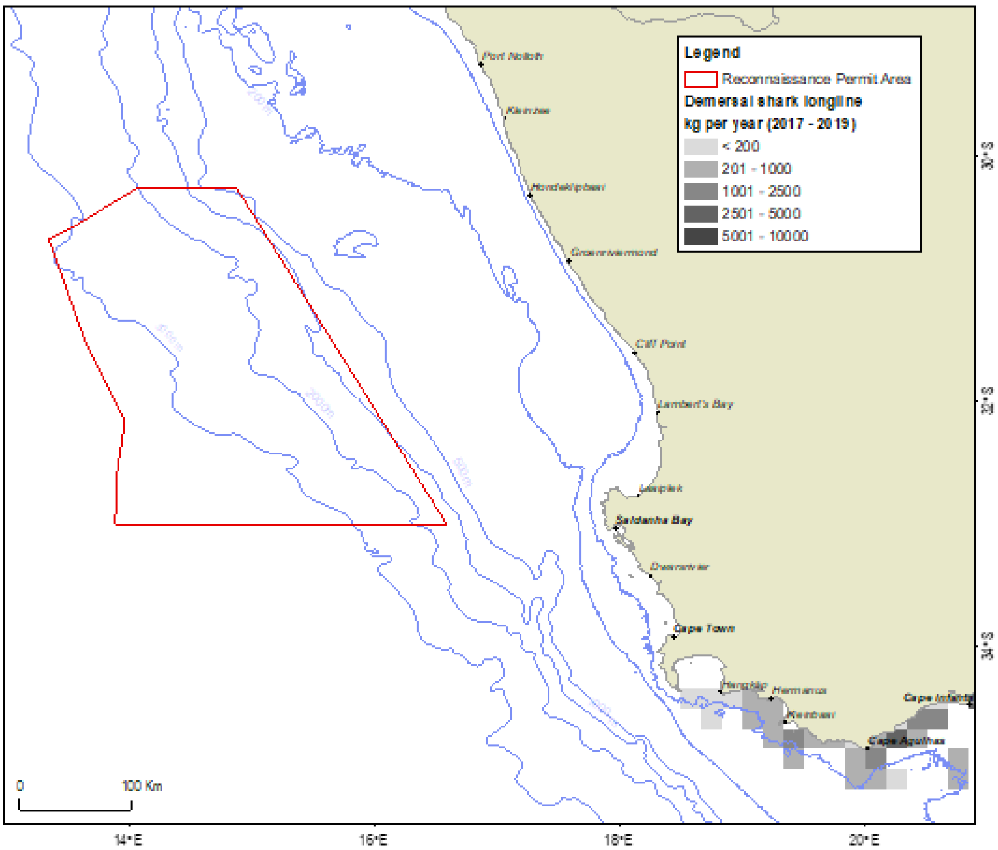


Figure 60: An overview of the spatial distribution of fishing effort expended by the shark-directed demersal longline sector in relation to the Reconnaissance Permit application area.

8.5.3.5 **SMALL PELAGIC PURSE-SEINE**

The pelagic-directed purse-seine fishery targets anchovy (*Engraulis encrasicolus*) and adult sardine (*Sardinops sagax*). Right Holders may also target round herring (*Etrumeus whitheadi*) and meso pelagic species (Lantern and Lightfish combined) which have industry precautionary upper catch limits (PUCLs) – currently set at 100 000 t for round herring and 50 000 t for Lantern and Lightfish (combined). Bycatch species are mainly juvenile sardine, horse mackerel and chub mackerel. It 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.

The total combined catch of anchovy, sardine and round herring landed by the pelagic fishery has decreased by 38% from 395 000 t in 2016 to just 243 000 t in 2021 (Figure 61). This is below both long-term (338 000 t) and short-term (294 000 t) averages.

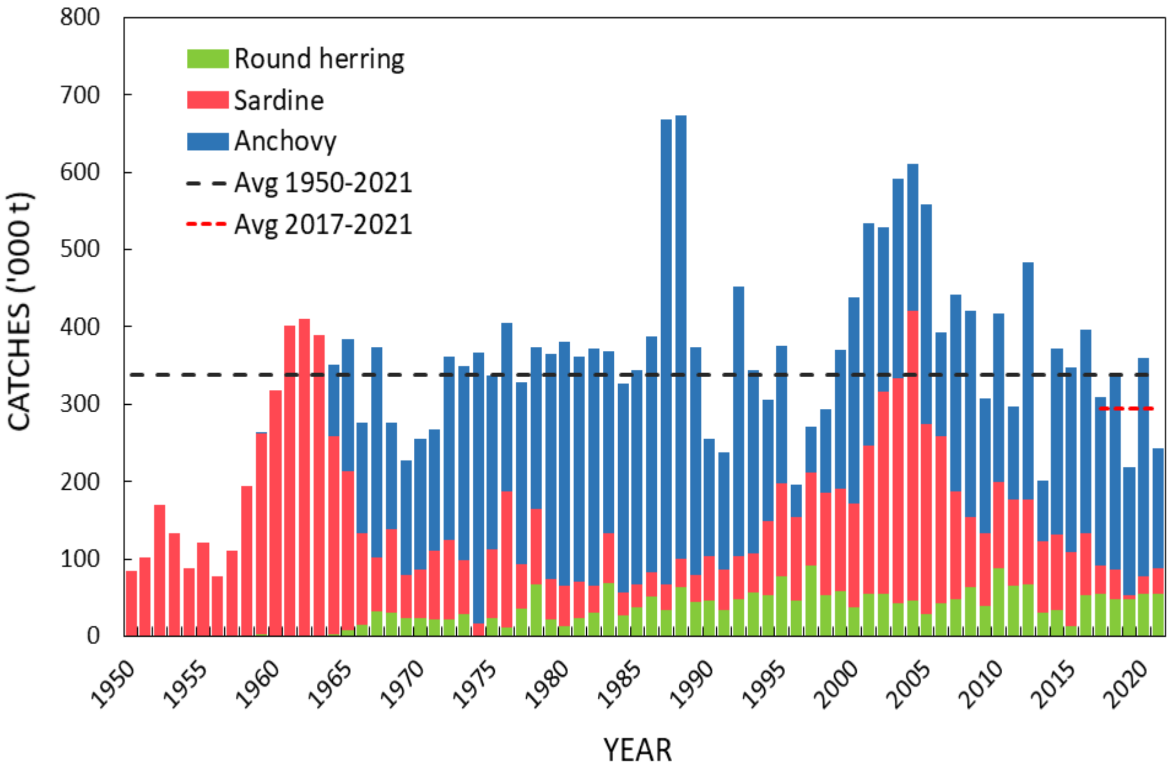


Figure 61: The annual combined catch of anchovy, sardine and round herring. Also shown is the average combined catch since the start of the fishery (1950-2021; black dashed line) and for the past five years (red solid line). Source DFFE, 2022.

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 11m 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 62). 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.

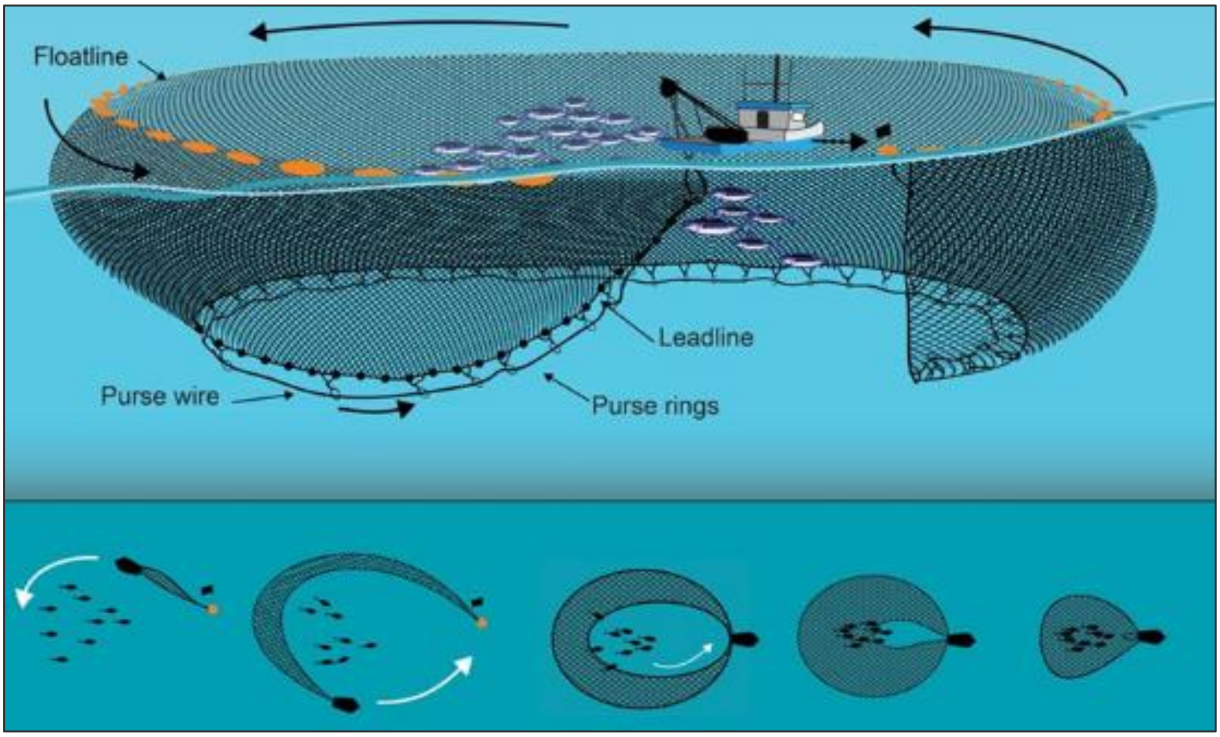


Figure 62: Typical configuration and deployment of a small pelagic purse seine for targeting anchovy, sardine and round herring as used in South African waters. Source: http://www.afma.gov.au/portfolio-item/purse-seine

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 catch and effort statistics for this sector are recorded by skippers on a grid block basis therefore the resolution of 10 by 10 nautical minutes.

The fishery operates throughout the year with a short seasonal break from mid-December to mid-January. Seasonality of catches is shown in Figure 63 with an increase in fishing effort and landings evident during the winter months.

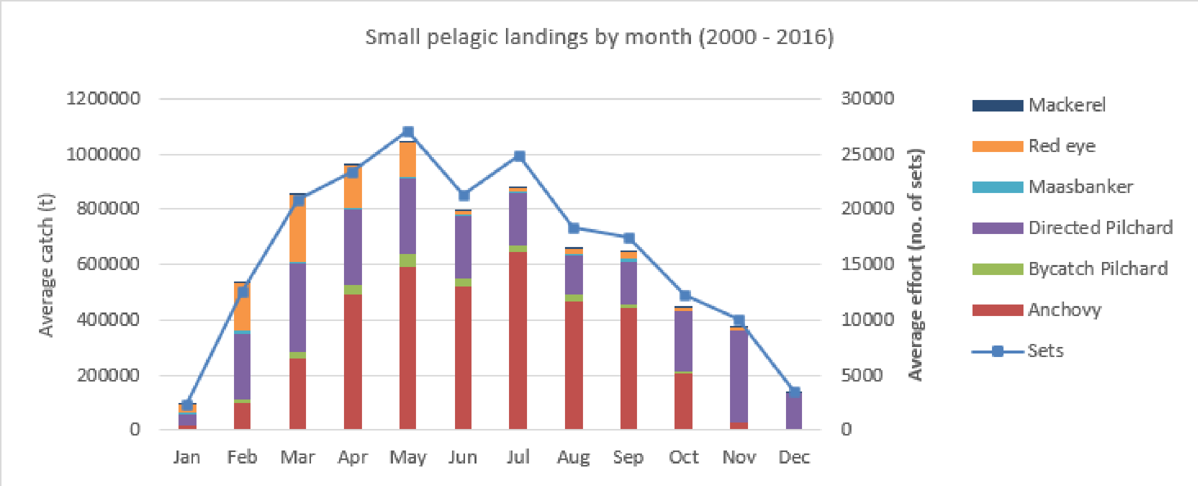


Figure 63: Graph showing monthly catch (tons) and effort (number of sets) reported for the small pelagic purse-seine fleet over the period 2000 to 2016 (cumulative).

Figure 64 shows the spatial extent of fishing grounds used by the sector over the period 2000 to 2016 in relation to the Reconnaissance Permit application area. The majority of fishing effort takes place in waters shallower than 200 m along the coastline of the Western Cape. Fishing grounds lie at least 60 km inshore of the Reconnaissance Permit application area and there is no overlap.

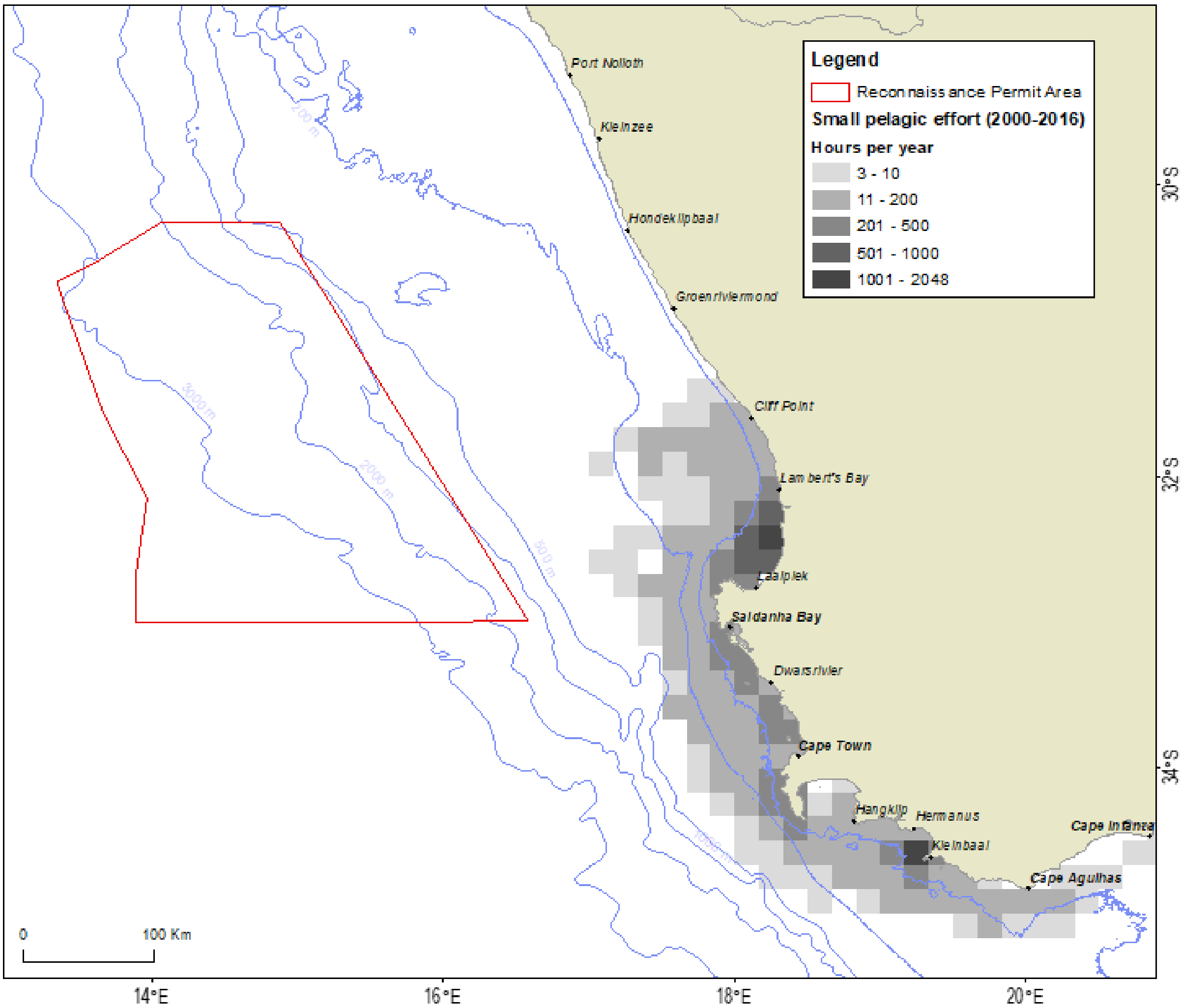


Figure 64: An overview of the spatial distribution of fishing effort recorded by the purse-seine sector targeting small pelagic species in in relation to the Reconnaissance Permit application area.

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 Exclusive Economic Zone (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). During the period 2000 to 2016, the sector landed an average catch of 4527 tons and set 3.55 million hooks per year. Catch and effort figures reported by the South African large pelagic longline fishery for the years 2000 to 2018 are shown in Figure 65. Catch by species and number of active vessels for each year from 2005 to 2018 are given in Table 20.

Catches landed by the South African fleet operating in the ICCAT region (i.e. off the West Coast) from 1998 – 2020 are shown in Figure 66.

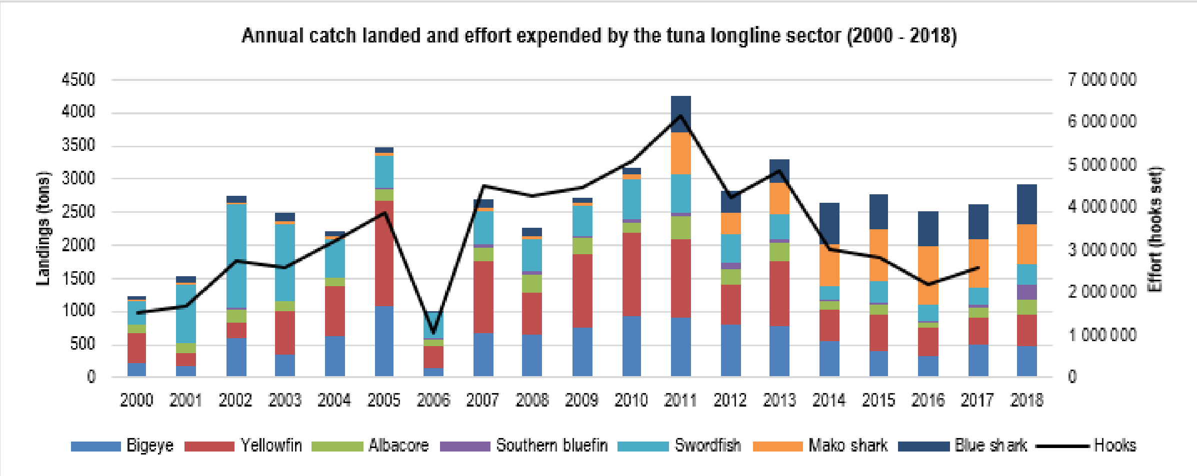


Figure 65: Inter-annual variation of catch landed and effort expended by the large pelagic longline sector in South African waters as reported to the two regional management organisations, ICCAT and IOTC (2000 - 2018).

Table 20: Total catch (t) and number of active domestic and foreign-flagged vessels targeting large pelagic species for the period 2005-2018 (Source: DEFF, 2019).

Year	Bigeye tuna	Yellowfin tuna	Albacore	Southern bluefin tuna	Swordfish	Shortfin mako shark	Blue shark	Number of active vessels	
								Domestic	Foreign-flagged
2005	1077	1603	189	27	408	700	225	13	12
2006	138	337	123	10	323	457	121	19	0
2007	677	1086	220	48	445	594	259	22	12
2008	640	630	340	43	398	471	283	15	13
2009	765	1096	309	30	378	511	286	19	9
2010	940	1262	165	34	528	591	312	19	9
2011	907	1182	339	49	584	645	542	16	15
2012	822	607	245	79	445	314	333	16	11
2013	882	1091	291	51	471	482	349	15	9
2014	544	486	114	31	223	610	573	16	4

Year	Bigeye tuna	Yellowfin tuna	Albacore	Southern bluefin tuna	Swordfish	Shortfin mako shark	Blue shark	Number of active vessels	
								Domestic	Foreign-flagged
2015	399	564	151	11	341	778	531	Fleets merged under SA flag with only a few foreign boats : up to 30 boats operating	
2016	315	439	85	18	275	883	528		
2017	497	400	172	47	246	726	523		
2018	478	478	238	208	313	613	592		

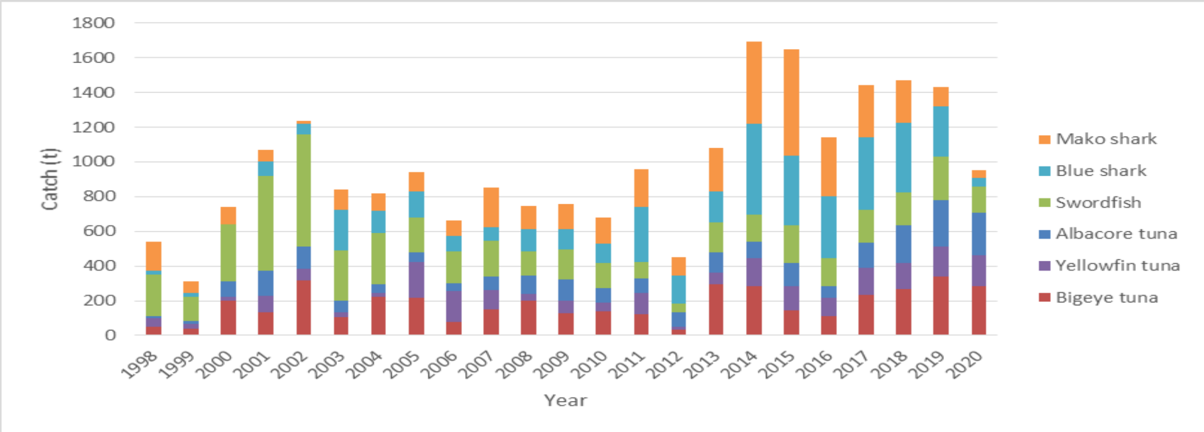


Figure 66: Inter-annual variation of catch landed by the large pelagic longline sector operating in the ICCAT region of South African waters (i.e. West of 20°E) (1998 – 2020).

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 longliners 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 longline 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 (DAFF, 2018).

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 3500 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 67.

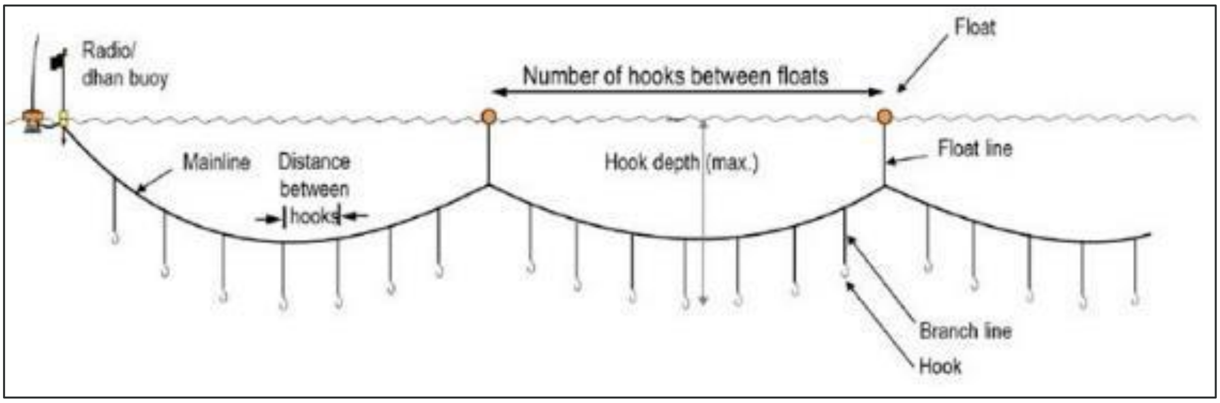


Figure 67: Schematic diagram showing typical configuration of longline gear targeting pelagic species (left), and photograph of typical high seas longline vessel (upper right).

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 (Punsly and Nakano, 1992).

Fishing areas are subdivided into the SE Atlantic (reporting to ICCAT) and the SW Indian Ocean (reporting to IOTC) along 20°E, and the West, Southwest, South and East sampling areas are shown. Bubble size is proportional to the numbers of hooks set per line. The numbers of hooks set by foreign vessels peaked between May and October each year, whereas local vessels fished throughout the year, with marginally fewer hooks set in January and February than other months (Figure 68b). Foreign vessels ventured further southwards than local vessels, which tended to remain within the EEZ (Figure 69; Jordaan *et al*., 2018).

Local vessels fish in all four areas, but in the East their range is limited to the northern half of the area, near a landing site at Richards Bay. Foreign vessels fished mainly in the SW Indian Ocean, with the bulk of all hooks set in the South (58%) and East (33%) areas, and the remaining 9% in the SE Atlantic (Figure 68b). Foreign vessels set an average of 2 493 ± 597 (SD) hooks per line, compared to only 1 282 ± 250 hooks per line used by local vessels.

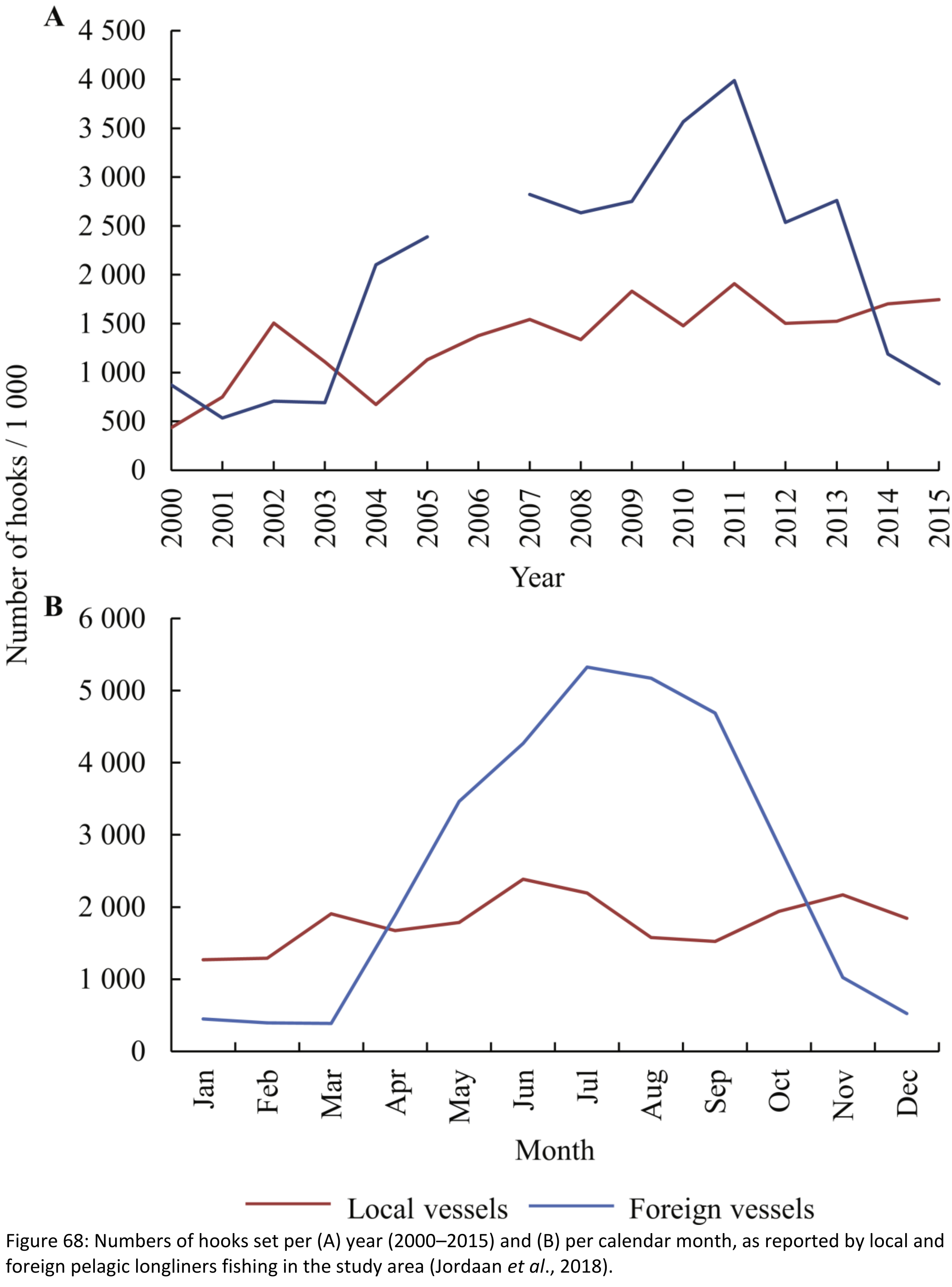


Figure 68: Numbers of hooks set per (A) year (2000–2015) and (B) per calendar month, as reported by local and foreign pelagic longliners fishing in the study area (Jordaan *et al.*, 2018).

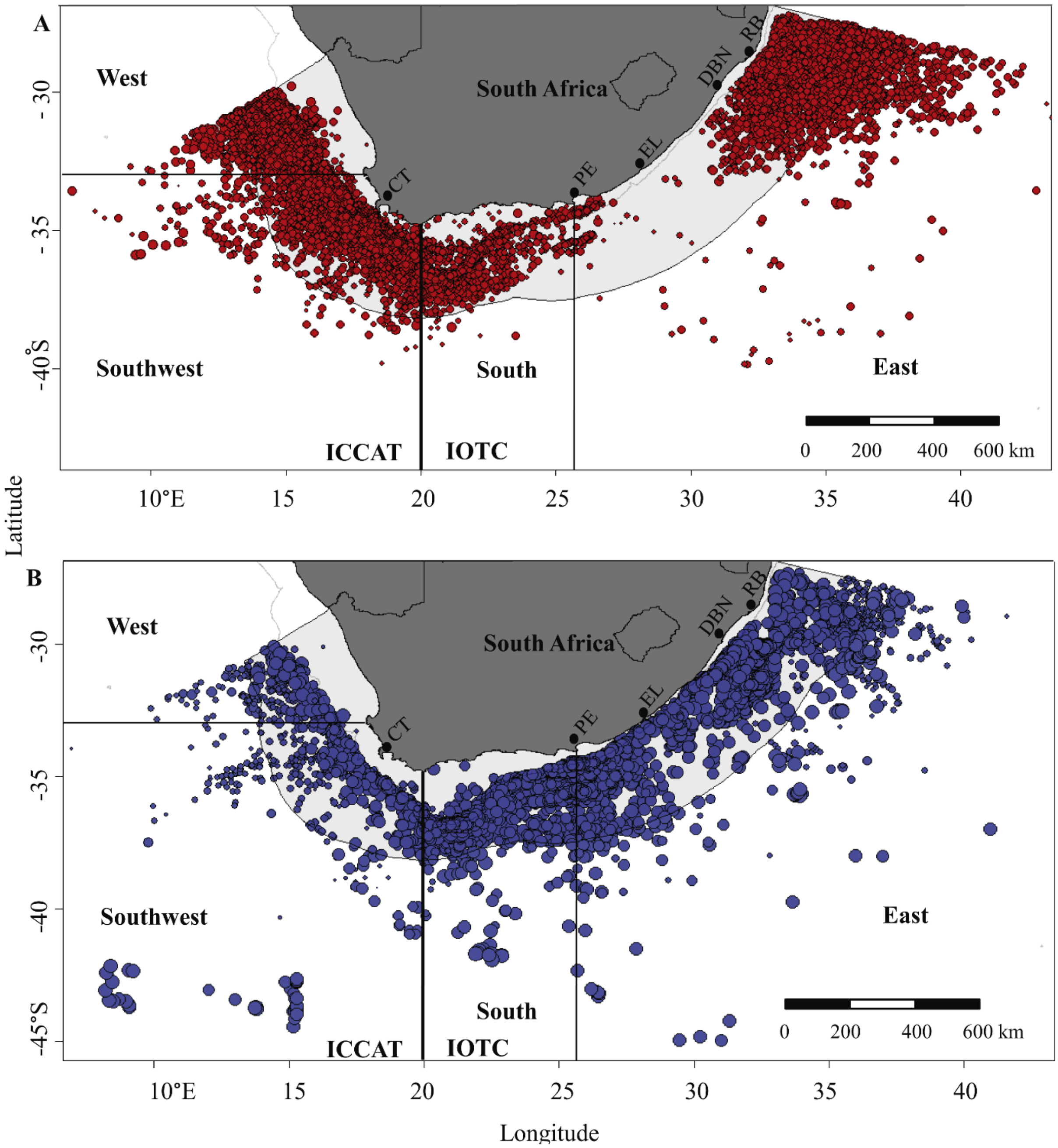


Figure 69: Geographical distribution of fishing effort by (A) local and (B) foreign pelagic longliners from 2000 to 2015, based on logbook data provided by vessel skippers (Jordaan *et al.*, 2018).

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. The recent spatial distribution of catch (2017 to 2019) in relation to the Reconnaissance Permit area is shown in Figure 70. Over this period, an average of 423 lines per year were set within the area yielding 579 tons of catch. This is equivalent to 10.29% of the overall effort and 8.1% of the total catch reported by the sector at a national scale.

Pelagic longline fishing activity can be expected along the inshore extent of the Reconnaissance Permit area especially in the northern extent of the area. Lines of up to 100 km in length are s*et al*ong the continental shelf break, and are left to drift in surface currents for several hours before retrieval. They therefore cover a large area whilst they drift and pose a significant risk of entanglement with a towed seismic array.

Average monthly catch and effort within the Reconnaissance Permit area is shown in Figure 71. This shows that catch is highest during the months of June and July, associated with an increase in fishing effort by the sector.

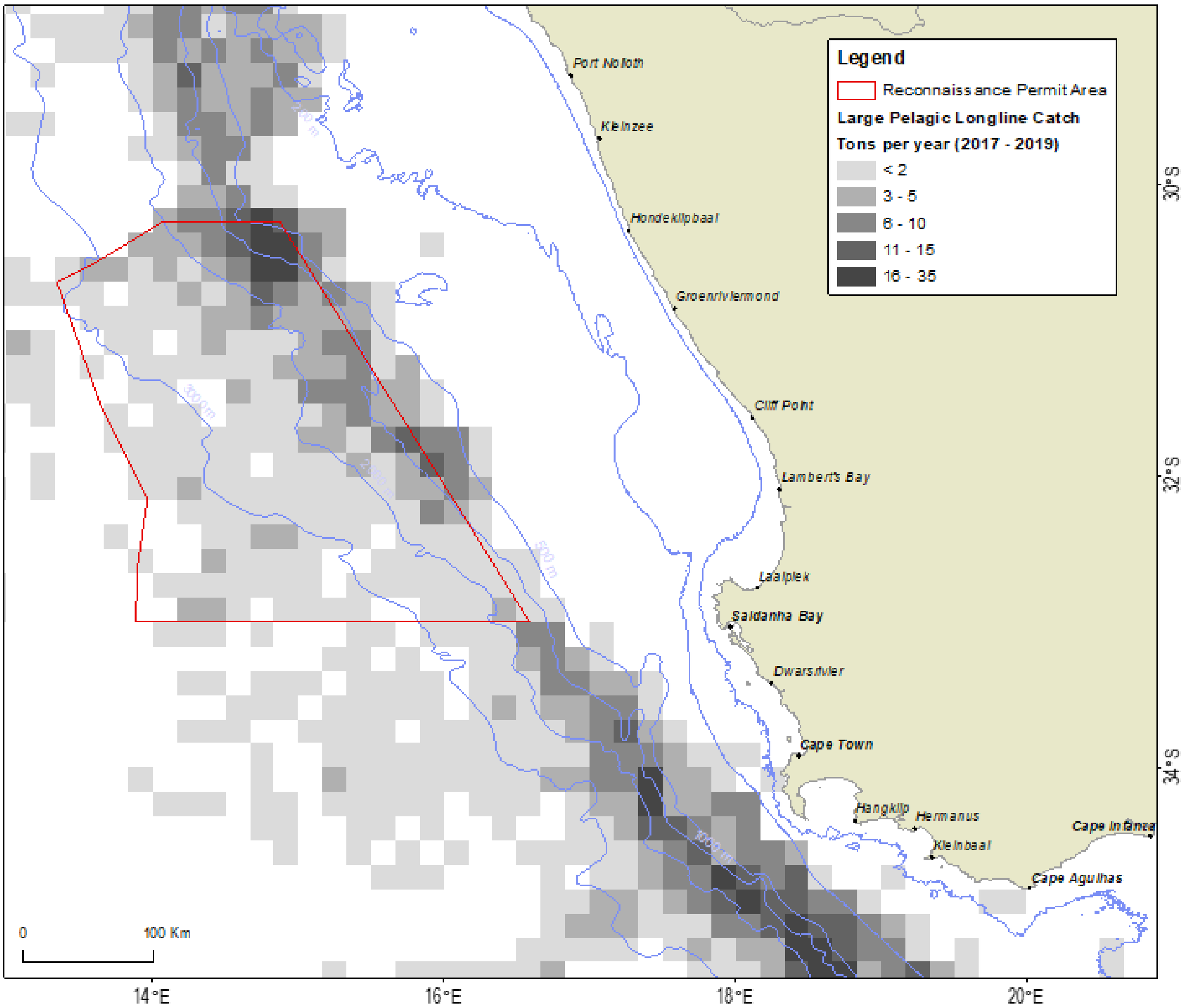


Figure 70: An overview of the spatial distribution of fishing effort expended by the longline sector targeting large pelagic fish species in relation to the Reconnaissance Permit application area.

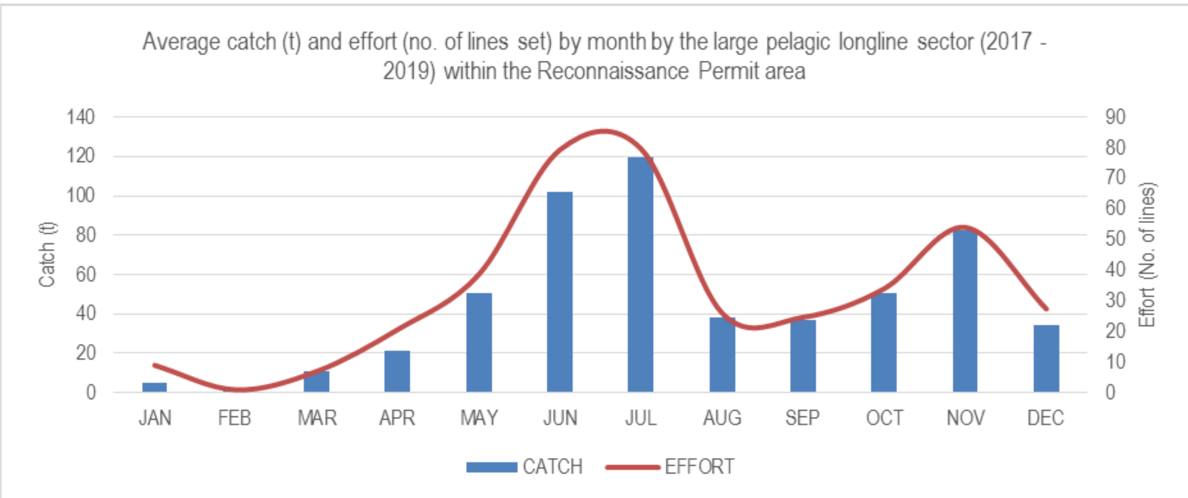


Figure 71: Average catch (t) and effort (no. of lines set) by month reported by the large pelagic longline sector in the vicinity of the Reconnaissance Licence area (2017-2019).

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*). The fishery is seasonal with vessels active predominantly between November and June and peak catches recorded from November to January. Due to the seasonality of tuna in South Africa's waters the tuna pole fishery is also allowed access to snoek (*Thyrsites atun*) and yellowtail (*Seriola lalandi*). Snoek-directed fishing activity is seasonal, taking place in coastal areas during the period March to July, with a peak in activity during the months of April and May. Access to these additional species has caused conflict with the traditional linefish sector.

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 21. 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 21: Total number of fishing days (effort), active vessels and total catch (t) of the main species caught by South African-flagged tuna pole-line vessels in the ICCAT region (West of 20E), 2008 – 2020 (ICCAT, 2022).

	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
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 (see Figure 73).

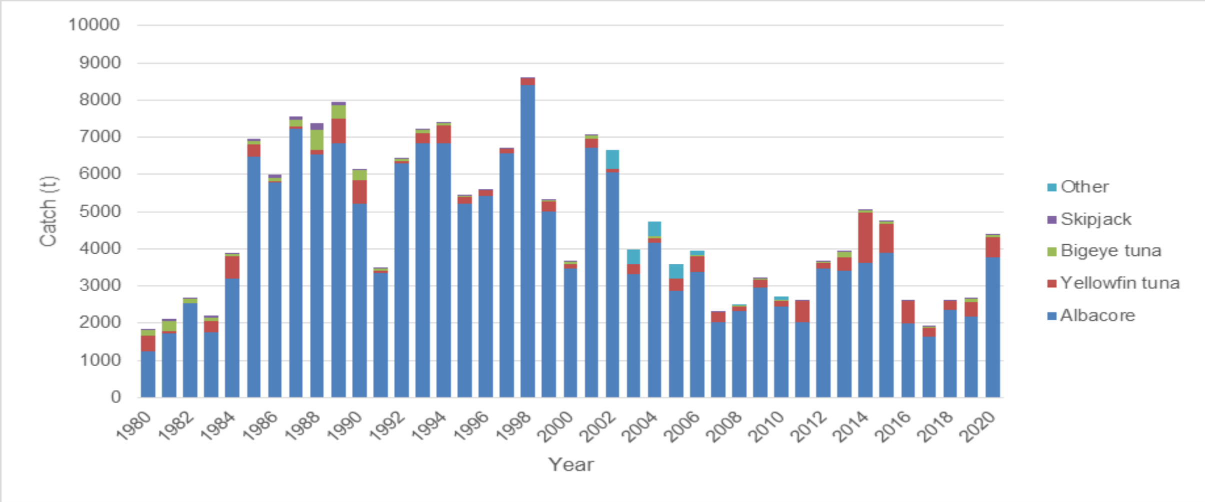


Figure 72: Catches (tons) of pelagic species by the South Africa pole-line ("Baitboat") fleet between 1980 and 2020 (ICCAT, 2022).

Figure 73: Schematic diagram of pole and line operation (Source: http://www.afma.gov.au/portfolio-item/minor-lines).

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 74 shows the location of fishing activity in relation to Reconnaissance Permit application area. Fishing activity for tuna occurs along the entire West Coast beyond the 200 m bathymetric contour, along the shelf break with favoured fishing grounds including areas north of Cape Columbine and between 60 km and 120 km offshore of Saldanha Bay. Fishing records received from DFFE for the reporting period 2017 to 2019 show that tuna-directed fishing takes place inshore of the Reconnaissance Permit application area within minimal activity within the area itself. An average of 24 fishing events per year were set within the area yielding 25 tons of albacore (although it is likely that some of this activity may be errors in the reporting of fishing positions and the likelihood of fishing activity within the area is considered to be low). The catch and effort within the area is equivalent to 0.87% and 0.95%, respectively, of the overall catch and effort reported by the sector at a national scale.

Albacore-directed fishing activity within deeper waters adjacent to the Reconnaissance Permit area shows a peak during February and March (see Figure 75). Snoek-directed fishing activity is coastal and seasonal in nature – taking place inshore of the 100 m depth contour during the period March to July, with a peak in activity during the months of April and May. Snoek-directed fishing activity is situated at least 140 km inshore of the application area and there is therefore no overlap of the survey expected with snoek-directed fishing activity.

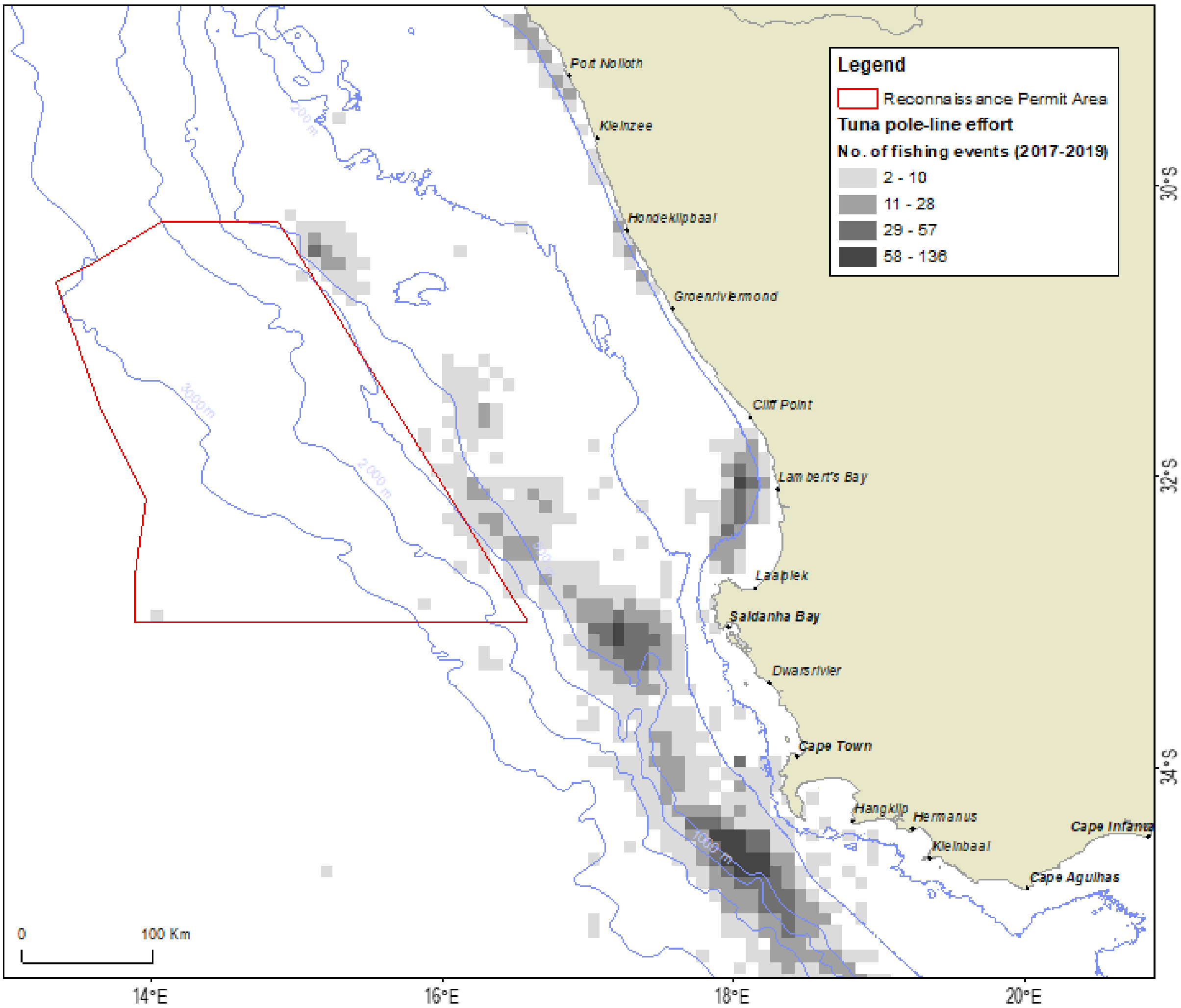


Figure 74: An overview of the spatial distribution of fishing effort expended by the pole- line sector targeting pelagic tuna (offshore areas) and snoek (inshore areas) in relation to the Reconnaissance Permit application area.

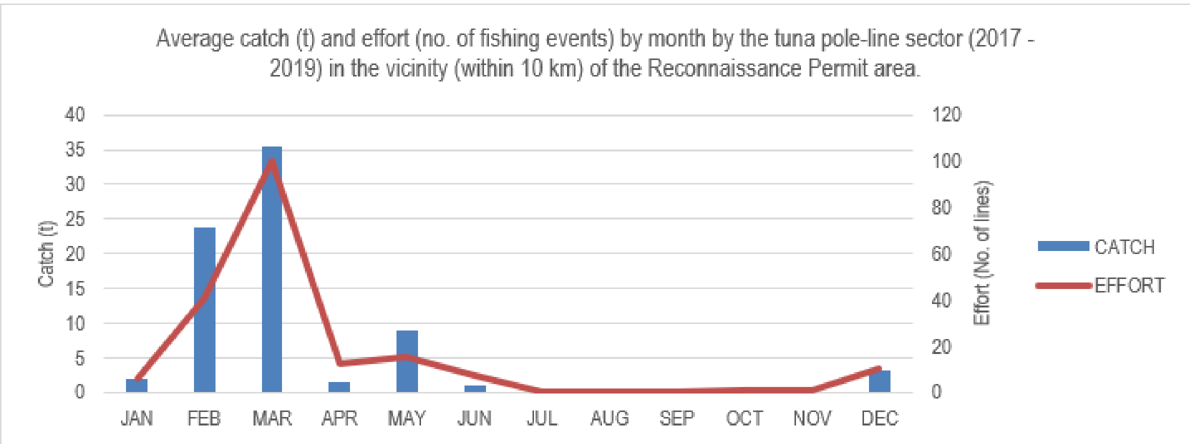


Figure 75: Average catch (t) and effort (no. of fishing events) by month reported by the tuna pole-line sector in the vicinity (within 10 km) of the Reconnaissance Licence area (2017-2019).

8.5.3.8 **TRADITIONAL LINEFISH**

The commercial linefish sector has its origins from the recreational sector. Essentially recreational linefishers commercialised resulting in a systematic decline in the “linefish" stocks. The Minister of Fisheries in the 1980’s reformed the sector. This was done by creating a small commercial linefish sector, as well as introducing a moratorium on exploiting many species that were collapsed or near collapse. The commercial linefish sector now only allows a limited number of key species to be exploited.

Of all South African marine fisheries, the line fishery is the most vulnerable to external impacts. Linefish resources are at risk of overcapacity as they are directly or indirectly exploited by other sectors, including the recreational, small-scale line fishery, inshore and offshore trawl fisheries, tuna pole-line fishery, the inshore net fishery and the demersal shark longline fishery (DEFF, 2020). The increased expectation of commercial access to linefish resources combined with the localised anticipation of community ownership by small-scale fishers may impact linefish stocks.

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). Table 22 lists the catch of important linefish species for the years 2010 to 2022.

Figure 76 shows the variability in catches of the eight most importance species by the line fishery over the period 1985 to 2021.

Table 22: Annual catch (t) of the eight most important linefish species for the period 2010 to 2021 (DEFF, 2022).

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
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
2019	1879	439	454	604	215	188	132	78	N/A*
2020	2356	548	635	533	183	222	158	66	N/A*
2021	2747	239	352	441	186	151	88	64	N/A*

*total catches unavailable at date of this report

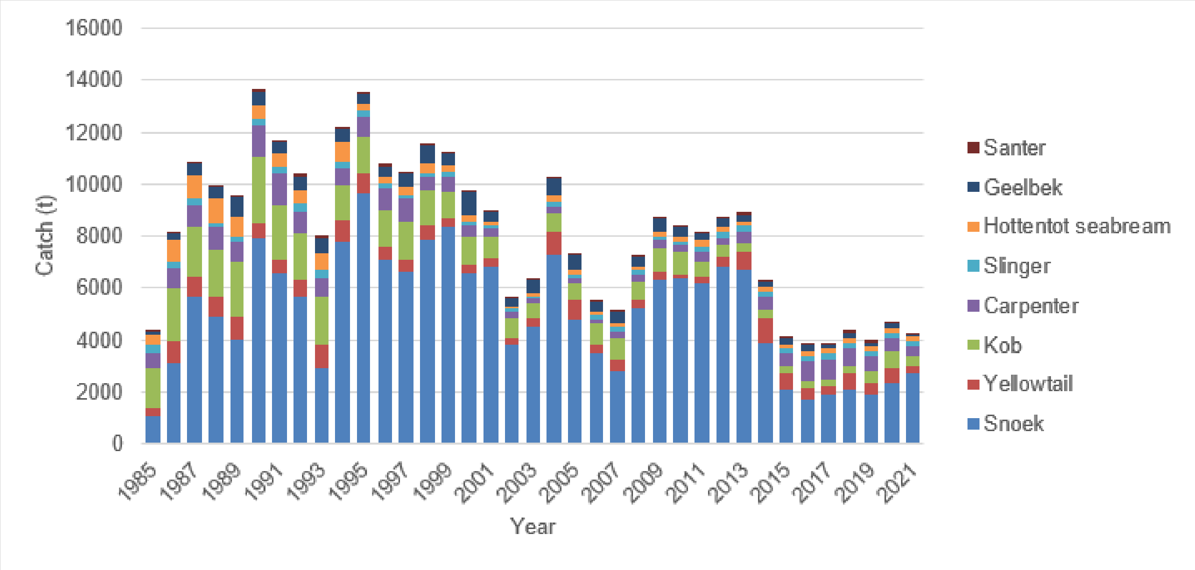


Figure 76: Annual catch (t) of the eight most important linefish species for the period 1985-2021 (DFFE, 2022).

The traditional commercial line fishery is a relatively low-cost and labour-intensive industry, therefore important from an employment and human livelihood point of view. Although the commercial line fishery has the largest fleet, it contributes only 6% of the total estimated value of all South African marine fisheries (DFFE, 2020). In 2017, the wholesale value of catch was reported as R122.1 million.

The commercial line fishery is a nearshore boat-based activity which is currently managed through a total allowable effort (TAE) allocation, based on boat and crew numbers. Since December 2000 it has consisted of 3450 crew operating from 455 commercial vessels. The number of rights holders is 425 (valid rights until 31 December 2020 and subsequently extended until 31 December 2021[4]). 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 TAE to small-scale fishing from 13% to 50% commencing in 2021 in order to boost economic possibilities for coastal communities.

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 23 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.

Table 23: Annual total allowable effort (TAE) and activated commercial line fish effort per management zone from 2008 to 2019 (DEFF, 2020).

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**	
Allocation	455 (3182)		301 (2136)		103 (692)		51 (354)	
Year	Allocated	Activated	Allocated	Activated	Allocated	Activated	Allocated	Activated
2008	455	372	301	239	103	82	51	51

[4] Extension to existing rights until DFFE has concluded a Fishing Rights Allocations Process ("FRAP") which, at the time of this report, is still underway.

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	
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 Linefish 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

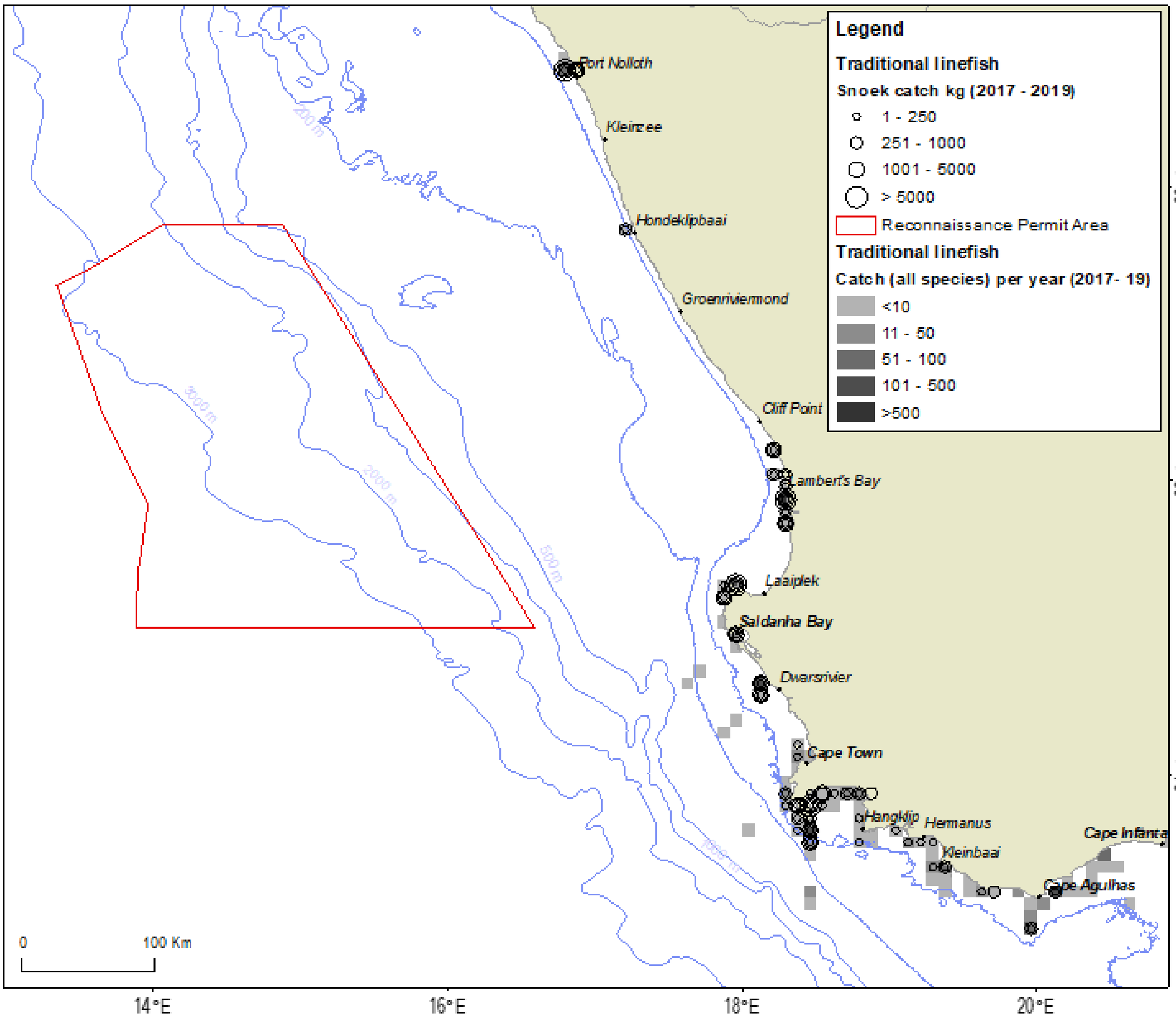
Crew use hand line or rod-and-reel to target approximately 200 species of marine fish along the full 3 000 km coastline, of which 50 species may be regarded as economically important. To distinguish between line fishing and long lining, line fishers are restricted to a maximum of 10 hooks per line. Target species include resident reef-fish, coastal migrants and nomadic species. Many species allocated to the small-scale fisheries “baskets” are primary targets of the commercial and recreational linefish sectors, and these shared resources must be carefully monitored given the increased fishing pressure expected. A revision of the linefish management protocol (LMP) is also underway to ensure the future sustainability of linefish stocks.

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. Fishing takes place throughout the year but there is some seasonality in catches.

Snoek is an important linefish 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 (Griffiths, 2002). 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 Reconnaissance Permit area.

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 expected5. This fishery's operational footprint may at times be limited by operating costs and is sensitive to local reports of fish availability. Further, in regard to migratory species, such as longfin tuna and snoek, economic and regulatory aspects relating to distances fished offshore is pertinent [i.e. such as the requirements of the South African Maritime Safety Authority (SAMSA)] in particular that "B" class certified vessels can operate up to 40 nm offshore.

Figure 77 shows the spatial extent of traditional linefish grounds in relation to the Reconnaissance Permit application area. 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 (i.e. the species is not part of the basket allocation), 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 120 km offshore and at least 100 km from fishing grounds targeted by the linefish sector.



5 Inaccuracies in reported fishing positions are unlikely to impact on the validity of the current assessment as a precautionary approach has already been adopted in assessing the maximum range of fishing grounds offshore with respect to the Reconnaissance Permit application area.

Figure 77: An overview of the spatial distribution of catch taken by the linefish sector in relation to the Reconnaissance Permit 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 found off the South African West Coast and consequently an important income source for West Coast fishermen providing employment for about 4200 people. 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. Fishing grounds stretch from the Orange River mouth to east of Cape Hangklip in the South-Eastern Cape although the commercial viability is focused mainly southwards from Management Zone B (see Figure 80).

The fishery is comprised of four sub-sectors – commercial offshore, commercial nearshore, small-scale and recreational, all of which have to share from the same national TAC. The 2021/22 TAC was set at 600 tonnes and apportionment of TAC by sub-sector is listed in Table 24. The TAC for the 2021/2022 fishing season was reduced by 28% from the previous fishing season (2020/2021). The updated stock assessment for the resource has indicated that it is further depleted than was thought to be the case two years ago, and poaching[6] is one of the major contributors to the recently exacerbated depleted status of the resource. The resource has over recent decades been at about 2.5% of the pristine level, but that over the last few years this had dropped to about 1.5%.

Annual TAC and average monthly landings over the period 2006 to 2020 are shown in Figure 78 and Figure 79, respectively. A historical time-series of TACs and landings is listed in Table 25.

Table 24: Apportionment of TAC of rock lobster by sub-sector (modified DFFE, 2021).

Description	2019/2020 TAC (t)	2020/2021 TAC (t)	2021/2022 (t)
Commercial fishing (offshore)	563.91	435.88	301.28
Commercial fishing (nearshore)	170.25	131.03	100.92
Recreational fishing	38.76	30.08	21.57
Subsistence (interim relief measure) fishing	170.25	131.03	100.92
Small-scale fishing sector (nearshore)			
Small-scale fishing sector (offshore)	140.83	108.97	75.32
Total	1084	837.0	600

Table 25: Total allowable catch, fishing sector landings and total landings for West Coast rock lobster (DEFF, 2020).

Season	Global TAC	Offshore allocation	Nearshore allocation	Interim Relief	Recreational	Total catch[3]
2000/01	2 018	1614		230	174	2154
2001/02	2 353	2151		[1]	202	2410

[6] In 2017, the poached rock lobster was estimated at 2 747 tonnes.

Season	Global TAC	Offshore allocation	Nearshore allocation	Interim Relief	Recreational	Total catch[3]
2002/03	2 957	2713		[1]	244	2706
2003/04	3 336	2422	594	[1]	320	3258
2004/05	3 527	2614	593	[1]	320	3222
2005/06	3 174	2294	560	[1]	320	2291
2006/07	2 857	1997	560	[2]	300	3366
2007/08	2 571	1754	560	[2]	257	2298
2008/09	2 340	1632	451	[2]	257	2483
2009/10	2 393	1632	451	180	129	2519
2010/11	2 286	1528	451	200	107	2208
2011/12	2 426	1541	451	251	183	2275
2012/13	2 276	1391	451	251	183	2308
2013/14	2 167	1356	451	276	83	1891
2014/15	1 800	1120	376	235	69	1688
2015/16	1 924	1243	376	235	69	1524
2016/17	1 924	1204	376	274	69	1564
2017/18	1 924	994	305	554	69	1355
2018/19	1 084	564	170	170	39	
2019/20	1 084	564	170	170	39	
2020/21	837	436	131	131	30	
2021/22	600	301	101	101	22	

1 No Interim Relief allocated; 2 Interim Relief accommodated under Recreational allocation; 3 Total catch by all sectors.

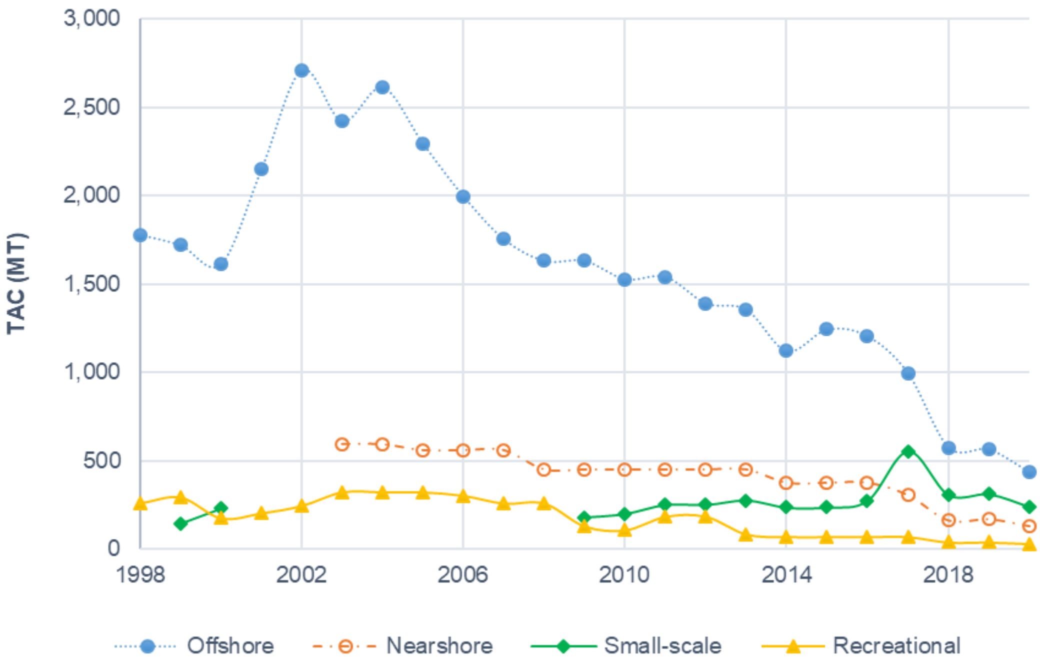


Figure 78: Graph showing the total allowable catch (TAC) of west coast rock lobster.

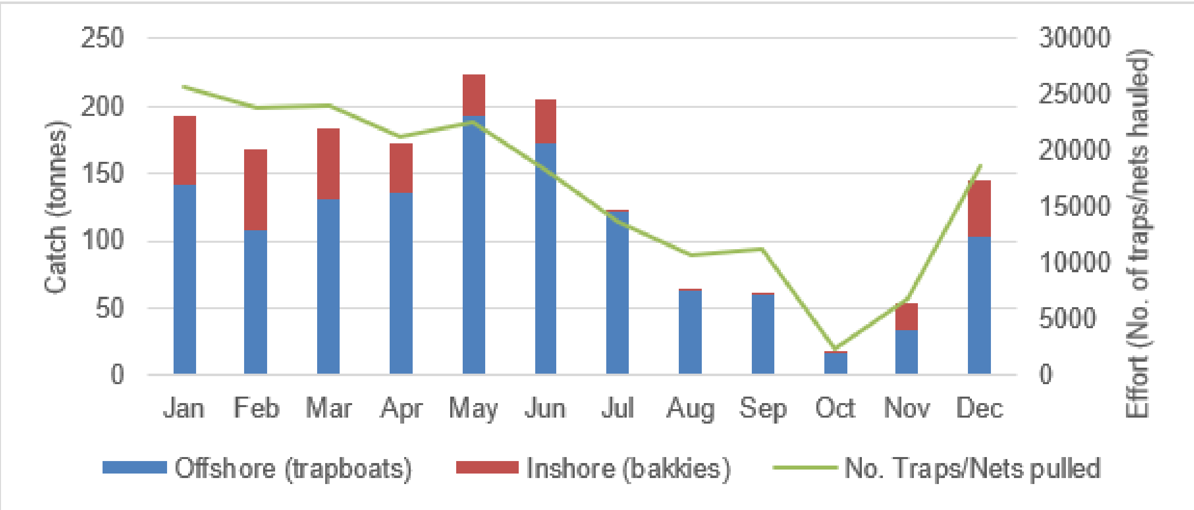


Figure 79: Graph showing the average monthly catch (tonnes) and effort (number of traps hauled) reported by the offshore (trapboat) and inshore (bakkie) rock lobster sectors over the period 2006 to 2020.

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 2021/22 fishing season per sector and zone are shown in Table 26.

Table 26: Start and end dates for the fishing season 2021/22 by management zone. Special Project Report on the review of the TAC for West Coast Rock Lobster for the 2021/22 fishing season by the Consultative Advisory Forum for Marine Living Resources.

Area	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	Commercial nearshore, interim relief, small-scale: nearshore	Commercial offshore, small-scale: offshore
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 80. 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.

Figure 81 shows rock lobster catch by management zone for the commercial offshore and nearshore sub-sectors. The Reconnaissance Permit area is situated at least 115 km from the closest rock lobster fishing grounds and there is no spatial overlap (see Figure 82).

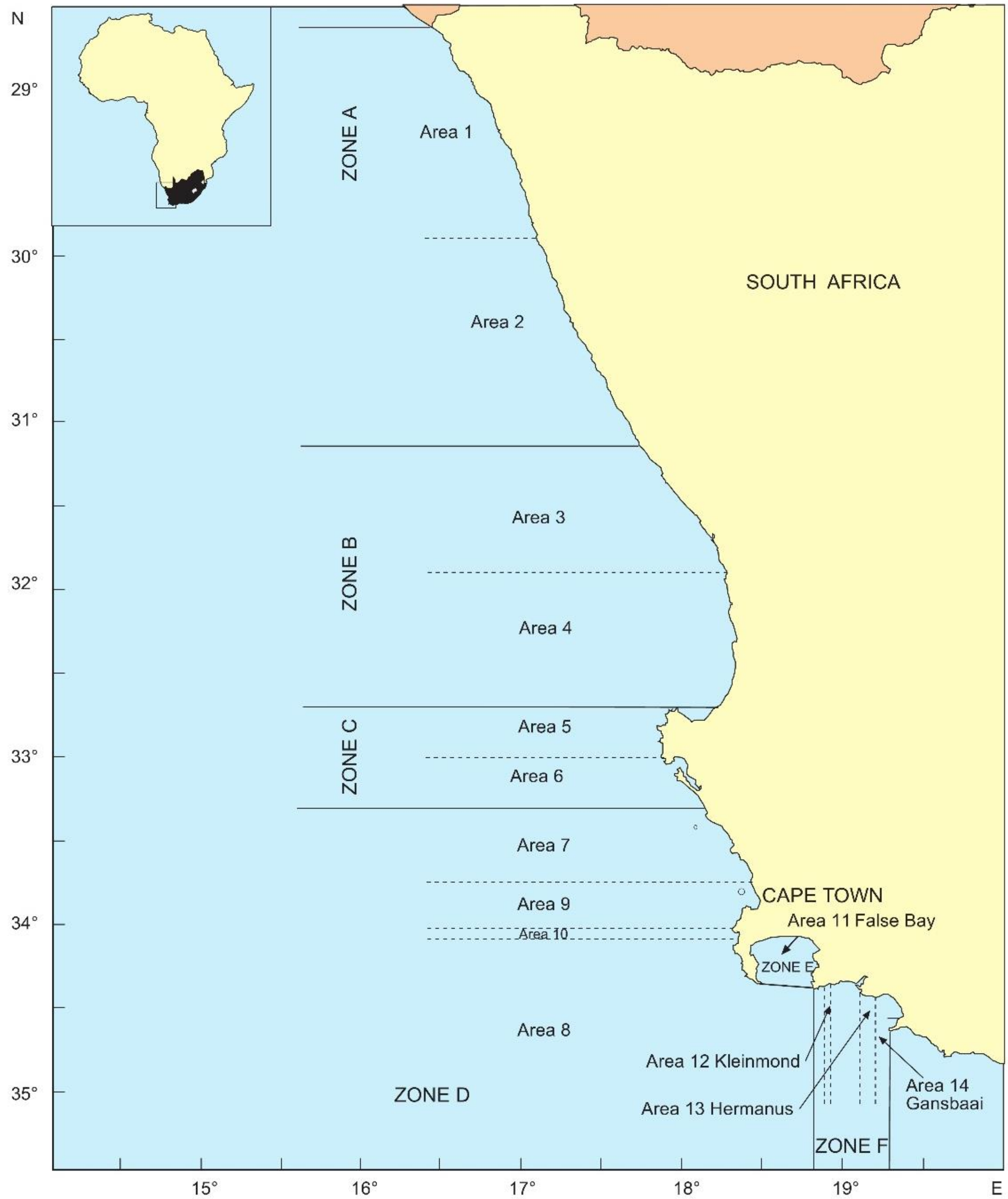


Figure 80: West Coast rock lobster fishing zones and areas. The five super-areas are: areas1–2, corresponding to zone A; areas 3–4, to zone B; areas 5–6, to zone C; area 7, being the northernmost area within zone D; and area 8+, comprising area 8 of zone D as well as zones E and F.

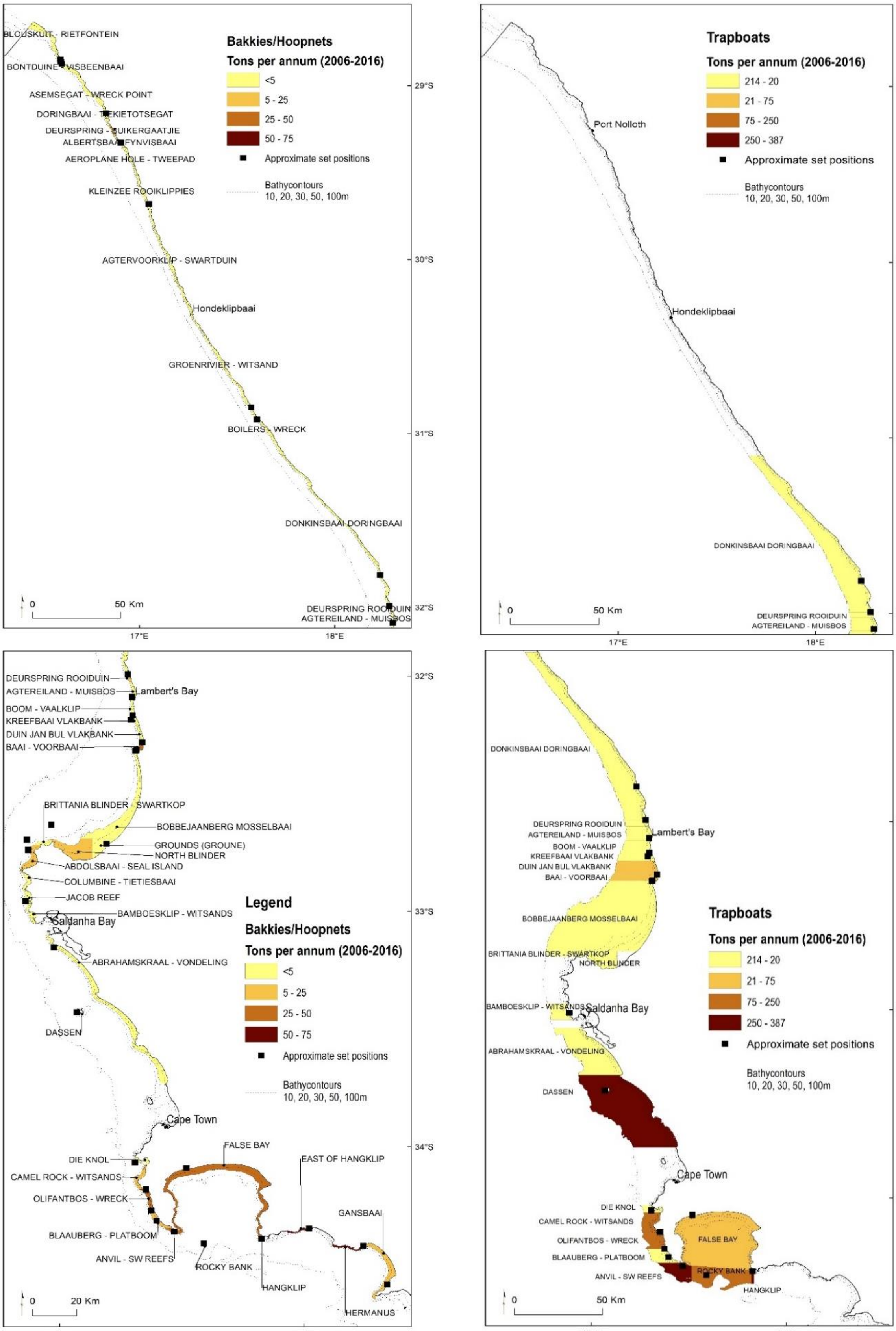


Figure 81: An overview of the spatial distribution of fishing effort expended by the west coast rock lobster inshore (bakkies/hoopnets) (left panel) and offshore (trapboat) (right panel) sectors within demarcated lobster management zones.

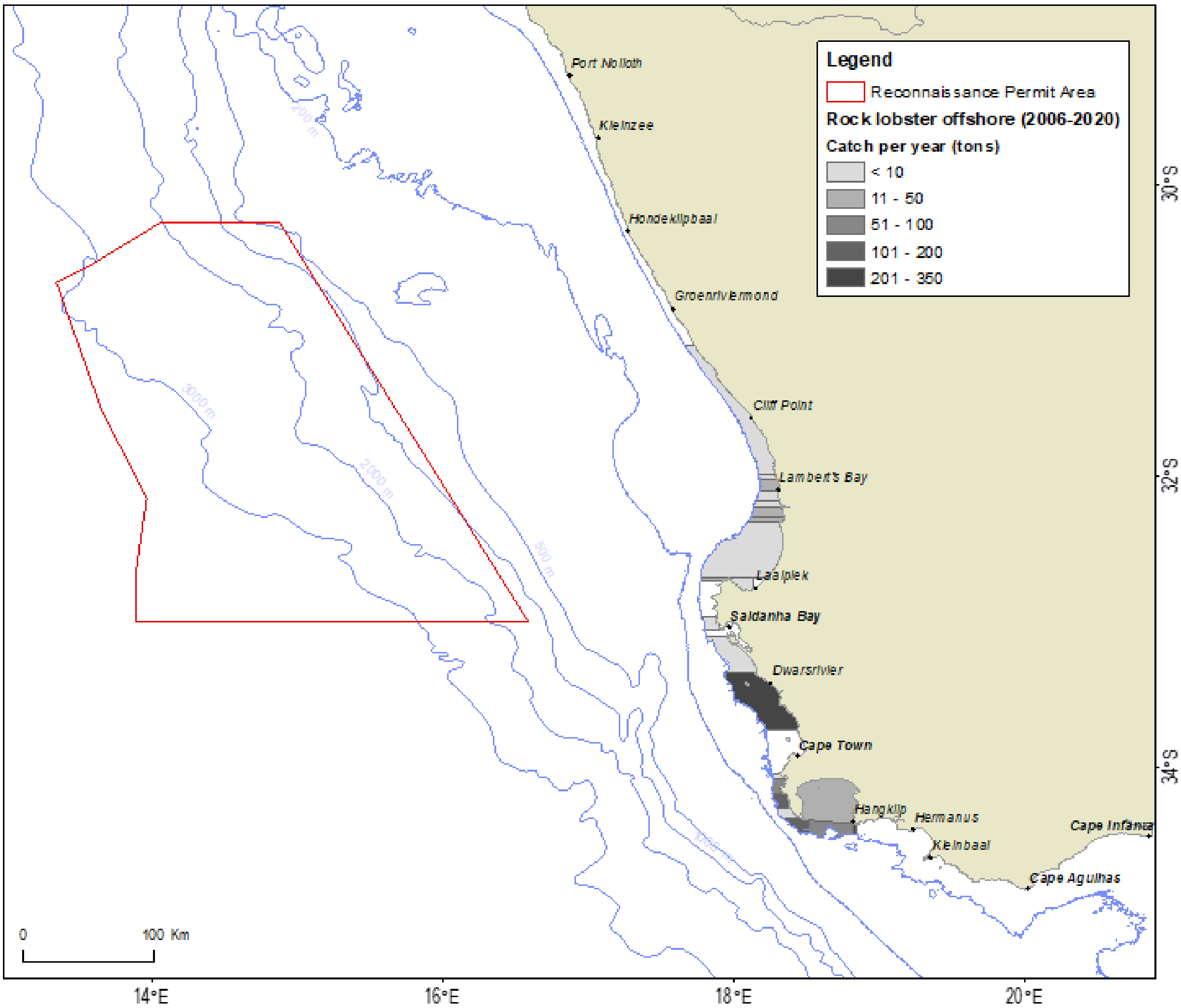


Figure 82: Spatial distribution of fishing effort expended by the west coast rock lobster offshore (trapboat) sector in relation to the Reconnaissance Permit application area.

8.5.3.10 SMALL-SCALE FISHERIES

The concept of Small-Scale Fisheries (SSF)[7] 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[8]. 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

[7] In regard to SSF, this assessment is guided by several key documents, namely the Marine Living Resources Act of 1998 (as amended); the Small Scale Fisheries Policy (2016) and in particular the Small Scale Fisheries Regulations of 2016. See also : Small-Scale Policy Implementation Plan available at http://www.smallscalefisheries.co.za/useful-resource

[8] See also the Thesis of Pretorius, G. (2022)

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. The SSF regulations (DAFF, 2016) do however define the fishing area for SSF as “"near-shore", meaning “the region of sea (including seabed) within close proximity to the shoreline”. The regulations further specify under Schedule 5 Small-scale fishing areas and zones in which “5. (1) In order to facilitate the establishment of areas where smallscale fishers may fish, the Department must set up a procedure to engage and consult with the small-scale fishing community in proposing demarcated areas that may be established as areas where small-scale fishers may fish” and which under section 5 (2)b. “take into account the mobility of each species in the allocated basket of species with sessile species requiring smaller fishing areas while nomadic and migratory species requiring larger area”.

Small-scale fishers fish to meet food and basic livelihood needs, but may also directly be involved in fishing for commercial purposes[9]. 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[10].

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 (Harris et. al. 2002; Sunde & Pedersen C. 2007; Sunde 2016.).

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 (https://www.masifundise.org/wp-content/uploads/2011/06/vissernet-eng-news-3-final.pdf). 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 (see also Pretorius, 2022). 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[11].

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[12]. 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.

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[9] There is no formal designation of artisanal (or traditional/subsistence) fishing in South Africa, which is generally considered as fishing or resource extraction for own use. As fisheries have evolved and the commercial benefit realised, subsistence fishers have increasingly moved to commercialisation aimed at supporting their livelihoods. This group can now, therefore, also include shore and boat-based anglers and spear-fishers who target a wide range of line fish species, some of which are also targeted by commercial operations, skin divers who collect rock lobsters and other subtidal invertebrates, bait collectors (mussels, limpets, red bait) and non-subsistence collectors of intertidal organisms. The high value of many intertidal and subtidal resources (e.g. rock lobster, abalone and mussels) has resulted in an increase in their production through aquaculture and small-scale harvesting in recent years (Clark et. al. 2010).

[10] The equipment used by small scale fishers includes rowing boats in some areas, motorized boats on the south and west coast and simple fishing gear including hands, feet, screw drivers, hand lines, prawn pumps, rods with reels, gaffs, hoop nets, gill nets, seine/trek nets and semi-permanently fixed kraal traps.

[11] It can include foot-fishers, but also boat fishers who may have difficult or restricted options for launching sites. Note that in some areas fishers are increasingly using more sophisticated technology such as fish finders and larger motorised boats. This ability means their activities may be increasingly commercialised and may overlap with more established commercial fishery sectors.

[12] A co-operative is jointly owned and democratically controlled by small-scale fishers.

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. The location of these coastal communities and the number of fishers per community are shown in Figure 3.41.

- In the Northern Cape, there are 103 fishers registered in the Namakwa district, comprising the Richtersveld and Kamiesberg local municipalities.
- Western Cape districts include 1) West Coast (Berg River, Saldanha Bay, Cederberg, Matzikama and Swartland local municipalities; 2) Cape Metro; 3) Overberg (Overstrand and Cape Agulhas); and 4) Eden (Knysna, Bitou and Hessequa). In total there are 2748 fishers registered in the province.
- In the Eastern Cape, the communities are again split up, broadly as 1) Nelson Mandela Bay, 2) Sarah Baartman, 3) Buffalo City, 4) Amathole, 5) O.R. Tambo and 6) Alfred Nzo. There are 5154 fishers registered in the province.
- KwaZulu-Natal has 2008 registered small-scale fishers divided by district into 1) Ugu, 2) Ethekwini Metropolitan, 3) Ilembe, 4) King Shwetshayo/Uthungula, and 5) Umkhanyakude.

Approximately 10 000 small-scale fishers have been identified around the coast. The licence block 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[13]. Section 6 of the regulations covers access Management of the rights of access and includes amongst other parts

Co-operatives can only request access to species found in their local vicinity. 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 nearshore by existing commercial sectors viz; traditional linefish, west coast rock lobster, squid, hake handline[14], 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[15], 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 (Clark, Hauk *et al*. 2002, Harris, Salo, & Russell 2010).

Snoek (*Thyrsites atun*), Cape bream / hottentot (*Pachymetopon blochii*) and yellowtail (*Seriola lalandi*) are important linefish species that are targeted by small-scale fishers operating nearshore along the West and

[13] Under the SSF regulations the species that may be included in the "basket" are provided in Annexures 2, 3 & 4 that includes fish species that are listed on the non-saleable list, and those that 2 shall only be caught for own consumption within the corresponding limits.

[14] Hake handline is a small subsector of the hake fishery and requires a fishing right apportionment. The fishery has in recent years not been active because of resource availability. It is perceived as having potential for allocation as part of the SSF and as part of their "basket".

[15] DFFE proposes that, commencing January 2021, 50% of the overall TAE and TAC for the traditional linefish and abalone sectors, respectively, will be apportioned to small-scale fishing whereas 25% of the overall TAE for squid will be apportioned to small-scale fishing (DEFF 2020).

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 to handline fishermen[16]. Snoek availability coincides with peaks in the availability of other small pelagic species, notably anchovy and sardine (Nepgen, 1979). As shown by Crawford *et al*. (1987) [17,18] snoek stay inshore on their southward migration i.e. April through to June and then move offshore into deeper waters to spawn[19] in July and August (and are not available to line fishers).

Small-scale 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 Reconnaissance Permit area (refer to

Figure 83). This assessment is however cognisant of the ongoing issues related to the perceived areas fished and species targeted by SSF off the West Coast of South Africa[20] e.g. that cultural practice of SSF may occur to 55 km offshore. While SSF regulations clearly specify that fishing is required to take place "nearshore" the actual differentiation between SSF and other fishing operations that might include SSF, such as the commercial "traditional linefish" and "pole and line" and the extent to which these commercial fisheries might include SSF, remains unclear. As such the offshore extent to which SSF may operate requires a precautionary approach in this assessment and consideration that the possibility exists (albeit a remote possibility that cannot be verified through the information made available on these fisheries), that SSF may have occurred historically and potentially in the future further offshore than suggested by the information made available for this assessment i.e. there is a remote possibility that some SSF may have targeted certain species (of which tuna and snoek are the main candidate species) further offshore than 20 km. The distance fished offshore by SSF and the associated risks determined in this assessment further necessarily considers practical aspects, notably that bottom fishing is impractical in waters deeper than 100 m and as such any bottom fishing, whether SSF or commercial, is highly unlikely beyond a precautionary depth being the 100 m depth contour. Further, in regard to migratory species, such as longfin tuna and snoek, economic and regulatory aspects relating to distances fished offshore is pertinent [i.e. such as the requirements of the South African Maritime Safety Authority (SAMSA)] in particular that most SSF are not likely to be "B" class certified (i.e. can operate up to 40 nm offshore and are longer than 9 m) are likely limited to "C" class being mainly vessels of <9 m[21] permitted to only operate < 15 nm offshore.

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[16] Snoek are known to undertake migrations in a southward direction from the waters of the northern Benguela into the southern Benguela towards the cape west and southern coasts. These migrations have certainly been long taken advantage of by fishers, including traditional linefishers and communities along the west coast. Commercial fishers as well as the Small Scale Fishery (SSF) sector capitalise on the inshore availability, but this opportunity is lost once the snoek move offshore in mid-winter and start their northward migration. Snoek are primarily a "winter" fish, moving systematically southwards in autumn and commercial linefish, recreational and community-based boats exploit this shoaling species mostly in the nearshore. Snoek are also caught by the hake trawl fleets in significant numbers at times as snoek may undertake diurnal migrations feeding or spawning in deeper waters (and are not accessible to surface line fishers at these times). There is however no definitive description of snoek migrations with regard to their exact spatial and temporal movements.

[17] The Benguela ecosystem : Part IV. pgs 438

[18] See also Nepgen (1979) in Fish. Bull. S Afr. 12:35-43

[19] 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 (Griffiths, 2002).

[20] On 22/08/22 the Western Cape High Court ruled that the process of designating SSF in the Western Cape had been "unlawful" and had to be redone.

[21] See https://www.samsa.org.za/Marine%20Notices/2011/MN%2013%20of%202011%20Small%20vessels%20Policy.pdf

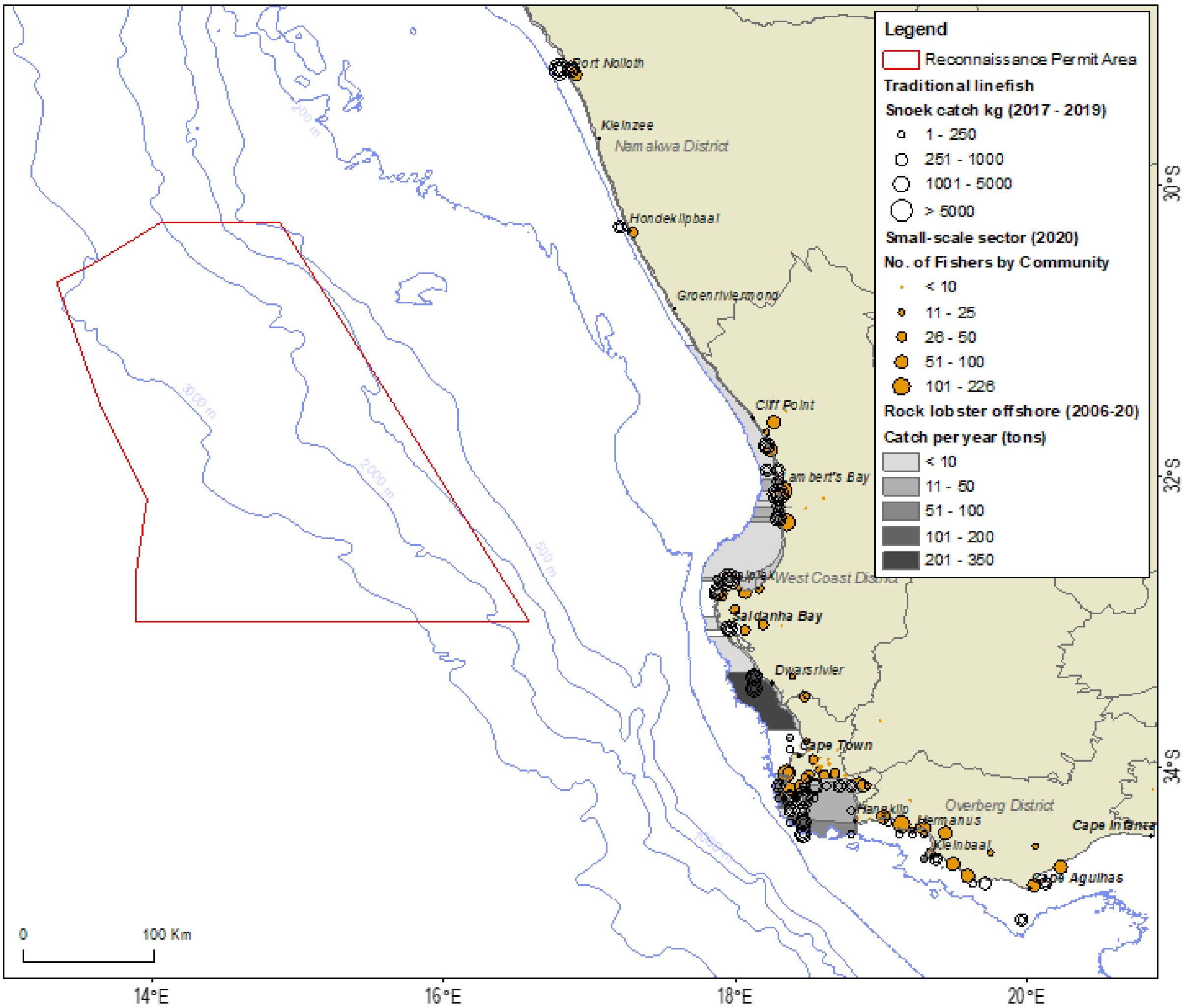


Figure 83: Overview of spatial distribution of small-scale fishing communities and number of participants per community along the South African west coast. The location of snoek catches reported by the linefish sector for the period 2017 to 2019 are shown.

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, *Chelon 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 gill-net 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 (Lamberth *et al*. 1997).

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 27 for the number of rights issued and Figure 84 for the fishing areas). The number of Rights Holders operating on the West Coast from Port Nolloth to False bay is listed as 28 for beach-seine and 162 for gillnet (DEFF, 2020). 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 linefish species that they traditionally exploited.

Table 27: 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
M	Muizenberg-Strandfontein	2	0	2	2
N	Macassar*	0	0	0	(1)
OE	Olifants River Estuary	0	45	45	45

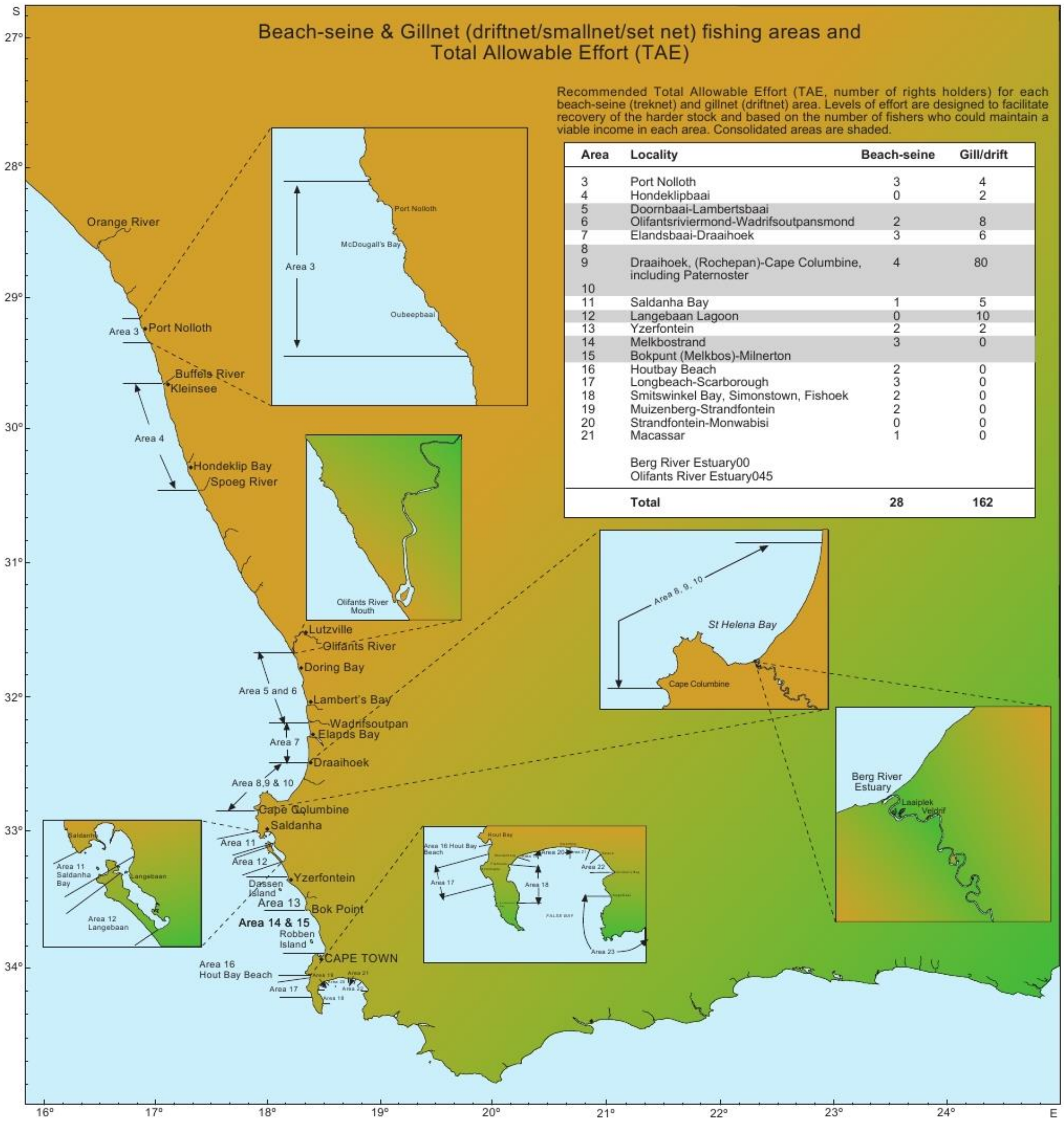


Figure 84: Beach-seine and gillnet fishing areas and TAE (DAFF, 2014)

The beach-seine fishery operates primarily on the West Coast of South Africa between False Bay and Port Nolloth (Lamberth 2006) with a few permit holders in KwaZulu-Natal targeting mixed shoaling fish during the annual winter migration of sardine (Fréon *et al*. 2010). 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).

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 (da Silva *et al*. 2015) 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.

The range of gillnets (50 m) and that of beach-seine activity (20 m) will not overlap with Reconnaissance Permit area. Figure 85 shows the expected range of gillnet fishing activity off the west coast of South Africa, situated at least 220 km from the Reconnaissance Permit area.

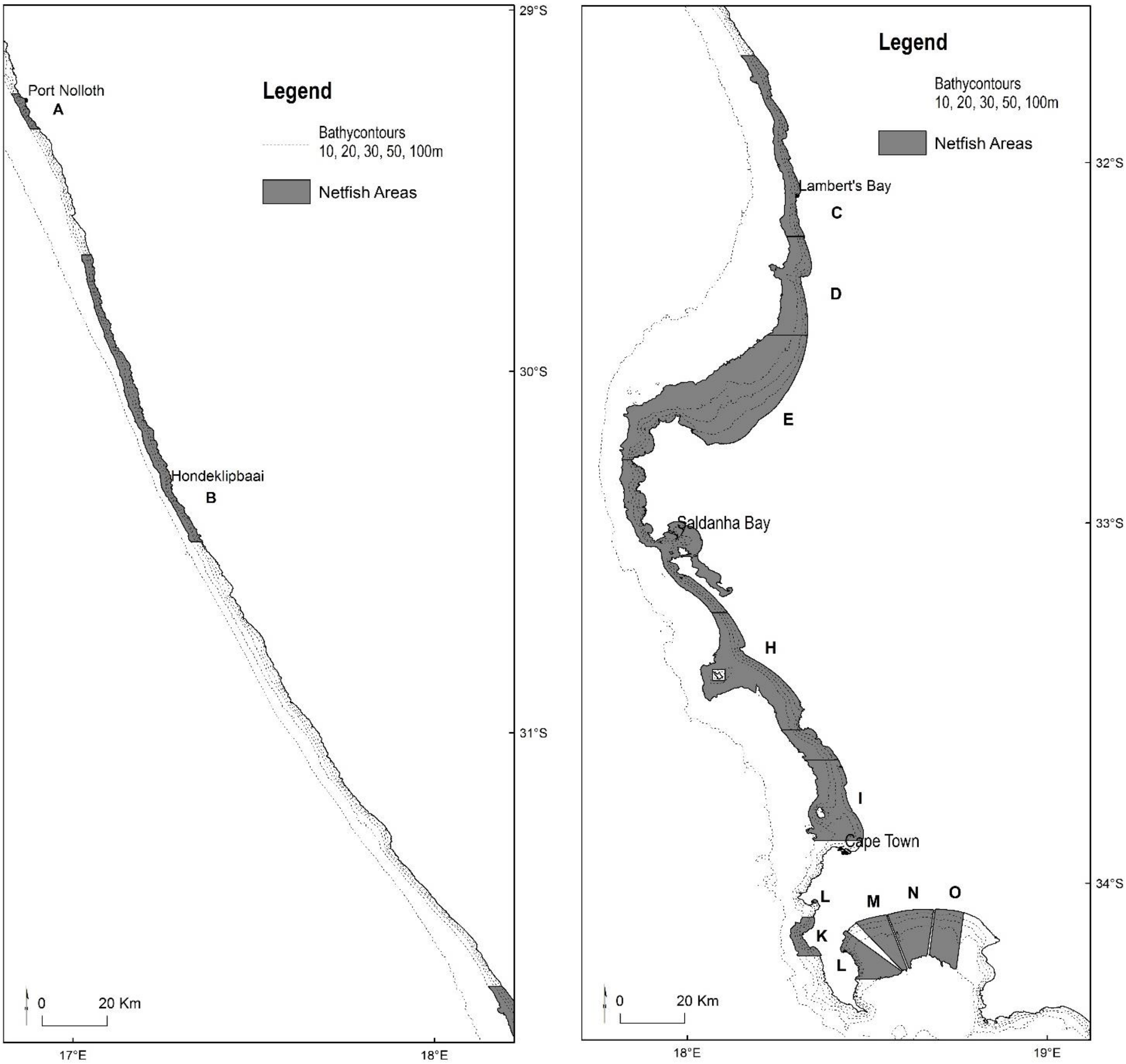


Figure 85: Netfish (gillnet and beach-seine) fishing areas (DAFF, 2016/17)

8.5.3.12 FISHERIES RESEARCH

Swept-area trawl surveys of demersal fish resources are carried out twice a year by DAFF 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/February. 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 86 shows the distribution of research trawls undertaken in relation to the Reconnaissance Permit area, with several deepwater trawls having been undertaken within the 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 isobaths, but selected transect run to the to 1 000 m contour in places. 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. Figure 86 shows the research effort undertaken off the West Coast during the November 2020 spawner biomass survey and May 2021 recruitment survey of small pelagic species. The Reconnaissance Permit area is situated at least 60 km offshore of the deepwater extent of research survey transects and there is no spatial overlap expected.

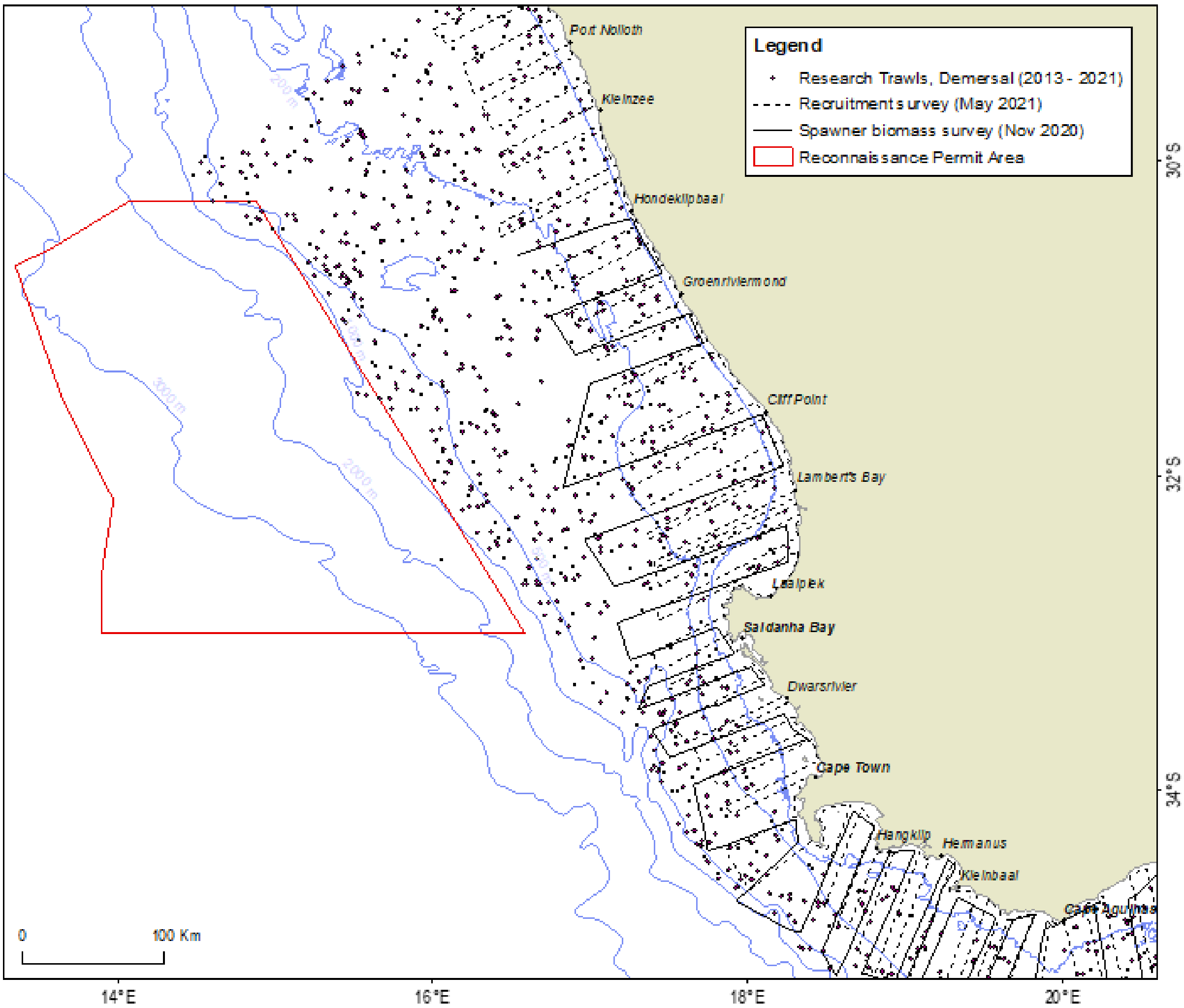


Figure 86: Spatial distribution of trawl start positions undertaken by DFFE from 2013 to 2021 to assess the biomass of demersal fish species along the West Coast. Also shown are the survey transects of recruitment and spawner biomass research surveys undertaken by DFFE in May 2021 and November 2020, respectively, in relation to the Reconnaissance Permit application area.

8.5.4 SUMMARY OF SEASONALITY IN FISHERIES

The seasonality of each of the main commercial fishing sectors that operate off the west coast (west of 20°E) of South Africa is indicated in Table 3.13. Fishing intensity within the Reconnaissance Permit application area is presented for each sector in Table 3.14.

Table 28: Summary table showing seasonal variation in fishing effort expended by each of the main commercial fisheries sectors operating off the West Coast of South Africa.

Sector	Fishing Intensity by Month (H = high; M = Low to Moderate; N = None)											
	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

Sector	Fishing Intensity by Month (H = high; M = Low to Moderate; N = None)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
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 Linefish	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 (linefish & 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

*Areas 8 and 11 only; # Area 8 only

Table 29: Summary table showing seasonal variation in relative intensity of fishing effort by fisheries sector within the Reconnaissance Permit application area.

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

8.6 OTHER USES OF THE AREA

This section provides a description of the other uses of the application area. The information has been sourced from the Marine Ecological Study undertaken by Pisces Environmental Services (Pty) Ltd included in Appendix 3.

8.6.1 BENEFICIAL USES

The Application Area is located well offshore beyond the 1 000 m depth contour. Other users of the offshore areas include the commercial fishing industry (see CapMarine 2022 – Fisheries Specialist Study), with marine diamond mining concessions being located well inshore of the eastern portion of the Reconnaissance Permit Area (Figure 88). Recreational activities along the coastline north of St Helena Bay are limited to the area around Lambert's Bay, Hondeklip Bay and Port Nolloth.

On the Namaqualand coast marine diamond mining activity is restricted to nearshore, diver-assisted operations from small, converted fishing vessels working in the a-concessions, which extend to 1 000 m offshore of the high-water mark. No deep-water diamond mining is currently underway in the South African offshore concession areas, although prospecting activities are ongoing. In Namibian waters, deep-water diamond mining by De Beers Marine Namibia is currently operational in the Atlantic 1 Mining Licence Area, immediately to the northeast of the Reconnaissance Permit Area.

These mining operations are typically conducted to depths of 150 m from fully self-contained mining vessels with on board processing facilities, using either large-diameter drill or seabed crawler technology. The vessels operate as semi-mobile mining platforms, anchored by a dynamic positioning system, commonly on a three to four anchor spread (Figure 87). Computer-controlled positioning winches enable the vessels to locate themselves precisely over a mining block of up to 400 m x 400 m. These mining vessels thus have limited manoeuvrability and other vessels should remain at a safe distance.

Other industrial uses of the marine environment include the intake of feedwater for mariculture, or diamond-gravel treatment, submarine telecommunications cables, ammunition dumps and hydrocarbon wellheads (Figure 88). None of these activities should in any way be affected by 3D seismic survey activities offshore.

Figure 87: Typical crawler-vessel (left) and drillship (right) operating in the Atlantic 1 Mining Licence Area (Photos: De Beers Marine).

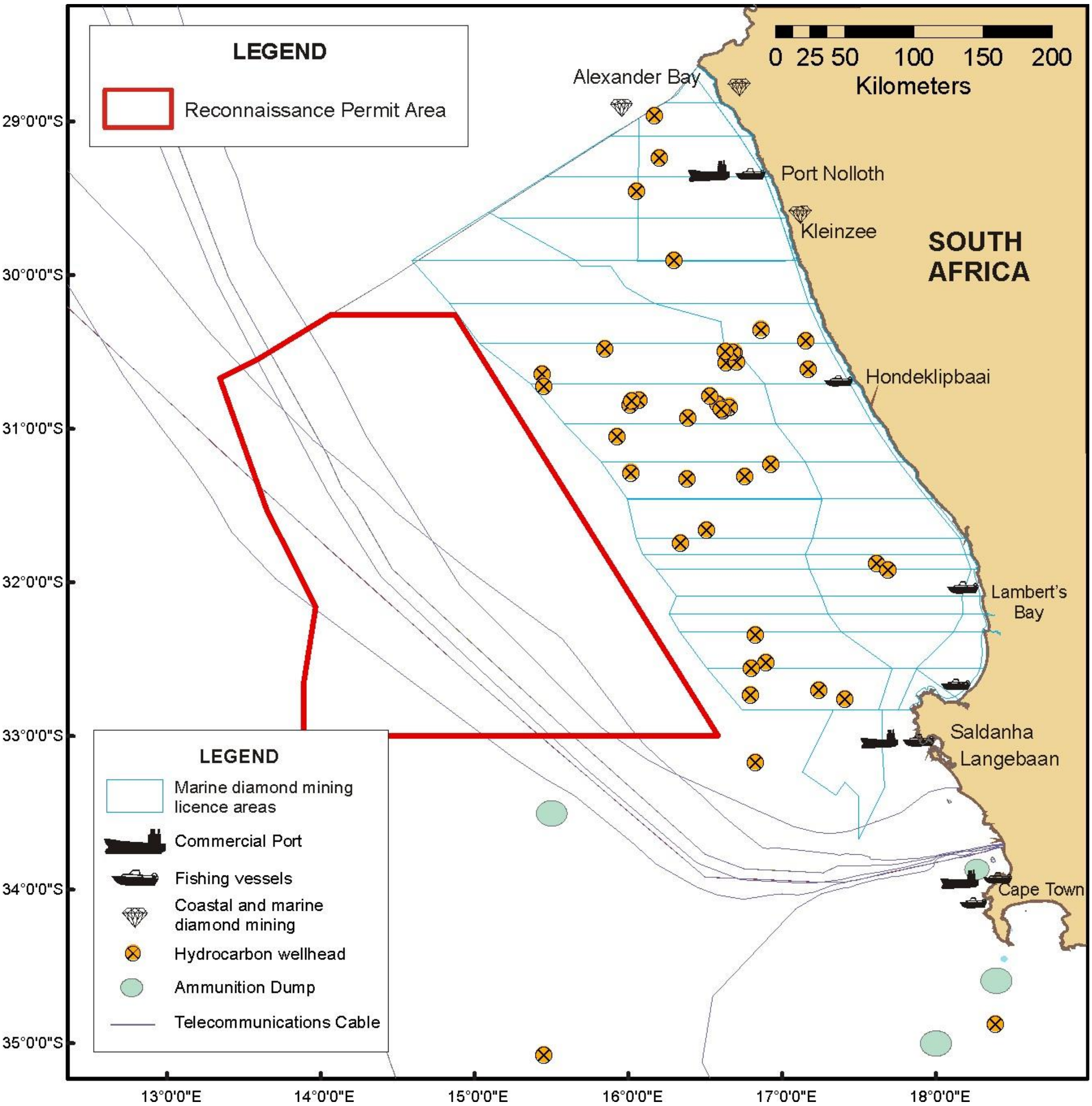


Figure 88: The Reconnaissance Permit Area (red polygon) in relation to project - environment interaction points on the West Coast, illustrating the location of marine diamond mining concessions and ports for commercial and fishing vessels. Existing hydrocarbon wellheads, telecommunications cables and ammunition dumps are also shown.

8.6.2 CONSERVATION AREAS AND MARINE PROTECTED AREAS

Numerous sanctuaries, marine protected area (MPA) exist offshore and along the coastline of the West coast, although none of them overlap with the Reconnaissance Permit Area. For the sake of completeness, these are described in more detail below.

8.6.2.1 **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 (Mayfield *et al*. 2005). They lie well inshore or to the south of the Reconnaissance Permit Area.

8.6.2.2 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 (Emanuel *et al*. 1992, Lombard *et al*. 2004). 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) (Lombard *et al*. 2004; Sink *et al*. 2012). Using biodiversity data mapped for the 2004 and 2011 NBAs a systematic biodiversity plan was developed for the West Coast (Majiedt *et al*. 2013) 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 89. 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 MPA lies ~10 km to the north of the northern boundary of the Reconnaissance Permit Area.

The 1 335 km^2 **Child's Bank MPA**, located 27 km inshore of the Reconnaissance Permit Area at its closest point, 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 (Sink *et al*. 2014). The MPA represents the least trawled stretch of muddy seabed on the west coast. This MPA is located 28 km east of the southern portion of the Reconnaissance Permit Area.

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 km^2 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 sea fans, 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 MPA lies 78 km east of the south-eastern corner of the Reconnaissance Permit Area.

The **Namaqua Fossil Forest MPA**, which lies ~173 km inshore of the Reconnaissance Permit 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, which 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.

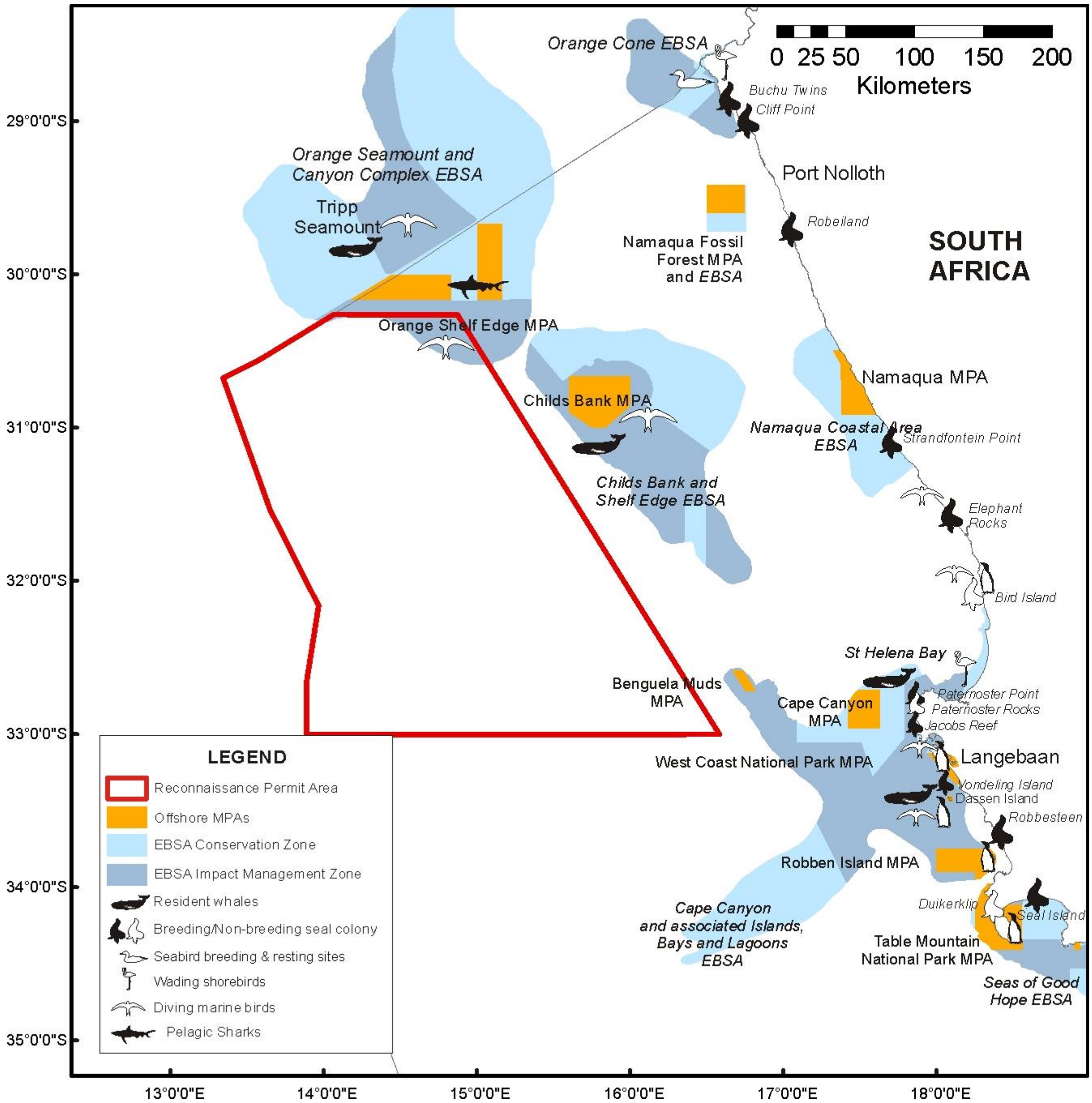


Figure 89: The Reconnaissance Permit Area (red polygon) in relation to project - environment interaction points on the West Coast, illustrating the location of seabird and seal colonies and resident whale populations, Marine Protected Areas (MPAs) and Ecologically and Biologically Significant Areas (EBSAs).

8.6.2.3 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 (Sink *et al*. 2019) (Figure 90). 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 (Sink *et al*. 2019). 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 Application Area are either poorly protected or not protected.

8.6.2.4 **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 (see Figure 89), 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.

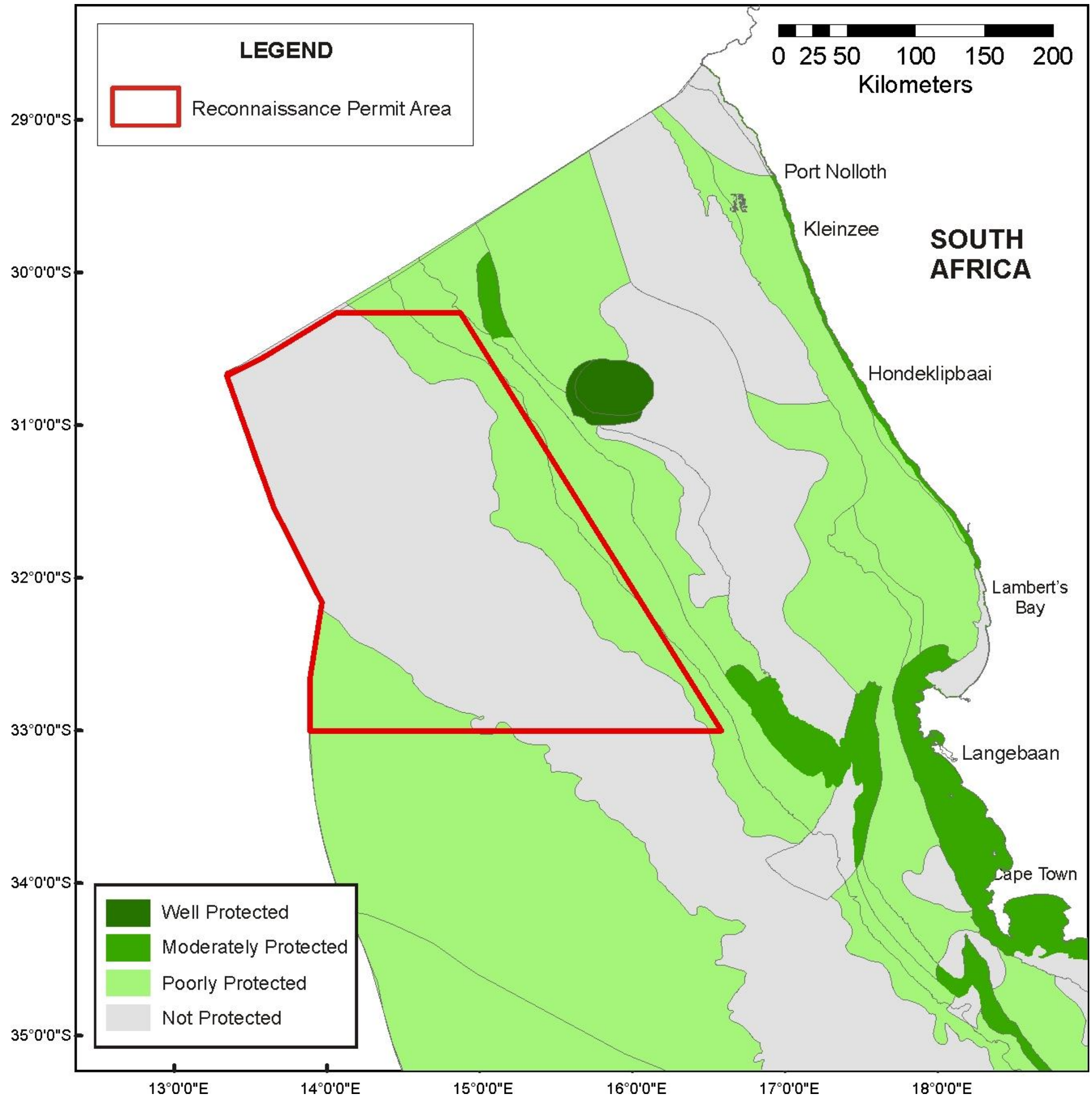


Figure 90: The Reconnaissance Permit Area (red polygon) in relation to protection levels of 150 marine ecosystem types as assessed by Sink *et al*. (2019).

The following summaries of the EBSAs in the Reconnaissance Permit area are adapted from http://cmr.mandela.ac.za/EBSA-Portal/Namibia/.

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 (SST mean = 18.3°C) and moderate chlorophyll levels related to the eastern limit of the Benguela upwelling on the outer shelf. There is aa slight overlap of the Reconnaissance Permit Area with this EBSA.

The **Orange Cone transboundary EBSA** lies well inshore of the Reconnaissance Permit 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 inshore of the Reconnaissance Permit 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 scleractinian 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 ~ 17 km east of the Reconnaissance Permit Area at its closest point, 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 well inshore of the Reconnaissance Permit 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 ~ 20 km inshore of the southern portion of the Reconnaissance Permit Area at its closest point. 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.

8.6.2.5 BIODIVERSITY PRIORITY AREAS

The National Coastal and Marine Spatial Biodiversity Plan[22] 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 Application Area overlaps with areas mapped as Critical Biodiversity Area 1 (CBA 1): Natural and Critical Biodiversity Area 2: (CBA 2) Natural. Approximately 32.25 % of the proposed 3D acquisition area is covered by CBA 1 and CBA 2 Natural, 0.22% by CBA 1 and CBA 2 Restore, and 1.75% by ESA (see Figure 91). 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 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.

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 (Harris *et al*. 2022).

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 – as is the case for this assessment), 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 (Harris *et al*. 2022).

[22] The latest version of National Coastal and Marine Spatial Biodiversity Plan (v1.2 was released in April 2022) (Harris *et al.* 2022). The Plan is intended to be used by managers and decision-makers in those national government departments whose activities occur in the coastal and marine space, e.g., environment, fishing, transport (shipping), petroleum, mining, and others. It is relevant for the Marine Spatial Planning Working Group where many of these departments are participating in developing South Africa's emerging marine spatial plans. It is also intended for use by relevant managers and decision-makers in the coastal provinces and coastal municipalities, EIA practitioners, organisations working in the coast and ocean, civil society, and the private sector.

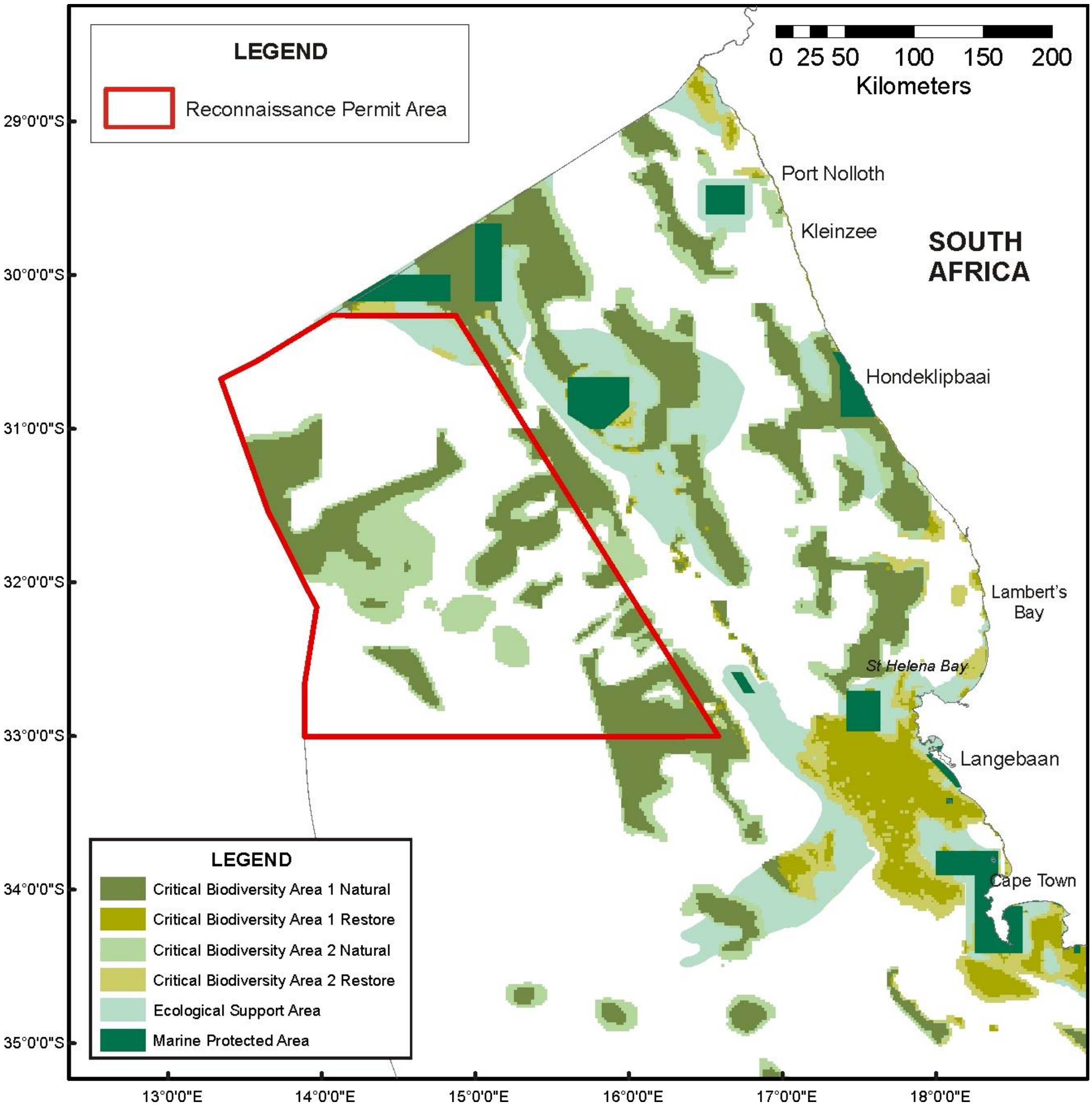


Figure 91: The Reconnaissance Permit Area (red polygon) in relation to Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) (Version 1.2 April 2022).

8.6.2.6 IMPORTANT BIRD AREAS (IBAS)

There are numerous coastal Important Bird Areas (IBAs) in the general project area (Table 30) (www. http://datazone.birdlife.org/). These are all located well inshore of the Reconnaissance Permit area and should in no way be directly affected by the proposed seismic surveys.

Table 30: List of Important Bird Areas (IBAs) and their criteria listings. RAMSAR sites are bolded.

Site Name	IBA Criteria
Orange River Mouth Wetlands (ZA023)	**A1, A3, A4i, A4iii**
Olifants River Estuary (ZA078)	A3, A4i
Verlorenvlei Estuary (ZA082)	**A4i**
Berg River Estuary (ZA083)	**A4i**

Site Name	IBA Criteria
West Coast National Park and Saldanha Bay Islands (ZA 084) (incorporating Langebaan RAMSAR site)	**A1, A4i, A4ii, A4iii**
Dassen Island (ZA088)	**A1, A4i, A4ii, A4iii**
Robben Island (ZA089)	A1, A4i, A4ii, A4iii
Rietvlei Wetland: Table Bay Nature Reserve (ZA090)	A1, A4i
Boulders Beach (ZA096)	A1
False Bay Nature Reserve (ZA095)	**A1, A4i, A4iii**

A1. Globally threatened species; A2. Restricted-range species; A3. Biome-restricted species;

A4. Congregations: i. applies to 'waterbird' species; ii. This includes those seabird species not covered under I; iii. modelled on criterion 5 of the Ramsar Convention for identifying wetlands of international importance. The use of this criterion is discouraged where quantitative data are good enough to permit the application of A4i and A4ii.

The Orange River Mouth wetland located ~235 km to the northeast of the Reconnaissance Permit Area provides an important habitat for large numbers of a great diversity of wetland birds and is listed as a Global IBA (www. http://datazone.birdlife.org/). The area was designated a Ramsar site in June 1991, and processes are underway to declare a jointly-managed transboundary Ramsar reserve.

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 92). There is no overlap of the Reconnaissance Permit Area with any of these Marine IBAs.

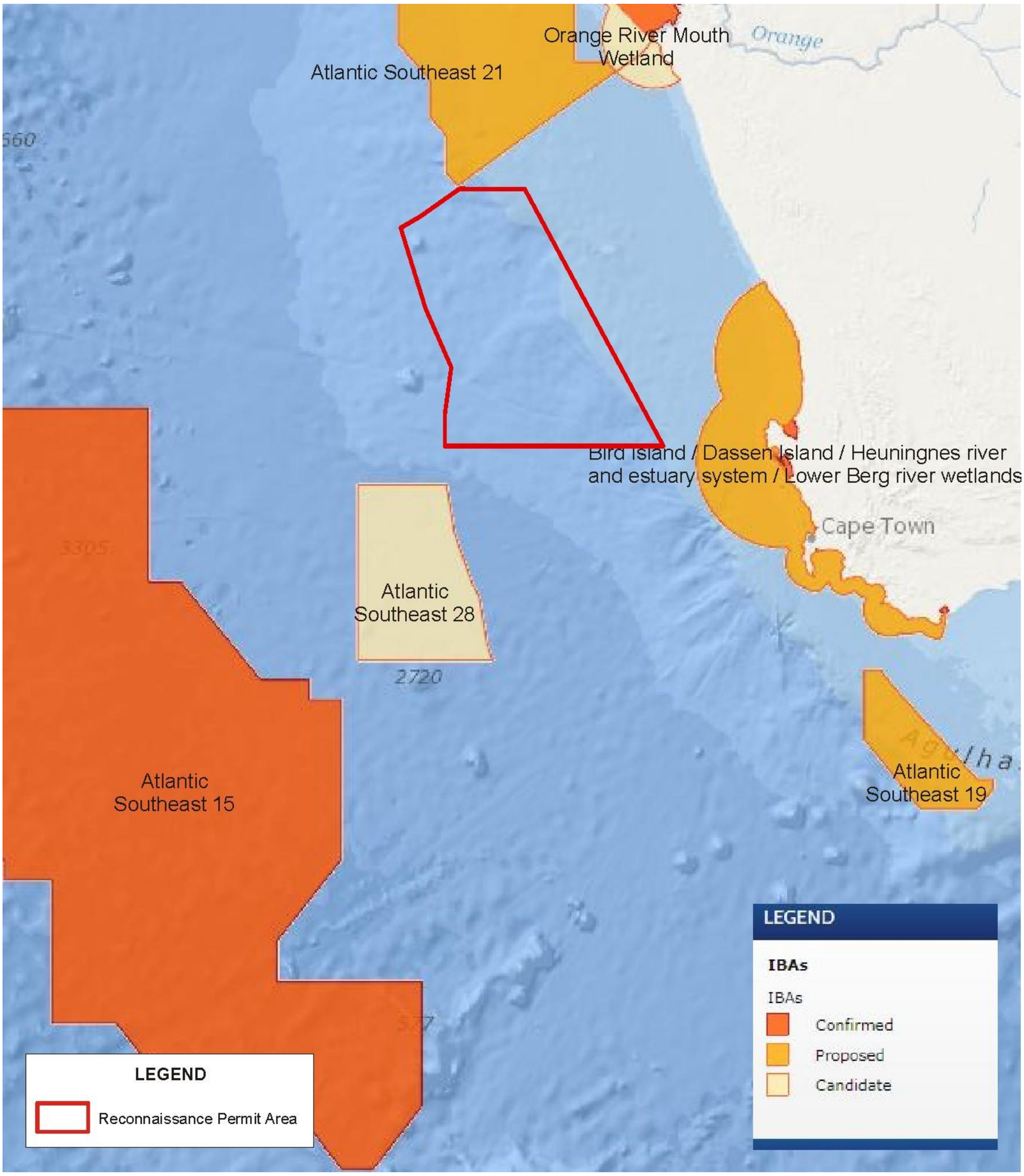


Figure 92: The Reconnaissance Permit Area (red polygon) in relation to coastal and marine IBAs in Namibia (Source: https://maps.birdlife.org/marineIBAs).

8.6.2.7 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.

Modelled on the BirdLife International process for determining IBAs, IMMAs are assessed against a number of criteria and sub-criteria, which are designed to capture critical aspects of marine mammal biology, ecology and population structure. These criteria are:

- **Criterion A – Species or Population Vulnerability**
    - Areas containing habitat important for the survival and recovery of threatened and declining species.
- **Criterion B – Distribution and Abundance**
    - Sub-criterion B1 – Small and Resident Populations: Areas supporting at least one resident population, containing an important proportion of that species or population that are occupied consistently.
    - Sub-criterion B2 – Aggregations: Areas with underlying qualities that support important concentrations of a species or population.
- **Criterion C – Key Life Cycle Activities**
    - Sub-criterion C1 – Reproductive Areas: Areas that are important for a species or population to mate, give birth, and/or care for young until weaning.
    - Sub-criterion C2 – Feeding Areas: Areas and conditions that provide an important nutritional base on which a species or population depends.
    - Sub-criterion C3 – Migration Routes: Areas used for important migration or other movements, often connecting distinct life-cycle areas or the different parts of the year-round range of a non-migratory population.
- **Criterion D – Special Attributes**
    - Sub-criterion D1 – Distinctiveness: Areas which sustain populations with important genetic, behavioural or ecologically distinctive characteristics.
    - Sub-criterion D2 – Diversity: Areas containing habitat that supports an important diversity of marine mammal species

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 93) namely the following:

- 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).

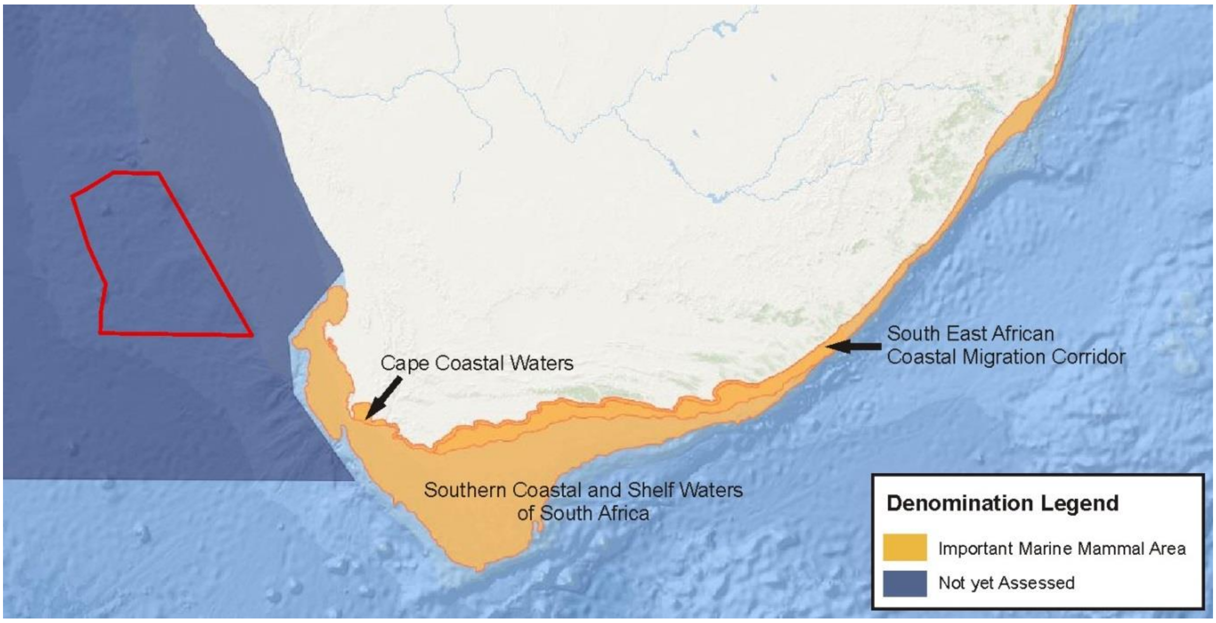


Figure 93: Reconnaissance Permit Area (red polygon) in relation to coastal and marine IMMAs (Source: www.marinemammalhabitat. org/imma-eatlas/).

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 (Criterion A, B1), Bryde's whale (Criterion C2), Indo-Pacific bottlenose dolphin (Criterion B1, C3, D1), Common dolphin (Criterion C2) and Cape fur seal (criterion C2). The IMMA covers the area supporting the important 'sardine run' and the marine predators that follow and feed on the migrating schools (Criterion C2) 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 km^2. 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 Reconnaissance Permit 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 3.

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 Community Survey 2016, the population of South Africa is approximately 55,7 million and has shown an increase of about 7.5% since 2011. The household density for the country is estimated on approximately 3.29 people per household, indicating an average household size of 3-4 people (leaning towards 3) 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 31) and the increases were well above the national average. The Richtersveld Local Municipality where Port Nolloth is located is the only one of the coastal municipalities in the Northern Cape that showed an increase in population. 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 km^2 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 94 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 95 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 31: Population density and growth estimates (sources: Census 2011, Community Survey 2016)

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**	**1,193,780**	**3.07**	**3.20**	**4.18**
Namakwa DM	*126,836*	*115,842*	*115,488*	*0.91*	*0.91*	*-0.31*
Richtersveld LM	9,608	11,982	12,487	1.25	1.30	4.21
Nama Khoi LM	17,990	47,041	46,512	2.61	2.59	-1.12
Kamiesberg LM	14,208	10,187	9,605	0.72	0.68	-5.71
Western Cape	**129,462**	**5,822,734**	**6,279,730**	**44.98**	**48.51**	**7.85**
West Coast DM	*31,118*	*391766*	*436,403*	*12.59*	*14.02*	*11.39*
Matzikama LM	12,981	67147	71,045	5.17	5.47	5.81
Cederberg LM	8,007	49,768	52,949	6.22	6.61	6.39
Bergrivier LM	4,407	61,897	67,474	14.05	15.31	9.01
Saldanha Bay LM	2,015	99,193	111,173	49.23	55.17	12.08
Swartland LM	3,708	113,762	133,762	30.68	36.07	17.58
City of Cape Town Metropolitan	*2,441*	*3,740,026*	*4,004,793*	*1,532.17*	*1,640.64*	*7.08*

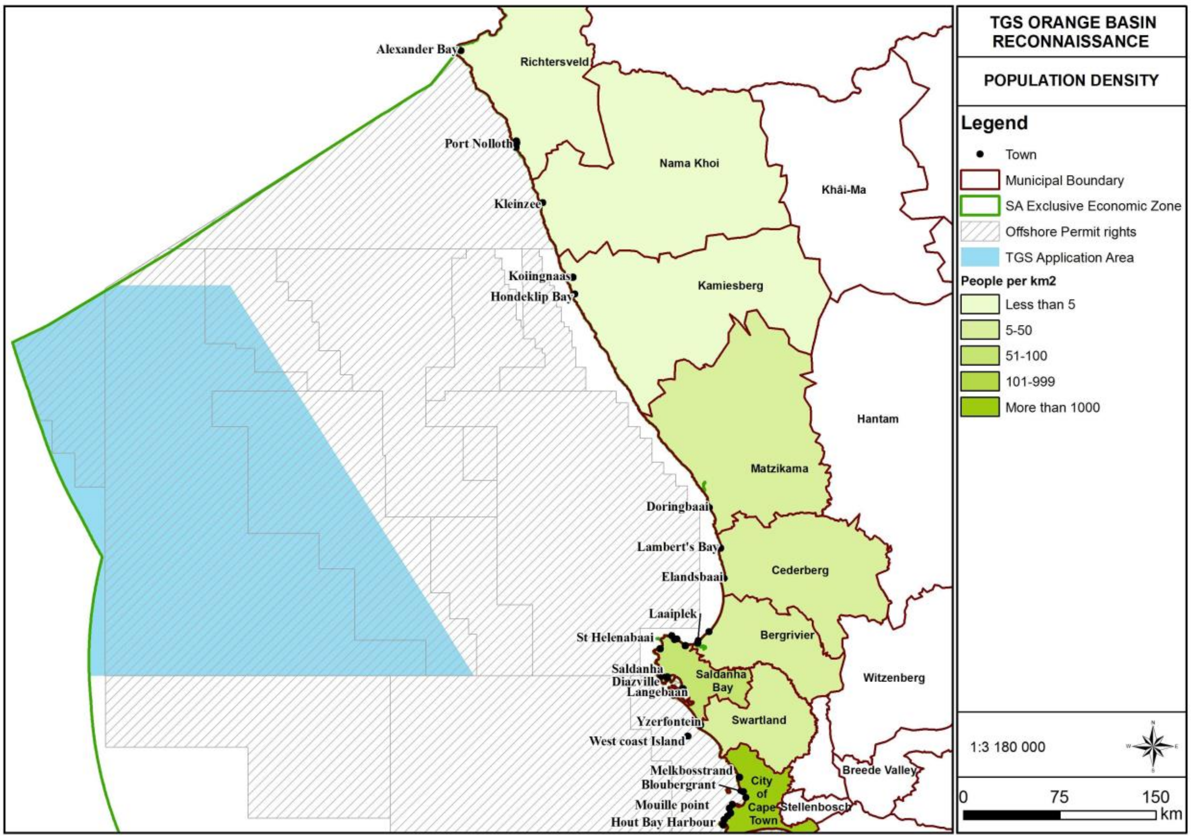


Figure 94: Population density (source: Community Survey 2016)

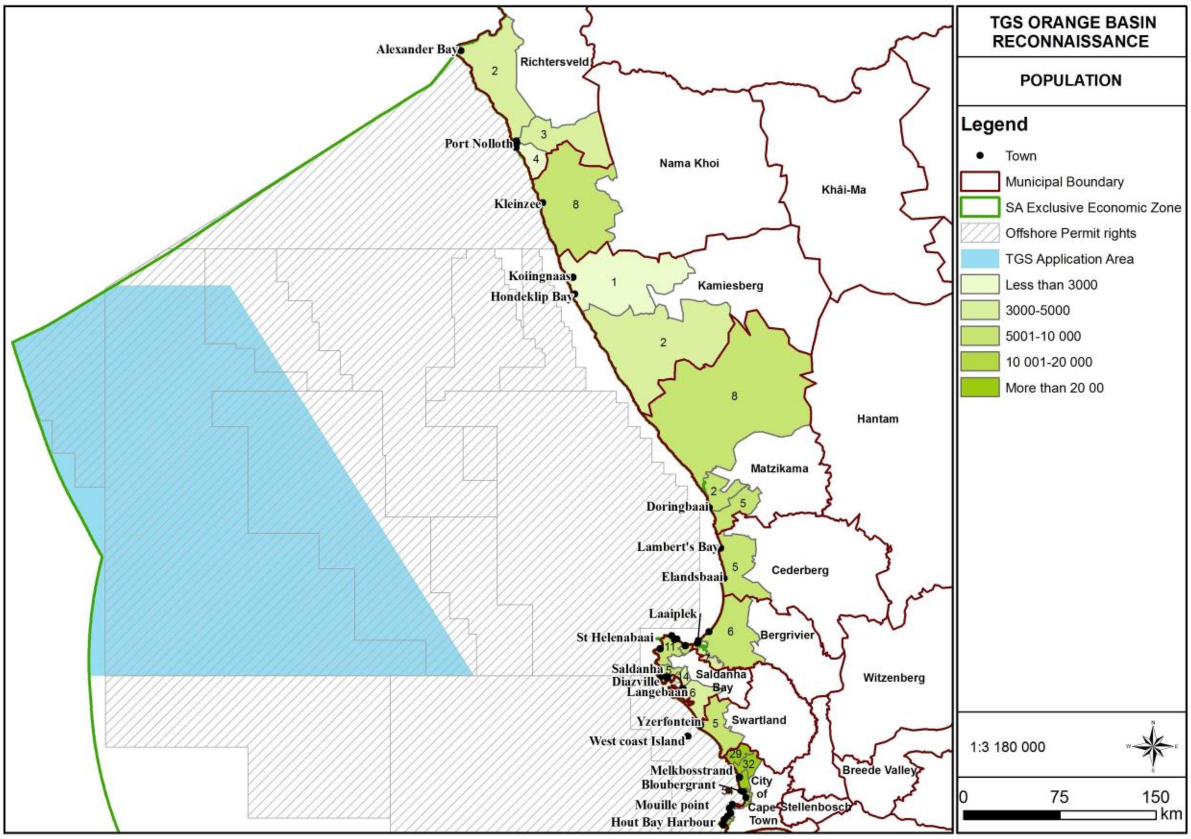


Figure 95: People per ward (source: Census 2011)

The number of households in the study area has increased on all levels (Table 32). The proportionate increase in households were greater than the increase in population on all levels. The greatest proportional increases in households were in the Swartland and Saldanha Bay Local Municipalities. The average household size has shown a decrease on all levels, which means there are more households, but with less members.

Table 32: Household sizes and growth estimates (sources: Census 2011, Community Survey 2016)

Area	Households 2011	Households 2016	Average household size 2011	Average household size 2016	Growth in households (%)
Northern Cape	**301,405**	**353,709**	**3.80**	**3.38**	**17.35**
Namakwa DM	*33,856*	*37,669*	*3.42*	*3.07*	*11.26*
Richtersveld LM	3,543	4,211	3.38	2.97	18.85
Nama Khoi LM	13,193	14,546	3.57	3.20	10.26
Kamiesberg LM	3,143	3,319	3.24	2.89	5.60
Western Cape	**1,634,000**	**1,933,876**	**3.56**	**3.25**	**18.35**
West Coast DM	*106,781*	*129,862*	*3.67*	*3.36*	*21.62*
Matzikama LM	18,835	20,821	3.57	3.41	10.54
Cederberg LM	13,513	15,279	3.68	3.47	13.07
Bergrivier LM	16,275	19,072	3.80	3.54	17.19
Saldanha Bay LM	28,835	35,550	3.44	3.13	23.29
Swartland LM	29,324	39,139	3.88	3.42	33.47
City of Cape Town Metropolitan	*1,068,573*	*1,264,849*	*3.50*	*3.17*	*18.37*

Figure 96 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.

The Kamiesberg Local Municipality has the highest total dependency ratio (Table 33), while in the Richtersveld Local Municipality have 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 are the highest. This suggests high levels of poverty in these areas. Figure 97 and Figure 98 show the total and employed dependency ratios on a ward level.

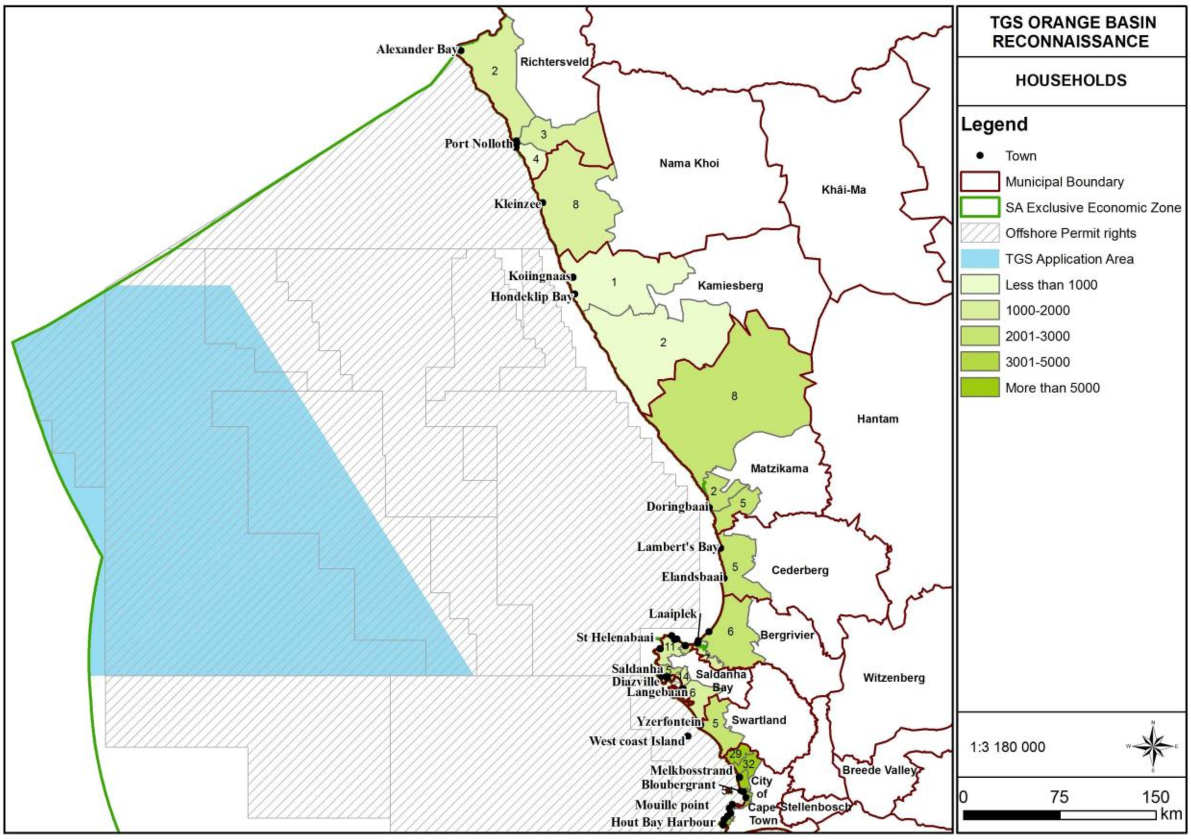


Figure 96: Households per ward (source: Census 2011)

Table 33: Total dependency ratios (source: Census 2011).

Area	Total dependency	Youth dependency	Aged dependency	Employed dependency
Northern Cape	**55.75**	**46.94**	**8.80**	**75.32**
Namakwa DM	***51.23***	***39.01***	***12.22***	***70.92***
Richtersveld LM	*42.51*	*33.96*	*8.55*	*61.38*
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*
Ward 8	45.05	35.42	9.63	76.99
Kamiesberg LM	*57.89*	*41.84*	*16.05*	*78.37*
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**
West Coast DM	***45.92***	***37.14***	***8.78***	***63.98***
Matzikama LM	*49.39*	*40.05*	*9.34*	*64.55*
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*

Area	Total dependency	Youth dependency	Aged dependency	Employed dependency
Ward 5	51.76	38.06	13.70	69.48
Bergrivier LM	*46.89*	*36.62*	*10.27*	*61.61*
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*
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*
Ward 5	50.76	33.31	17.44	58.03
City of Cape Town Metropolitan	***43.61***	***35.65***	***7.97***	***65.39***
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

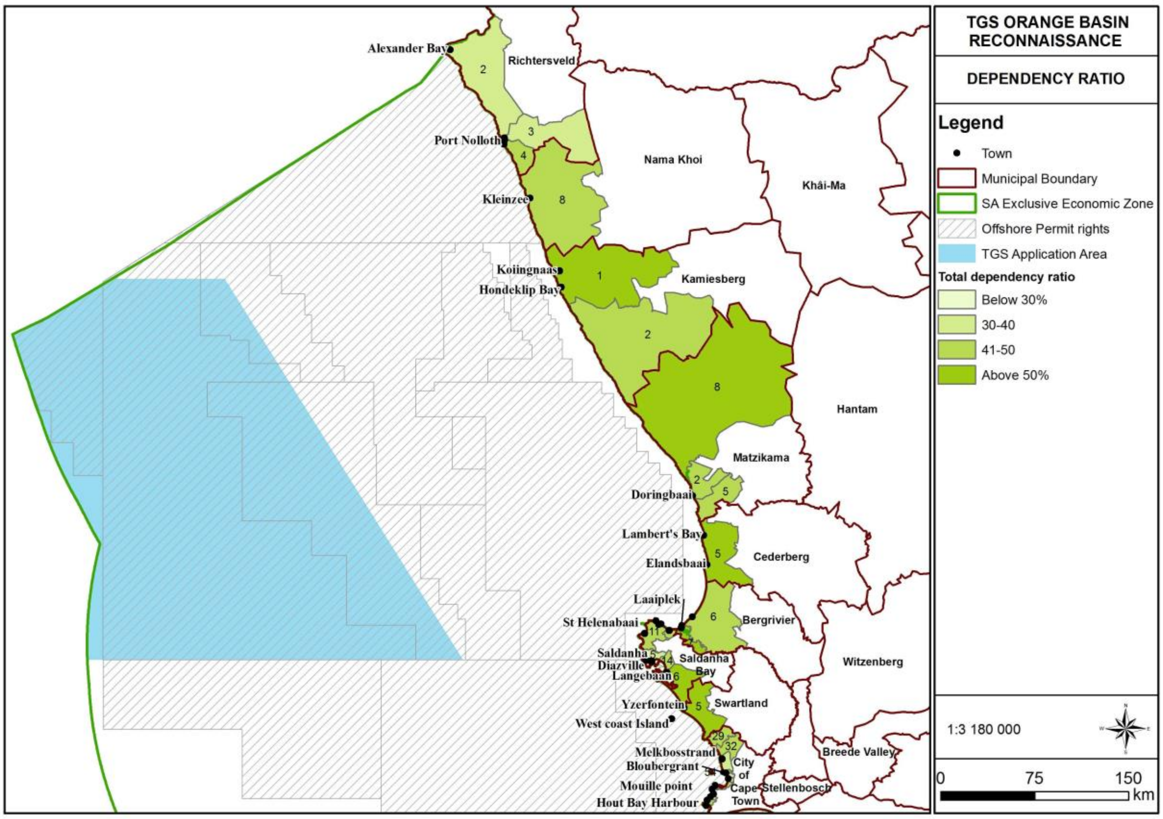


Figure 97: Total dependency ratios (source: Census 2011)

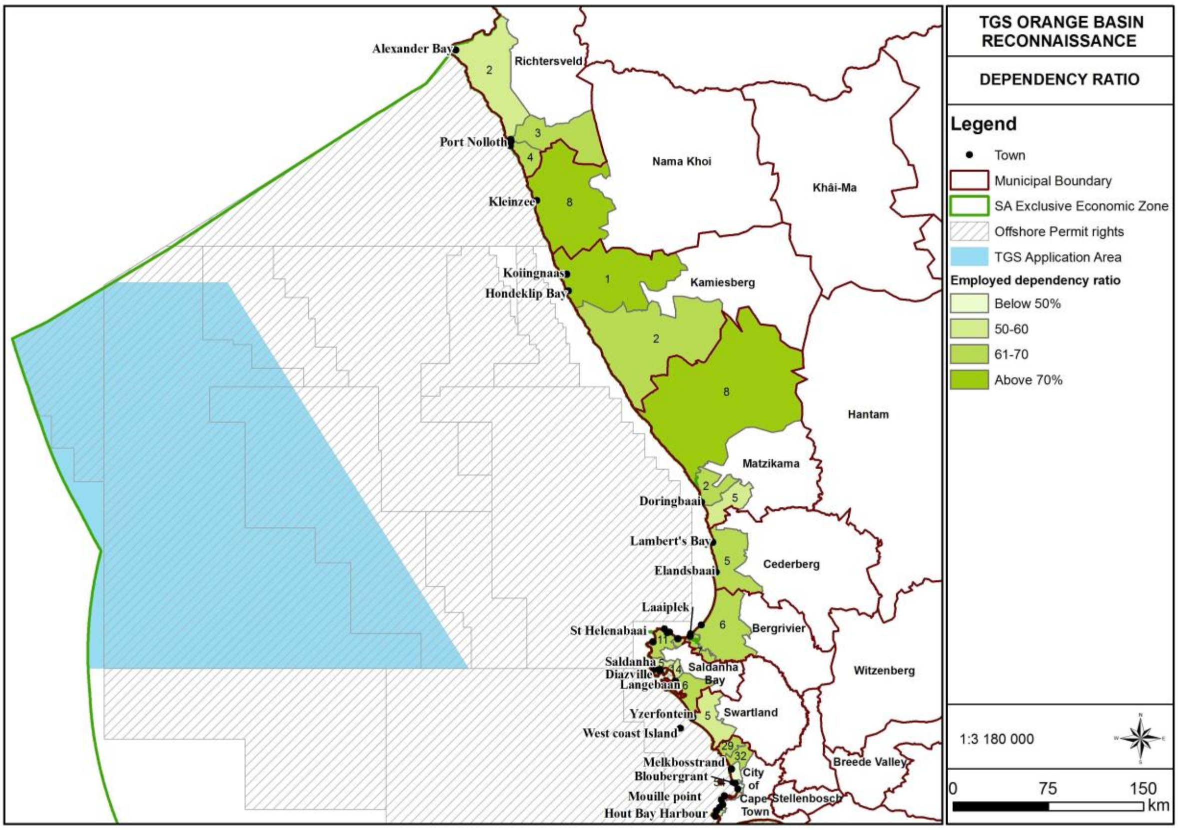


Figure 98: Employed dependency ratio (source: Census 2011).

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 (Table 34), indicating an increase in the number of multi-dimensionally poor households.

The intensity of poverty experienced refers to the average proportion of indicators in which poor households are deprived (Statistics South Africa, 2014). 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 34) 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 34: 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 99). 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 100).

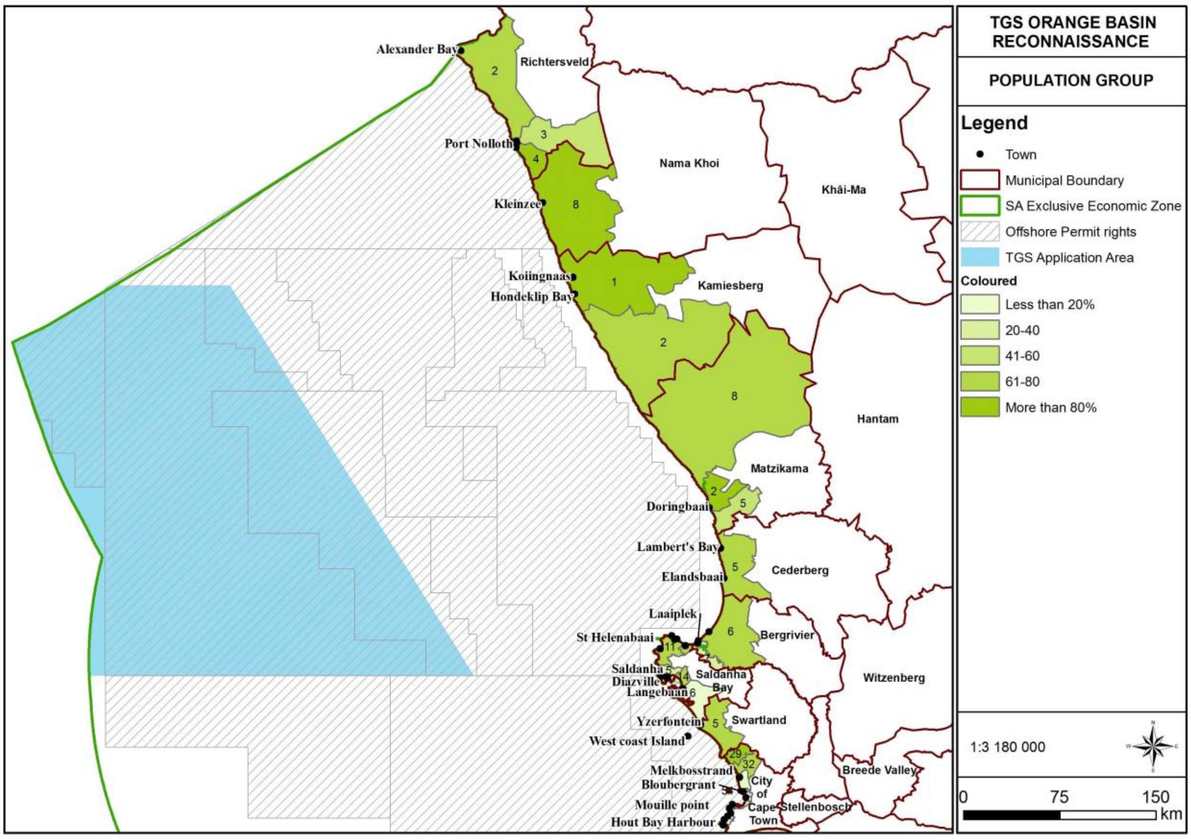


Figure 99: Classified as Coloured (shown in percentage, source: Census 2011)

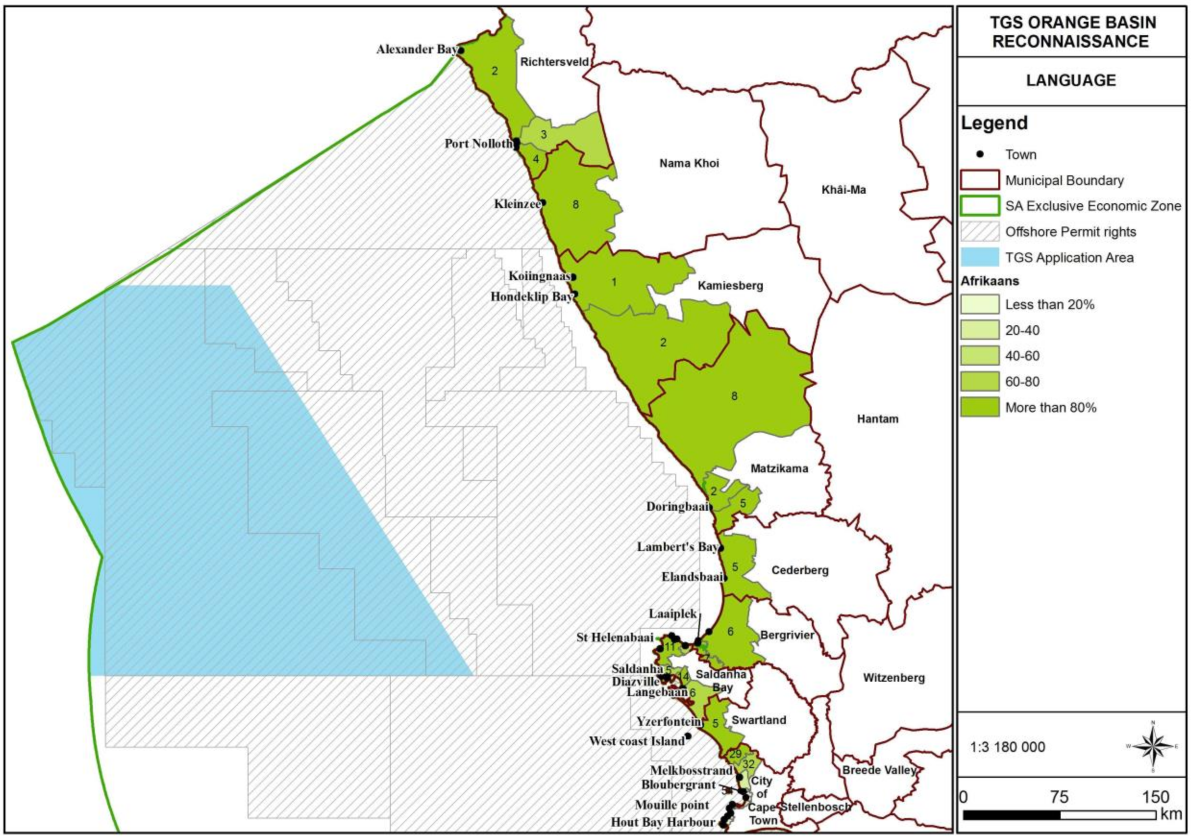


Figure 100: Home language Afrikaans (shown in percentage, source; Census 2011)

8.7.1.3 EDUCATION

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 101).

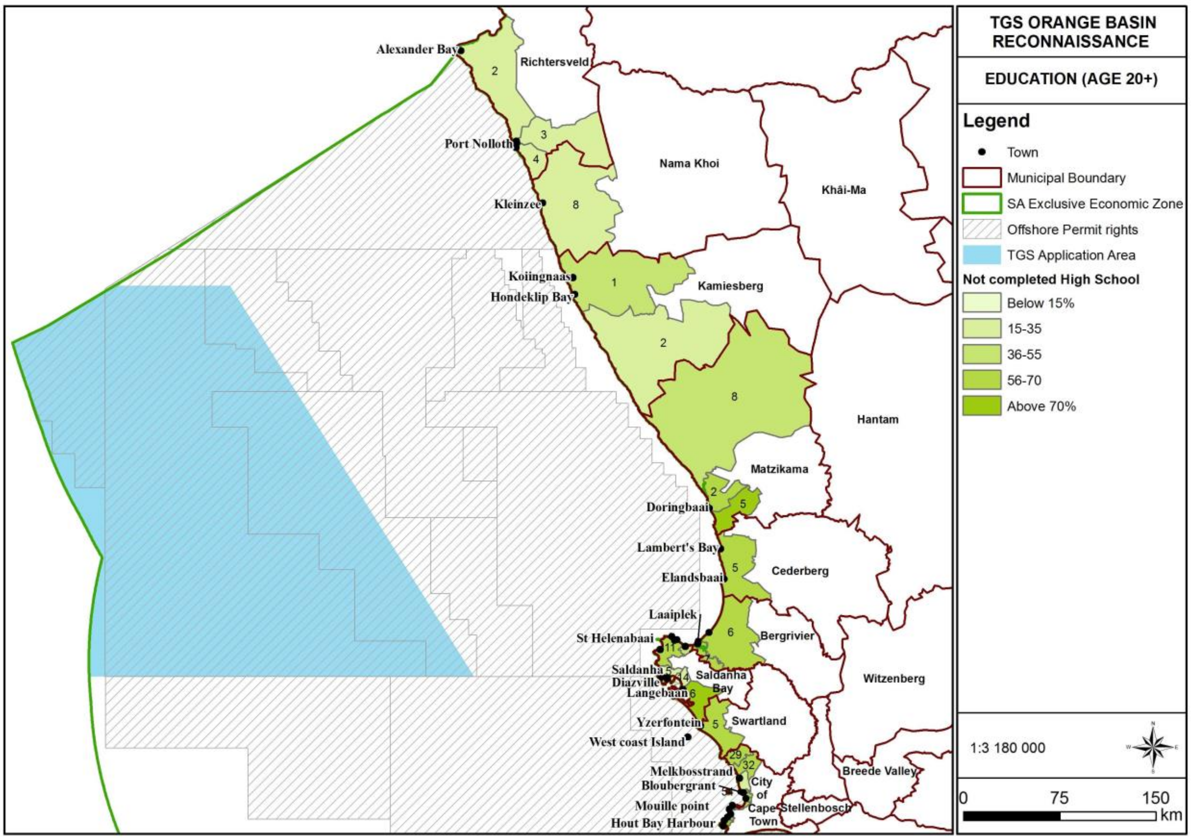


Figure 101: Proportion of people that did not complete secondary school (shown in percentage, source: Census 2011).

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 102). 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.

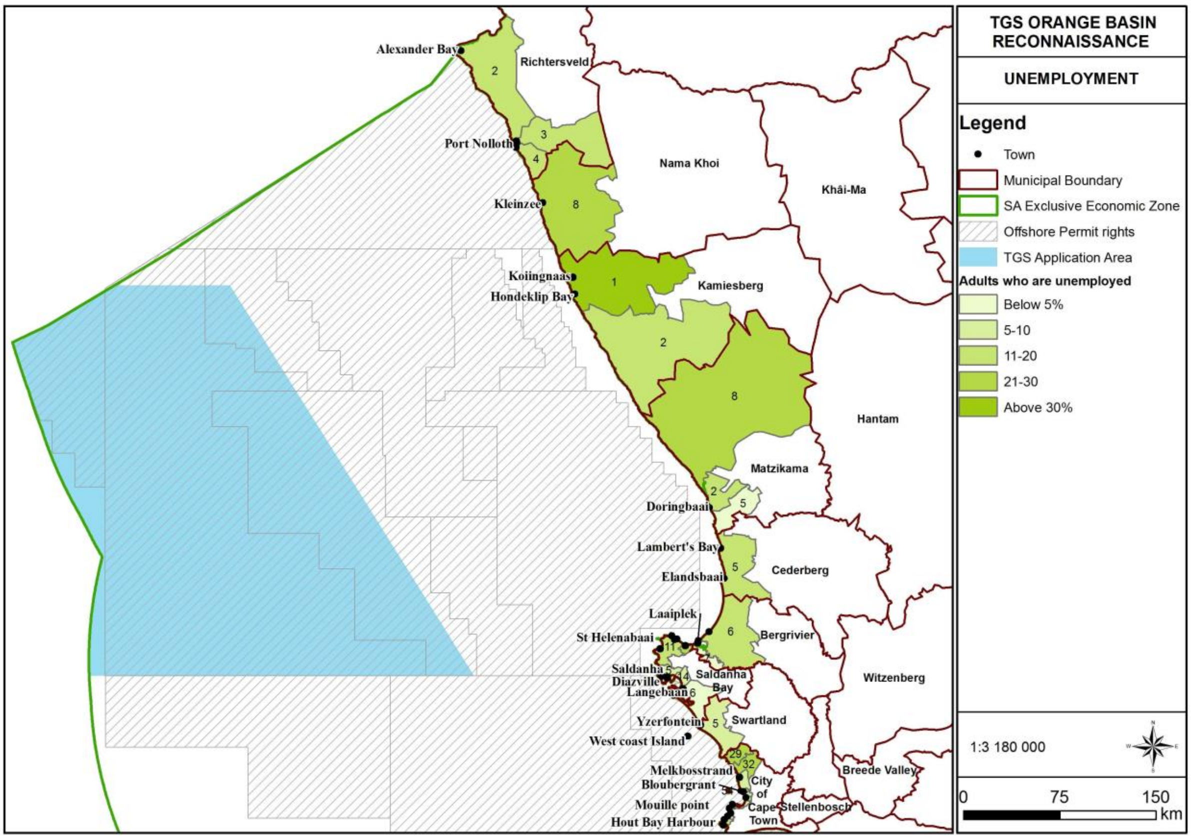


Figure 102: Proportion of adults that are unemployed (shown in percentage, source: Census 2011).

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 103). 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.

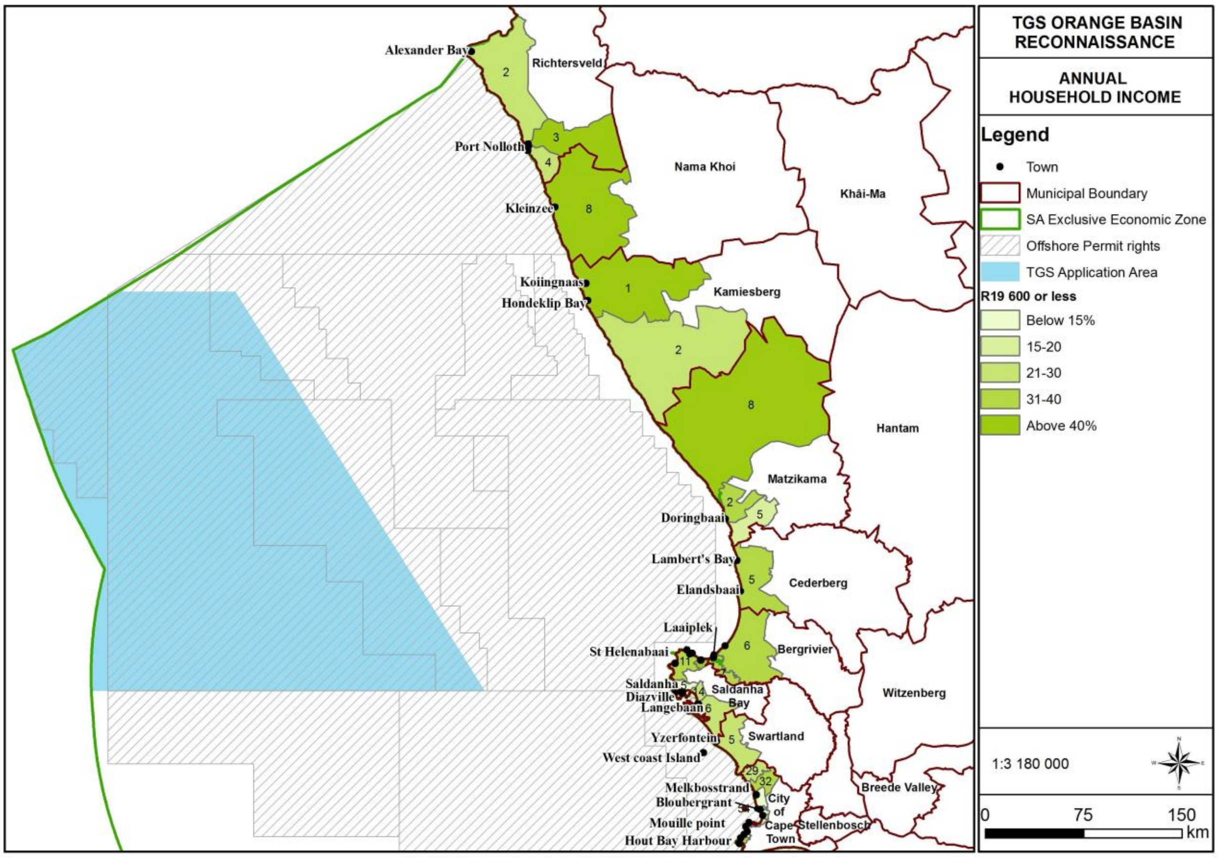


Figure 103: Proportion of households with an annual income of R19 600 or less in 2011 (shown in percentage, source: Census 2011).

8.7.1.6 **HOUSING**

The majority of households live in areas that are classified as urban, except in the Matzikama Local Municipality (Figure 104). 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 (Figure 105), 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.

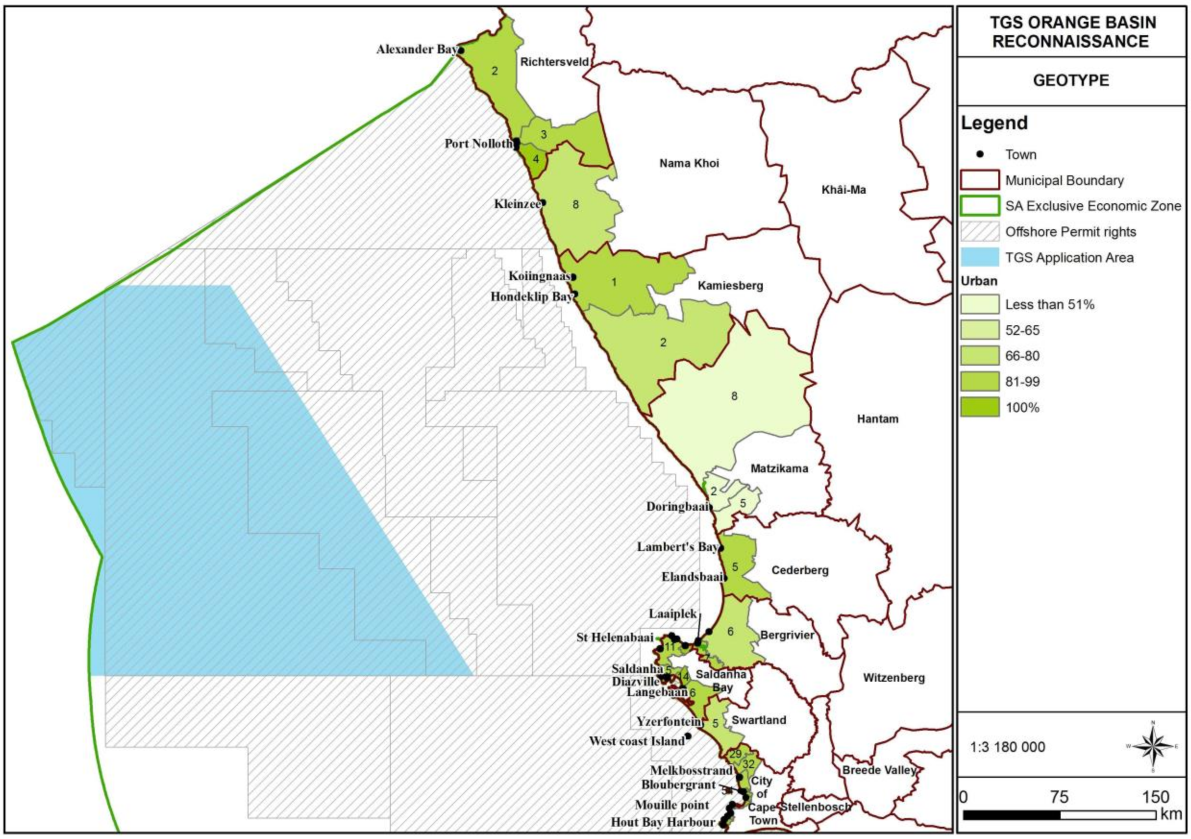


Figure 104: Proportion of households that live in urban areas (shown in percentage, source: Census 2011).

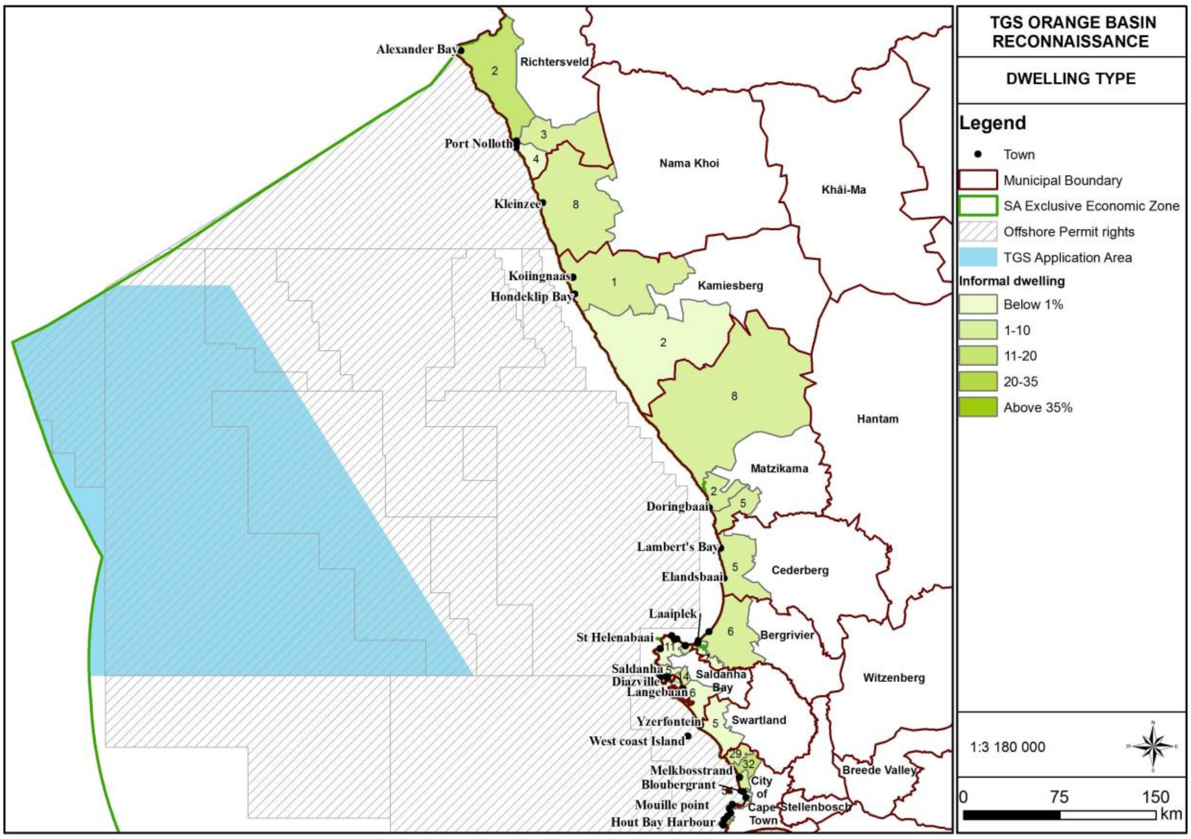


Figure 105: Proportion of households that live in informal dwellings (shown in percentage, source: Census 2011).

8.7.1.7 **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 Ward 1 of the Kamieskroon Local Municipality where Hondeklip Bay is located (Figure 106).

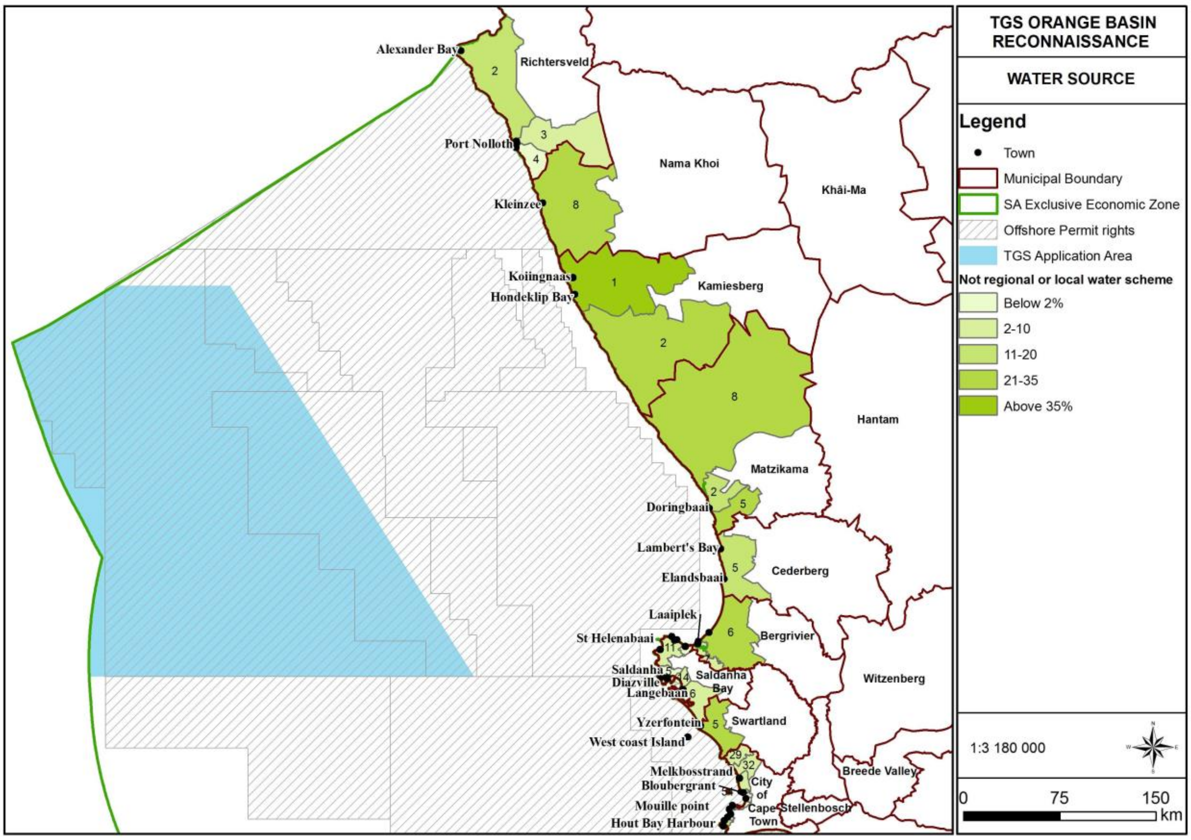


Figure 106: Proportion of households that does not get water from a regional or local water scheme (shown in percentage, source: Census 2011).

The incidence of access to piped water inside the dwelling varies and tend to be lower in the Northern Cape municipalities (Figure 107). Access to a flushing toilet is in general lower in the Northern Cape Municipalities (Figure 108).

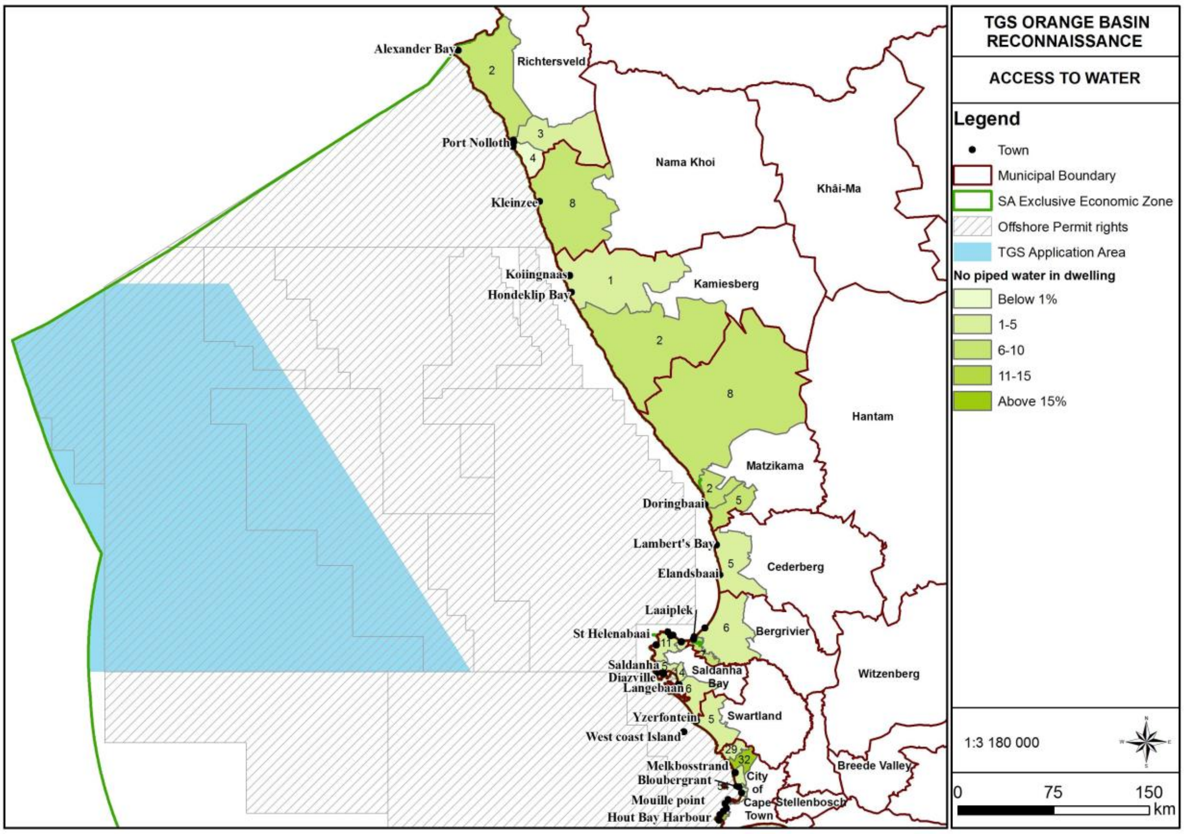


Figure 107: Proportion of households that does not have piped water in the dwelling (shown in percentage, source: Census 2011).

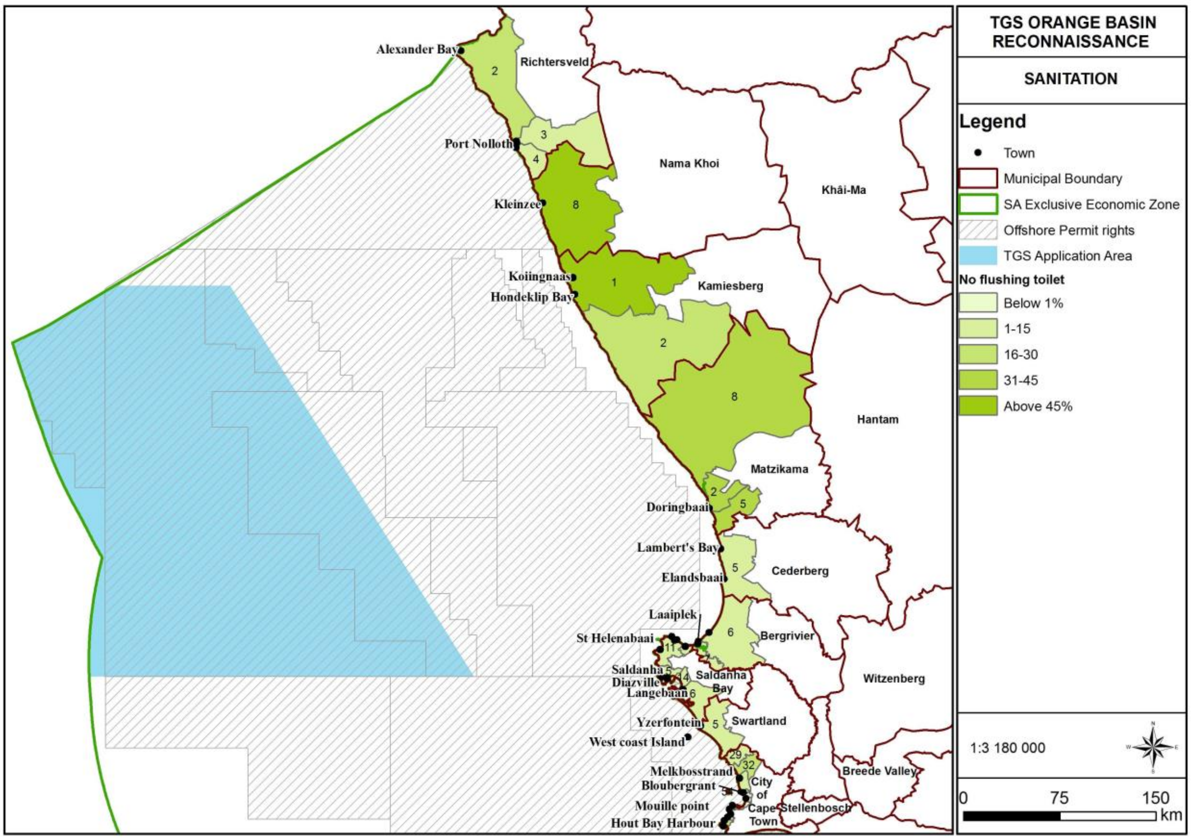


Figure 108: Proportion of households that does not have a flush toilet (shown in percentage, source: Census 2011).

8.7.1.8 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 109) but a lower proportion use electricity for heating (Figure 110) and cooking (Figure 111) purposes.

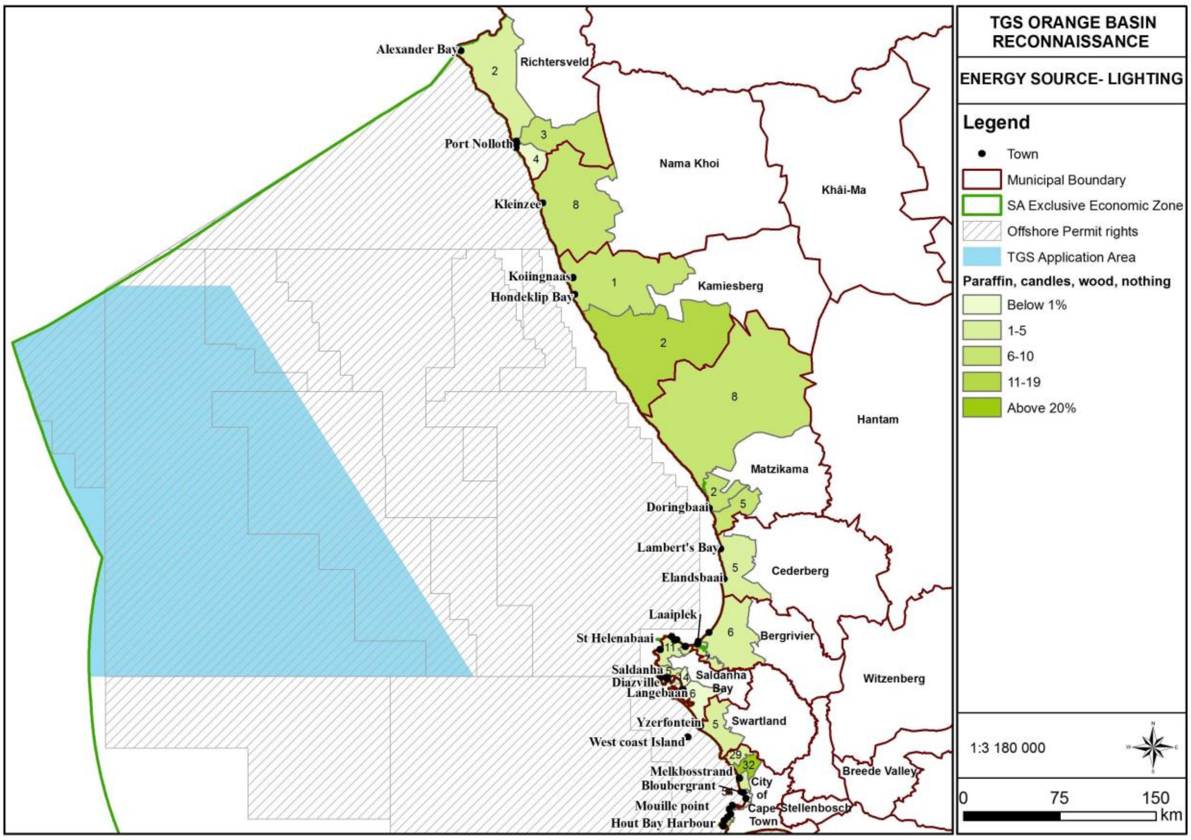


Figure 109: Proportion of households that use paraffin, candles, wood or nothing for lighting purposes (shown in percentage, source: Census 2011).

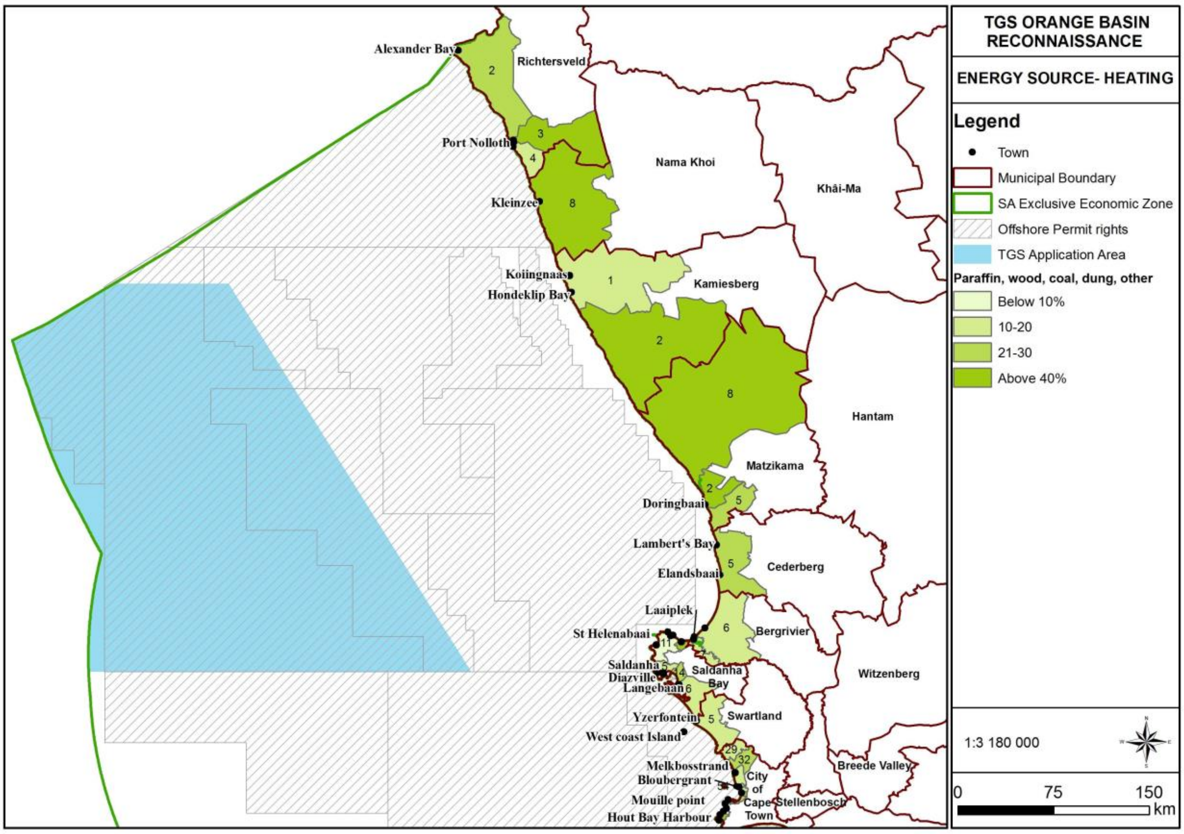


Figure 110: Proportion of households that use paraffin, wood, coal, dung or something else for heating purposes (shown in percentage, source: Census 2011).

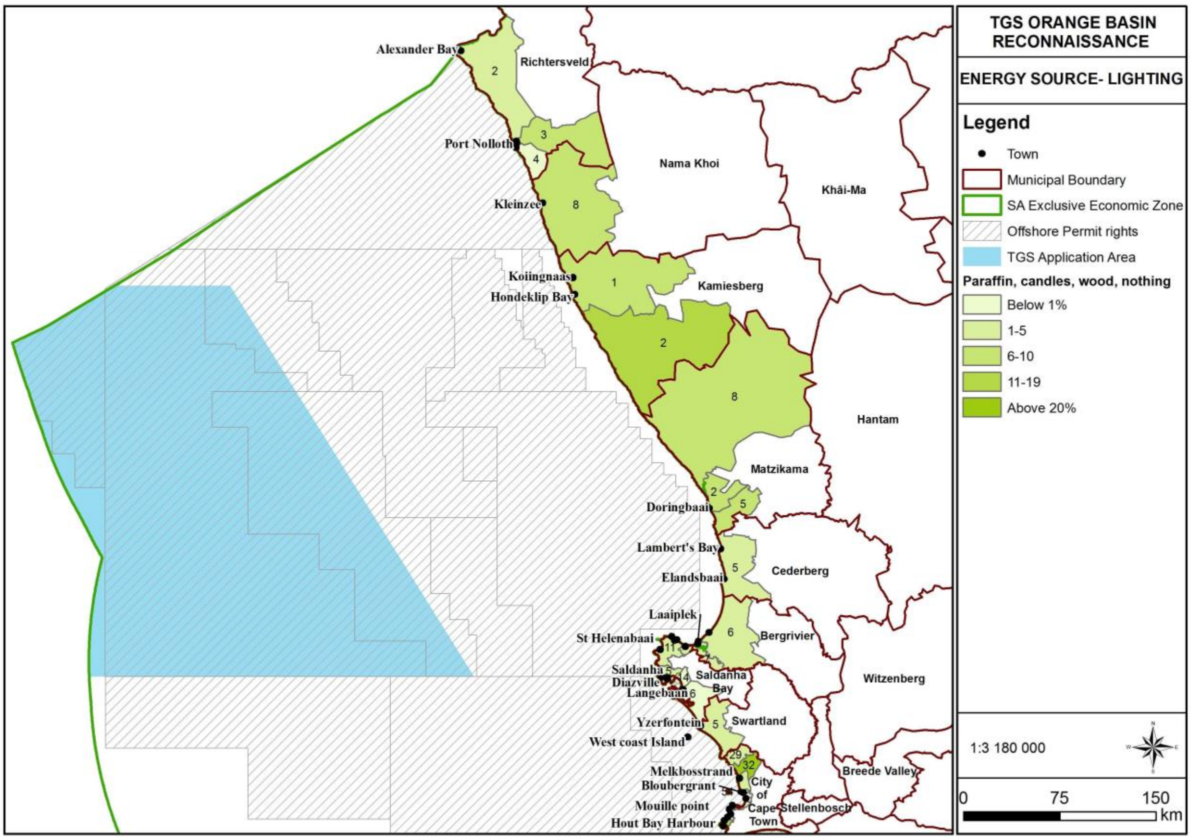


Figure 111: Proportion of households that use paraffin, wood, coal, dung or something else for cooking purposes (shown in percentage, source: Census 2011).

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 112 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 Application Area.

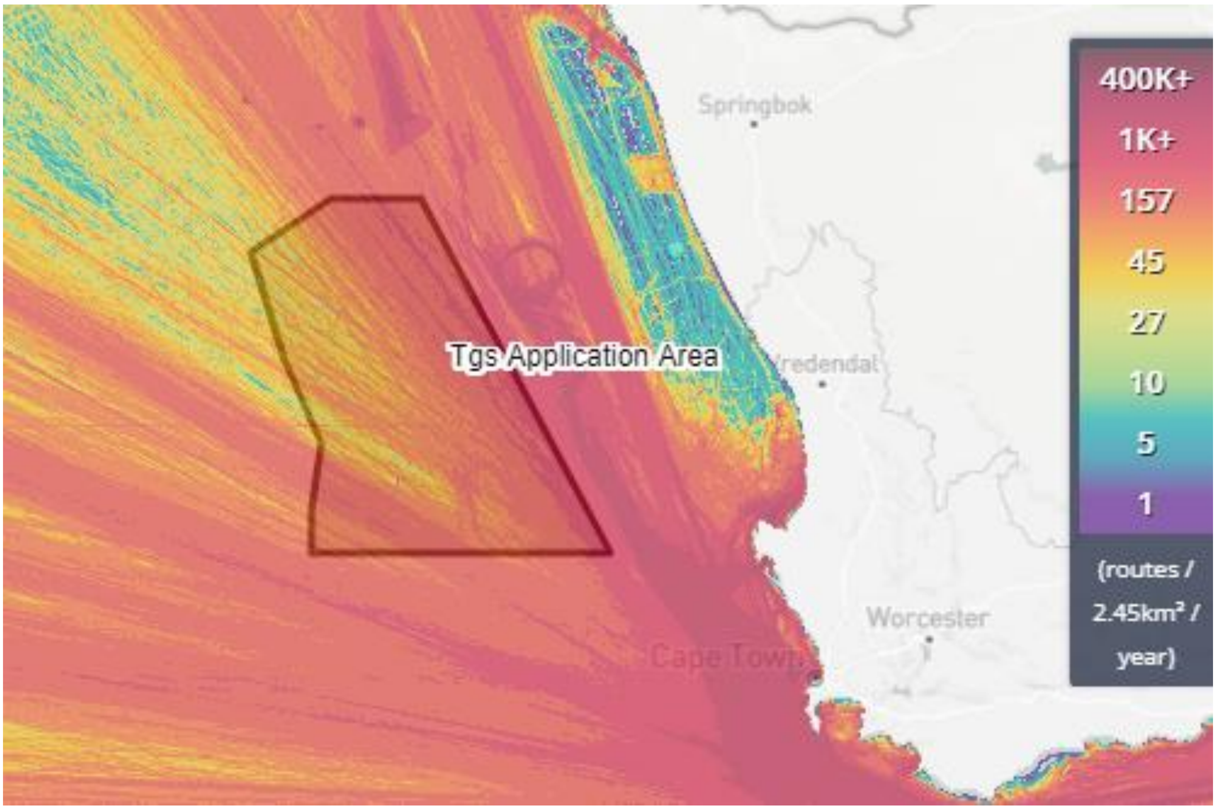


Figure 112: Shipping traffic density along the South African Coast.

8.8 CULTURAL AND HERITAGE RESOURCES

This section provides and overview of the cultural and heritage environment for the study area. The information has been sourced from the Heritage Impact Assessment undertaken by PGS Heritage (Pty) Ltd included in Appendix 3.

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 di*et al*ong 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 1 km 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. 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.

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.

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.

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’. 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**

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. 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”. 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. 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.

8.8.3.1.1 THE INTRODUCTION OF THE KHOIKHOI

For thousands of years, the Khoikhoi 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. 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. 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.

One of the most important West Coast pastoralist sites, Kasteelberg, is an open-air archaeological site located 4 km 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.

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.

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. 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. 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. Unfortunately, indigenous groups who lived on the coast were the first people to be severely impacted by colonial oppression.

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 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.

8.8.3.3.5 MARITIME HERITAGE RESOURCES

The following section was developed by maritime archaeologist Vanessa Maitland.

The first recorded European voyages down the west coast of Africa were by the Portuguese. When the first Portuguese explorers travelled down the west African coast, they stuck close to the coastline, to map the land. However, occasionally they were swept towards the Americas, as is evident by the fate of the fleet of Pedro Alvares Cabral, in 1500. This was first Portuguese fleet which was to sail annually to the Indies. Twenty days after the fleet left Brazil, which they had "discovered", it was struck by storms and four ships, including the one under command of Bartolomeu Dias, foundered somewhere in the southern Atlantic. Different researchers put them anywhere between Tristan da Cunha and the Cape.

Bartolomeu Dias and his fleet passed the Orange River Mouth in 1487/1488 (Axelson, 1973). Thereafter, the rate of exploration and trade increased exponentially, as is evidenced by the increase in shipwrecks over the centuries. These early voyages were not well documented, and the archives often merely report that a fleet of a certain number of vessels left and only a certain amount returned, with only vague references to their place and manner of loss. Therefore, there are many undocumented wrecks, along the coastline and even more offshore.

There is some anecdotal evidence that the Phoenicians circumnavigated Africa (Herodotus, 1954). If this is true, these ships had to stick right to the coastline and therefore are likely to be inshore. There's increasing evidence that the Chinese voyages of the 1400s explored parts, if not all, of the African coast (Paine, 2013). However, once again the archival evidence to date, and availability to Western researchers, limits this knowledge.

There are many ships that are only recorded as having disappeared between Europe and the Far East and Americas. As well as between local ports. The mechanics of sailing vessels and winds meant that for a ship to get from Europe to the Cape, they often sailed via South America. There are also numerous missing U-boats and other war vessels from WW1 and WW2 that may be found.

Thousands of ships have disappeared in the southern Atlantic Ocean, a portion of these can be seen in Figure 113. There are numerous historical reports of abandoned vessels being seen by other ships (Figure 114).

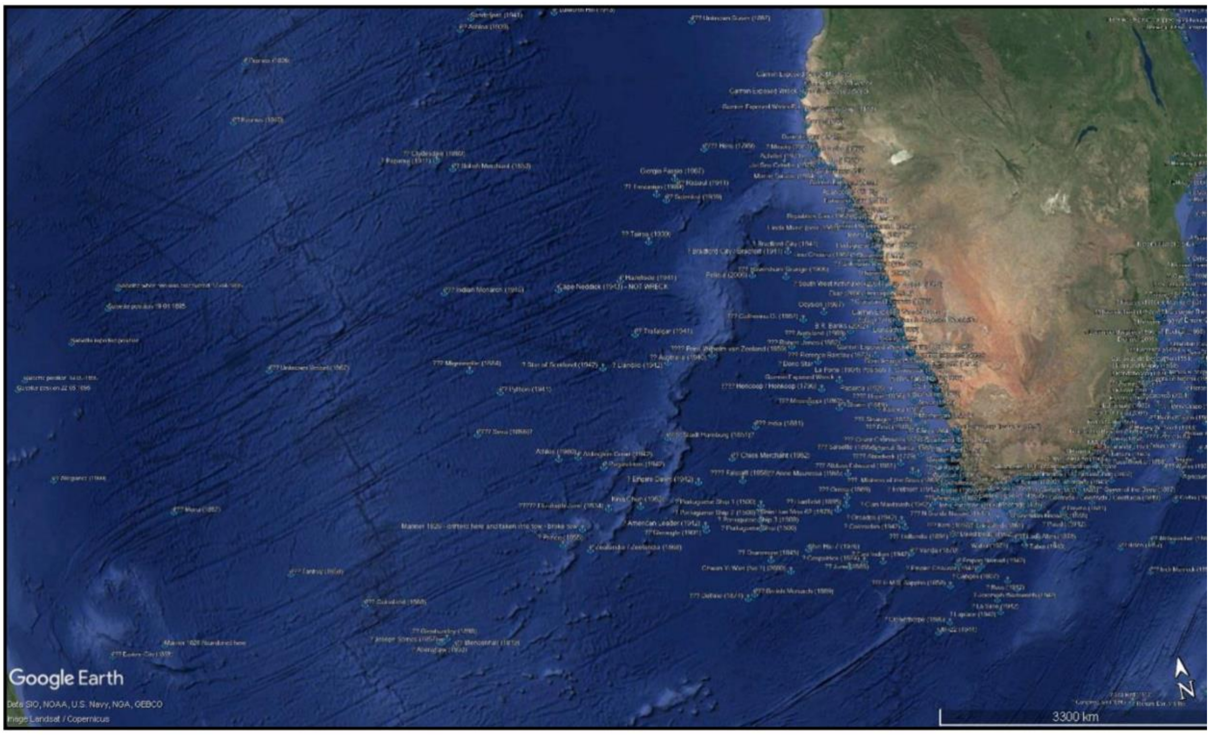
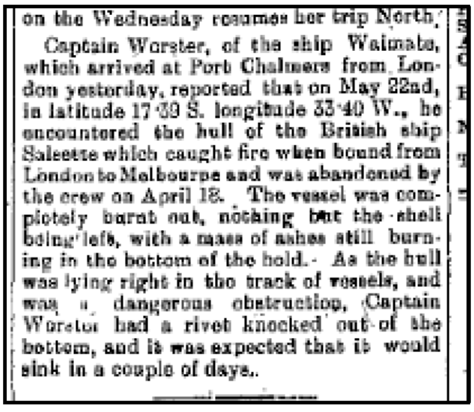


Figure 113 - A portion of the ships wrecked off South Africa and in the southern Atlantic.



on the Wednesday resumes her trip North.

Captain Worster, of the ship Waimate, which arrived at Port Chalmers from London yesterday, reported that on May 22nd, in latitude 17·39 S. longitude 33·40 W., he encountered the hull of the British ship Salsette which caught fire when bound from London to Melbourne and was abandoned by the crew on April 18. The vessel was completely burnt out, nothing but the shell being left, with a mass of ashes still burning in the bottom of the hold. As the hull was lying right in the track of vessels, and was a dangerous obstruction, Captain Worster had a rivet knocked out of the bottom, and it was expected that it would sink in a couple of days.

Figure 114 - Report in The Auckland Star 26-07-1895, by the Walmate on the drifting hulk of the Salsette.

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 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:

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

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in Table 35 below.

Table 35: 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 36.

Table 36: 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 37: 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 38.

Table 38: 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 39: 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.
Irreplaceable Loss of Resources (LR)	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	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 39. 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 40).

Table 40: 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 41: 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
< 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).

Value	Description
≥ 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 42 below. It should be noted that this report will be made available to I&AP's for review and comment and their comments and concerns will be addressed in the final BA Report 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 4. 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.

With reference to Table 29 in Section 8.5.4 above, it should be noted that there are only two fishing sectors that operate within the application area – i.e. the Large Pelagic Longline Sector and the Tuna Pole-Line Sector. As a result, it is anticipated that there will be no impacts on the remaining fisheries sectors described in Section 8.5 above and the impacts on these sectors have not been assessed further.

Table 42: 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
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

#	Impact	Phase
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	Impacts of exclusion from fishing ground on the large pelagic longline sector due to the safety zone around the survey vessel	Operation
17	Impact of Exclusion of the Tuna Pole-Line Sector from access to Fishing Ground	Operation
18	Impact of Underwater Sound on the Large Pelagic Longline Sector	Operation
19	Impact of Underwater Sound on the Tuna Pole-Line Sector	Operation
20	Impacts of an operational spill on the large pelagic longline sector	Operation
21	Impacts of the unplanned loss of equipment to sea from the survey vessel	Operation
22	Impacts on Cultural Heritage	Operation
23	Impacts of an operational spill or collision on marine fauna	Operation
24	Impacts on Cultural Heritage	Operation
25	Uncertainty	Planning
26	Concerns about cumulative impacts	Planning
27	Further marginalisation of vulnerable groups	Planning
28	Stakeholder fatigue and disillusionment	Planning
29	Perceived impact on livelihoods	Operation
30	Impacts on sense and spirit of place	Operation
31	Impacts on social licence to operate	Operation
32	Community expectations	Operation
33	Social unrest	Operation

9.3 DESCRIPTION AND ASSESSMENT OF IMPACTS

This section lists the potential impacts were identified during the BA based on the methodology described above. The impact assessment matrix is included in Appendix 3 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 and Sound Transmission Loss Modelling Study. For a more detailed description of the impacts, please refer to the Marine Ecological Assessment and Acoustics Sound Transmission Loss Modelling Study undertaken by Pisces Environmental Services (Pty) Ltd included in Appendix 3.

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 Application 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 Application 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.

Physiological injury and mortality: The potential impact of seismic noise on physiological injury of mysticetes and odontocetes, considering their high sensitivity, the high probability of the impact occurring and the medium consequence, is deemed to be of MEDIUM significance pre-mitigation.

Behavioural avoidance: The potential impact of seismic noise on behavioural changes in mysticetes and odontocetes, considering their high sensitivity, the high probability of the impact occurring and the medium consequence, is deemed to be of MEDIUM significance pre-mitigation.

Masking of Sounds and Communication: The potential impact of seismic noise on the masking of environmental sounds and communications in mysticetes and odontocetes, considering their high sensitivity, the high probability of the impact occurring and the medium consequence, is deemed to be of MEDIUM significance pre-mitigation.

Indirect impacts due to effects on predators or prey: The potential indirect impact of seismic noise on food sources of mysticetes and odontocetes, considering their high sensitivity, the low likelihood of the impact occurring and the very low consequence, is thus deemed to be of VERY LOW significance pre-mitigation.

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.

<table>
<tr><th>Impact</th><th>Phase</th><th>Pre-mitigation Impact</th><th>Post-mitigation Impact</th><th>Final Significance</th></tr>
<tr><td>Impacts of seismic noise on mysticetes and odontocetes</td><td>Operation</td><td>Medium</td><td>Low</td><td>Low</td></tr>
<tr><th colspan="5">Mitigation Measures</th></tr>
<tr><td colspan="5">• Please refer to Section 11.4.1 below for detailed mitigation measures for cetaceans. Key mitigation measures include:
• Application of the mitigation hierarchy;
• Pre-survey planning;
• Passive acoustic monitoring and MMOs;</td></tr>
</table>

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
• 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 unlikely to be encountered in the Reconnaissance Permit Area (see Figure 46).

Physiological injury and mortality: The potential impact of seismic noise on physiological injury or mortality of seals, considering their low sensitivity, the very low likelihood of the impact occurring and the medium consequence, is deemed to be of LOW significance pre-mitigation.

Behavioural avoidance: The potential impact of seismic noise on behavioural changes in seals, considering their low sensitivity, the very low likelihood of the impact occurring and the very low consequence, is deemed to be of VERY LOW significance pre-mitigation.

Masking of Sounds and Communication: The potential impact of seismic noise on the masking of environmental sounds and communications in seals, considering their low sensitivity, the very low likelihood of the impact occurring and the very low consequence, is deemed to be of VERY LOW significance pre-mitigation.

Indirect impacts due to effects on predators or prey: The potential indirect impact of seismic noise on food sources of seals, considering their low sensitivity, the very low likelihood of the impact occurring and the very low consequence, is thus deemed to be of VERY LOW significance pre-mitigation.

With the implementation of the typical 'soft-start' procedures, the residual impacts of physiological Injury and mortality reduce to VERY) LOW significance. All other impacts on seals would all remain NEGLIGIBLE.

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 during all 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 "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.

Physiological injury and mortality: The potential impact of seismic noise on physiological injury or mortality of turtles, considering their high sensitivity and medium consequence, is deemed to be of MEDIUM significance. In the case of hatchlings and juveniles, the impact can be considered of MEDIUM significance due to their high sensitivity and the potentially high intensity of the impact pre-mitigation.

Behavioural avoidance: The potential impact of seismic noise on behavioural changes in turtles, considering their medium sensitivity, the medium probability of the impact occurring and the very low consequence, is deemed to be of VERY LOW significance pre-mitigation.

Masking of Sounds and Communication: The potential impact of seismic noise on the masking of environmental sounds and communications in turtles, considering their medium sensitivity, the medium probability of the impact occurring and the very low consequence, is deemed to be of VERY LOW significance pre-mitigation.

Indirect impacts due to effects on predators or prey: The potential indirect impact of seismic noise on food sources of turtles, considering their medium sensitivity, the very low likelihood of the impact occurring and the very low consequence, is thus deemed to be of VERY LOW significance pre-mitigation.

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 during all 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).
- 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.

Physiological injury and mortality: The potential impact of seismic noise on physiological injury or mortality of pelagic seabirds, considering their medium sensitivity, the medium likelihood of the impact occurring and low consequence, is deemed to be of LOW significance pre-mitigation.

Behavioural avoidance: The potential impact of seismic noise on behavioural changes in pelagic seabirds, considering their medium sensitivity the medium likelihood of the impact occurring and very low to low consequence, is deemed to be of VERY LOW to LOW significance pre-mitigation.

Indirect impacts due to effects on predators or prey: The potential indirect impact of seismic noise on food sources for pelagic seabirds, considering their medium sensitivity, the very low likelihood of the impact occurring and the very low consequence, is thus deemed to be of VERY LOW significance pre-mitigation.

With the implementation of the mitigation measures above, 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 during all 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).

9.3.1.1.5 NOISE IMPACTS ON FISH

Fish hearing has been reviewed by numerous authors including Popper and Fay (1973), Hawkins (1973), Atema *et al*. (1988), Hawkins & Popper (2018) and Slabbekoorn *et al*. (2019) (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 (Tavolga & Wodinsky 1963), and it has been suggested that fish can shift from particle velocity sensitivity to pressure sensitivity as frequency increases (Cahn *et al*. 1970, in Turl 1993). 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 airguns, 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) (Hirst & Rodhouse 2000), and overlap with the range at which fish hear well (Dalen & Mæsted 2008). 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 (Popper & Hawkins 2018).

Physiological injury and mortality: The potential impact of seismic noise on physiological injury or mortality of fish, considering their high sensitivity and medium consequence, is thus deemed to be of MEDIUM significance pre-mitigation.

Behavioural avoidance: The potential impact of seismic noise on behavioural changes in large migratory pelagic fish, considering the high sensitivity, the low to medium likelihood of the impact occurring and medium consequence, is deemed to be of MEDIUM significance pre-mitigation.

Reproductive success / spawning: The potential impact of seismic noise on the reproductive success and spawning of nearshore commercial fish species, considering their high sensitivity, the low to medium likelihood of the impact occurring and the very low consequence, is deemed to be of LOW significance pre-mitigation.

Masking of environmental sounds and communication: The potential impact of seismic noise on the masking of sounds of fish, considering the high sensitivity, the low likelihood of the impact occurring and the very low consequence is thus deemed to be of LOW significance pre-mitigation.

Indirect impacts due to effects on predators or prey: The potential indirect impact of seismic noise on food sources for fish, considering their high sensitivity, the low likelihood of the impact occurring and the very low consequence, is thus deemed to be of LOW significance pre-mitigation.

The potential impacts cannot be eliminated due to the nature of the seismic sound source required during surveying. The location of the Application 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				
• Implement a “soft-start” procedure of a minimum of 20 minutes’ duration on initiation of the seismic source during hours it is confirmed visually by the MMO during the pre-shoot watch (60 minutes) that there are no shoaling large pelagic fish within 500 m of the seismic source. • Terminate seismic source on o Observation of slow swimming large pelagic fish (including whale sharks, basking sharks, manta rays) within the 500 m mitigation zone. o 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.				

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
• 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).				

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 (Offutt 1970; Hawkins & Myrberg 1983; Budelmann 1988, 1992; Packard *et al*. 1990; Popper *et al*. 2001) 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 airgun 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.

The potential impact of 3D seismic noise on benthic, and neritic and pelagic invertebrates, considering the low sensitivity, the low likelihood of the impact occurring is thus deemed to be of NEGLIGIBLE significance pre-mitigation.

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, zooplankton and ichthyoplankton 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 airgun sound source.

The potential 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 pre-mitigation.

This potential impact cannot be eliminated due to the nature of the seismic sound source required during surveying. With the implementation of the below 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

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Mitigation Measures				
• As the Application 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, TGS has agreed to avoid the key "ring fenced" fishing and spawning areas in the south-east of the reconnaissance permit 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)

Elevated underwater and aerial noise can affect marine fauna, including cetaceans, by:

- causing direct physical injury to hearing;
- masking or interfering with other biologically important sounds (e.g. communication, echolocation, signals and sounds produced by predators or prey);
- causing disturbance to the receptor resulting in behavioural changes or displacement from important feeding or breeding areas.

Vessel Noise: The potential impact of vessel noise causing physiological injury to, or behavioural avoidance by, pelagic and coastal sensitive species, is deemed to be of VERY LOW significance pre-mitigation.

Aircraft Noise: The potential impact of aircraft noise causing physiological injury to, or behavioural avoidance by, pelagic and coastal sensitive species, is deemed to be of LOW significance pre-mitigation.

The generation of noise from helicopters cannot be eliminated if helicopters are required for crew changes. 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 (see for example Booth *et al*. 2020; Derous *et al*. 2020) is difficult.

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

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
• 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 Reconnaissance Permit 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.

The potential for collision of birds with the survey vessel due to lighting or behavioural disturbance by vessel lighting is deemed to be of VERY LOW significance pre-mitigation, due to the medium sensitivity of the receptors, the low likelihood of the impact occurring and the 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 (Bax *et al*. 2003).

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 (Bax *et al*. 2003).

The potential for introductions of non-native marine species through hull fouling or ballast water discharge is deemed to be VERY LOW pre-mitigation, due to the very low sensitivity of the offshore receptors, the low likelihood of the impact occurring and the low consequence.

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.
- 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 Application 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 impacts associated with normal waste discharges from the survey vessel is deemed to be of VERY LOW significance pre-mitigation, due to the medium sensitivity of the offshore receptors, the medium probability of the impact occurring and the very low consequence.

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 potential for collision with or entanglement by turtles and cetaceans during the seismic survey or the transit of the vessel to or from the Application Area is deemed to be of LOW significance pre-mitigation, due to the high sensitivity of the receptors, but verly low likelihood of the impact occurring and the low consequence.

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

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 Application 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) as well as when they are present in the vicinity.				

9.3.1.3.2 LOSS OF EQUIPMENT

The potential impacts associated with lost equipment include:

- Potential disturbance and damage to seabed habitats and crushing of epifauna and infauna within the equipment footprint; and
- Potential physiological injury or mortality to pelagic and neritic marine fauna due to entanglement in streamers, arrays and tail buoys drifting on the surface or in the water column.

The impacts associated with the accidental loss of equipment are deemed to be of VERY LOW significance pre-mitigation, due to the medium sensitivity of the offshore receptors, the very low likelihood of the impact occurring and the very low consequence.

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.				

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

The impact methodology used to assess the impact significance calculates an overall LOW pre-mitigation significance. However, considering the high sensitivity of receptors and the very low (offshore) and medium consequence (nearshore), the potential impact on the marine fauna is in reality considered to range from LOW significance (offshore) to MEDIUM significance (nearshore) without mitigation. The likelihood of the impact occurring is, however, low.

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 undertaken 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 115, 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.

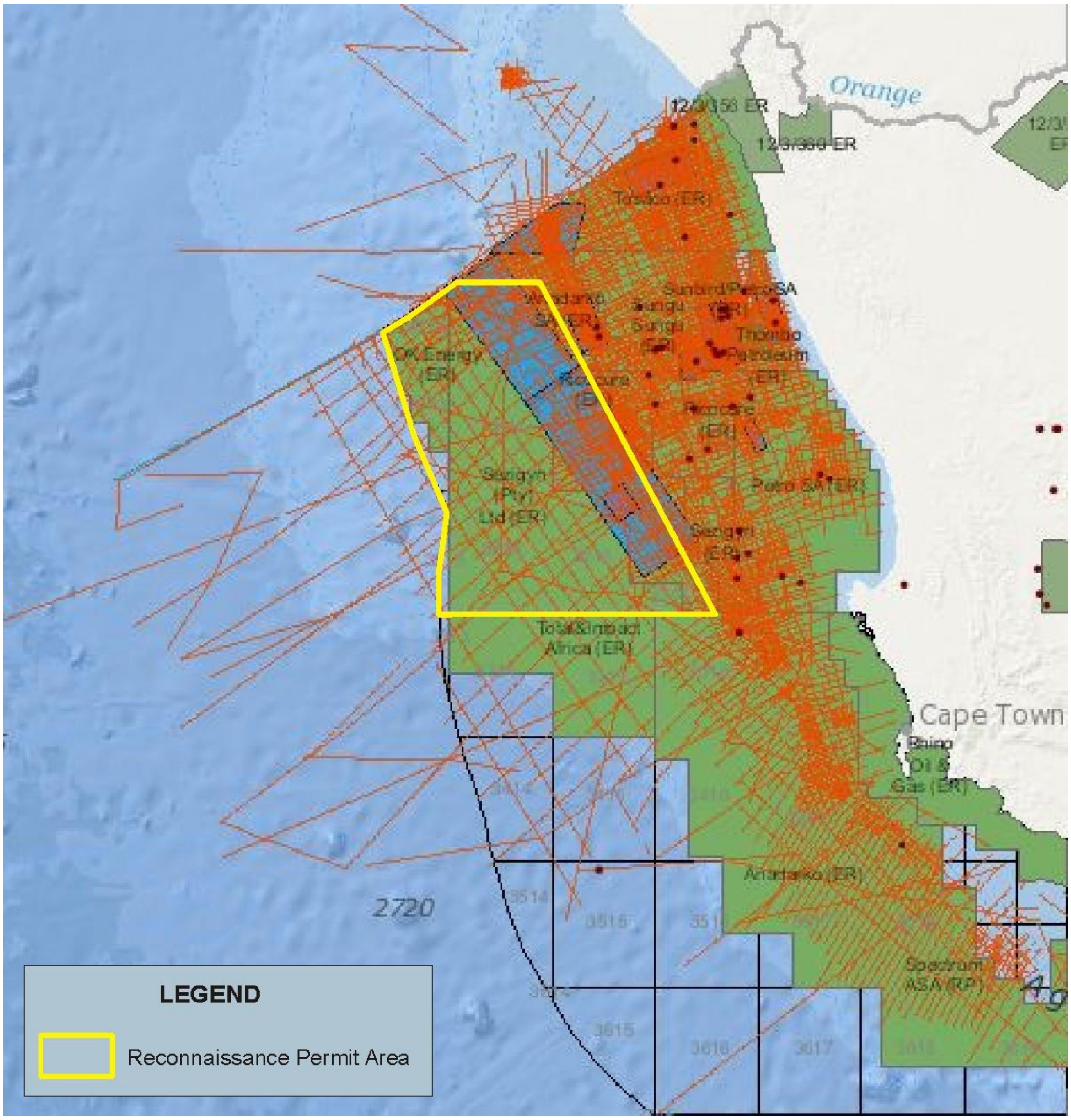


Figure 115: Application Area in relation to historical 2D (red lines) and 3D (blue and purple polygons) surveys conducted on the West Coast between 2001 and 2018 (Source: PASA).

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, l*et al*one 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.

The impacts to marine fauna associated with concurrent surveys are deemed to be of MEDIUM significance, due to the high sensitivity of the offshore receptors, the very high likelihood of cumulative effects of acoustic impacts on marine fauna.

With the implementation of the above-mentioned controls and mitigation measures, the intensity of the impact would reduce to MEDIUM and the probability of the impact would reduce to LIKELY, but the overall significance would remain MEDIUM.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Impacts to marine fauna of concurrent seismic acquisition by multiple operators	Operation	Medium	Medium	Medium
Mitigation Measures				
• Should surveys be run simultaneously, ensure that a distance of at least 40 km is maintained between survey vessels[23] until sufficient objective evidence is obtained that a reduced buffer distance is acceptable.				

[23] This 40 km buffer maintained by any other survey vessels aligns to advice by the US Department of Interior (2014) and 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.

9.3.2 IMPACTS ON FISHERIES

This section provides a description of the Fisheries Impacts identified by in the Fisheries Study and Sound Transmission Loss Modelling Study. For a more detailed description of the impacts, please refer to the Fisheries Study and Sound Transmission Loss Modelling Study included in Appendix 3.

9.3.2.1 **EXCLUSION FROM FISHING GROUND DUE TO TEMPORARY SAFETY ZONE AROUND SURVEY VESSEL**

A purpose-built seismic vessel would be contracted to conduct the 3D seismic survey. The acoustic source would consist of up to 20 active airguns with an overall operating pressure of 2 000 pound-force per square inch (psi). The acoustic source would be situated approximately 50 m behind the seismic vessel at 7 m to 8 m below the water surface. The receiver array for the 3D survey would consist of up to 10 streamer cables, 8 km in length, towed in parallel with a separation of 150 m. The streamer cables would be towed at a depth of between 6 m and 10 m and would therefore not be visible to other vessels. A tailbuoy would mark the far end of each of the streamer cables and would be marked by AIS.

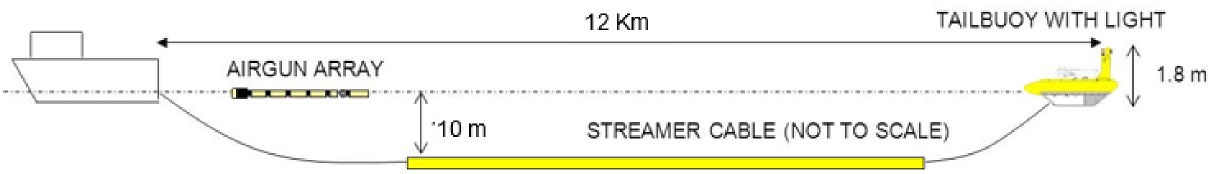


Figure 116: Schematic diagram showing side-view of the airgun array and hydrophone cable ("streamer") towed in a 2D seismic survey.

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 airgun 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.

Based on the location of the Reconnaissance Permit application area, there is no impact of exclusion from fishing grounds expected on the demersal trawl, midwater trawl, demersal longline, small pelagic purse-seine, linefish, west coast rock lobster or small-scale fisheries. There is a high probability that the large pelagic longline sector (targeting tuna, swordfish and shark) will experience loss of access to fishing ground over the duration of the proposed 70 day survey. Although the Reconnaissance Permit area is situated offshore of the continental shelf break, this being an area of peak fishing activity, there is a high probability that vessels and drifting lines could be expected within the Reconnaissance Permit area. The extent of the impact is considered to be regional due to the large area (57 400 km^2) within which the survey could take place[24]. The impact of exclusion is assessed to be of high magnitude[25]. Based on the combination of extent, duration and magnitude of the impact, and considering the high probability that the impact would occur, the overall significance of the impact is considered to be MEDIUM NEGATIVE. Due to the low probability of the operations of the tuna pole-line sector within the Reconnaissance Permit area, the overall significance of the impact on the sector is considered to be LOW NEGATIVE.

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. Timing the survey to avoid taking

[24] Also noting that during a 3D seismic survey the vessel would acquire the data progressively across the designated area i.e. the area of exclusion area is localised at any one point in time. However, the impact rating has been assessed based on the cumulative impact of exclusion across the full extent of the Reconnaissance Permit area.

[25] Where fishing operations in the affected area could temporarily cease

place during the months of June and July (periods of seasonally high fishing effort) could lead to a residual impact of LOW NEGATIVE significance on the large pelagic longline sector.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Fisheries Exclusion: Large Pelagic Longline	Operation	Medium	Low	Low
Fisheries Exclusion: Tuna Pole-line	Operation	Low	Low	Low
Mitigation Measures				

- Timing of the seismic survey to avoid periods of peak fishing activity during June and July is recommended in order to reduce the probability of disruption to the large pelagic longline fishing sector.
- 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.
- 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 (Caroll *et al* 2017). 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.

The zones of impact on fish of impulsive signal emissions from the array source are presented in Table 43. The results relate only to physiological effects on fish. The zones of potential injuries were predicted to be within 160 m from the 3D array for fish species with a swim bladder and 80 m for fish species without a swim bladder. The zone of potential impact was predicted to be within 160 m for fish eggs and larvae.

Based on the noise exposure criteria provided by Popper *et al*. (2014) for fish that use a swim bladder for hearing, relatively high behavioural risks are expected at near to intermediate distances (tens to hundreds of meters) from the source location. Relatively moderate behavioural risks are expected for at far field distances (thousands of meters) from the source location.

The cumulative sound fields based on one assumed 24-hour survey operation were modelled and the zones of cumulative impact (i.e. the maximum horizontal perpendicular distances from assessed survey lines to cumulative impact threshold levels) are presented in Table 44. The zones of potential mortal injuries for fish species with and without a swim bladder, and for fish eggs and larvae are predicted to be within 60 m from the survey lines. For recoverable injury, the zones of impact are predicted to be within 20 m from the survey lines for fish without a swim bladder, and within 200 m for fish with a swim bladder. The zones of TTS effect for fish species with and without swim bladders are predicted to be within 3.5 km from the survey lines for the 3D survey 24-hour operation scenarios considered.

Existing experimental data regarding recoverable injury for fish eggs and larvae is sparse and no guideline recommendations have been provided. However, based on a subjective approach, noise impacts for fish eggs and larvae are expected to be moderate at the near field (i.e. in the distance of tens of meters) from the source location, low at intermediate (i.e. in the distance of hundreds of meters) and far field (i.e. in the distance of thousands of meters) from the source location.

Table 43: Zones of immediate impact from single pulses (2D / 3D seismic airgun arrays) for mortality and recoverable injury for fish, fish eggs and fish larvae (SLR, 2022).

Type of animal	Zones of impact – maximum horizontal distances from source to impact threshold levels			
	Mortality and potential mortal injury		Recovery injury	
	Criteria - Pk SPL dB re 1µPa	Maximum threshold distance, m	Criteria - Pk SPL dB re 1µPa	Maximum threshold distance, m
Fish: no swim bladder (particle motion detection)	> 213	70 / 80	>213	70 / 80
Fish: swim bladder is not involved in hearing (particle motion detection)	>207	140 / 160	>207	140 / 160

Type of animal	Zones of impact – maximum horizontal distances from source to impact threshold levels			
	Mortality and potential mortal injury		Recovery injury	
	Criteria - Pk SPL dB re 1µPa	Maximum threshold distance, m	Criteria - Pk SPL dB re 1µPa	Maximum threshold distance, m
Fish: swim bladder involved in hearing (primarily pressure detection)	>207	140 / 160	>207	140 / 160
Fish eggs and fish larvae	>207	140 / 160	-	-

Table 44: Zones of cumulative impact from multiple pulses (2D / 3D seismic airgun arrays) for mortality and recoverable injury for fish, fish eggs and fish larvae (SLR, 2022).

Type of animal	Zones of impact – maximum horizontal perpendicular distances from assessed survey lines to cumulative impact threshold levels (2D / 3D)					
	Mortality and potential mortal injury		Recoverable injury		TTS	
	Criteria - SEL_{24hr} dB re 1 $\mu Pa^2 \cdot s$	Maximum threshold distance, m	Criteria - SEL_{24hr} dB re 1 $\mu Pa^2 \cdot s$	Maximum threshold distance, m	Criteria - SEL_{24hr} dB re 1 $\mu Pa^2 \cdot s$	Maximum threshold distance, m
Fish: no swim bladder (particle motion detection)	219	< 10	216	15 / 20	186	2 000 / 3 500
Fish: swim bladder is not involved in hearing (particle motion detection)	210	20 / 30	203	80 / 200	186	2 000 / 3 500
Fish: swim bladder involved in hearing (primarily pressure detection)	207	40 / 60	203	80 / 200	186	2 000 / 3 500
Fish eggs and fish larvae	210	20 / 30	-	-	-	-

Pulfrich (2022) concluded that the impact of the acoustic source on fish eggs and larvae accounts for an insignificant amount of mortality compared to the natural mortality rate per day for most fish species at that life stage. The Reconnaissance Permit area does not coincide with spawning areas of key commercial fish species.

The overall effects on the fishing industry of physiological injury to fish as a result of the proposed surveys is considered to be of overall LOW NEGATIVE significance (with mitigation) on the large pelagic longline sector, the only sector that operates within the Reconnaissance Permit application area.

The zones of impact of pulsed sounds on behavioural responses of fish were not modelled in the STLM because of the variability in published findings on the topic. However, if a precautionary approach is adopted, a sound range of 161 to 166 dB re 1 µPa RMS may be used as an indicator of the sound pressure level at which behavioural modifications of fish start to take place. The STLM results predict a RMS SPL of 162 dB re 1µPa at a horizontal distance of 4 km from the airgun array (SLR 2021). For the purposes of this assessment, we have assumed that the catch rates to a distance of 4 km from the Reconnaissance Permit area could be affected.

Based on the location of the Reconnaissance Permit area, the noise generated during the survey would be expected to the large pelagic longline and tuna pole-line sectors. Because the sector operates across the extent of the Reconnaissance Permit area, the affected area is considered to be of regional extent. Behavioural effects are generally immediate, with duration of the effect being less than or equal to the duration of exposure.

The noise generated during the survey would be expected to attenuate to below threshold levels for behavioural disturbance before reaching the fishing grounds of all other sectors viz. demersal trawl, midwater trawl, demersal longline, small pelagic purse-seine, traditional linefish, west coast rock lobster, small-scale fisheries and net fisheries. The Reconnaissance Permit area does not overlap with spawning areas of key commercial species (and the timing of the proposed survey is not expected to coincide with peak spawning periods).

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 linefish and small-scale fisheries sectors). The Reconnaissance Permit area is situated well offshore of the shelf break which is where snoek are known to spawn during winter-spring.

The impact of sound on the large pelagic longline sector is assessed to be of overall MEDIUM NEGATIVE significance before mitigation, whereas the impact on the tuna pole-line sector is assessed to be of overall LOW NEGATIVE significance. Due to the distance of the Reconnaissance Permit area from fishing grounds, the sound is likely to attenuate to below threshold levels for behavioural disturbance of all other fisheries sectors viz. the demersal trawl, midwater trawl, demersal longline, small pelagic purse-seine, traditional linefish, west coast rock lobster, small-scale fisheries and netfish sectors. There is no impact expected on these sectors.

With the implementation of recommended mitigation measures, the residual impact of sound generated during the proposed survey is assessed to be of LOW NEGATIVE overall significance to the large pelagic longline and tuna pole-line sectors. There is no impact expected on the demersal trawl, midwater trawl, demersal longline, small pelagic purse-seine, traditional linefish, 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: Tuna Pole-Line Sector	Operation	Low	Low	Low
Mitigation Measures				

- The seismic survey should avoid taking place during periods of peak fishing activity (June and July) in order to reduce the probability of disruption to the large pelagic longline fishing sector.
- 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.

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

- o 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 during all hours it is confirmed visually by the MMO during the pre-acquisitio**n** watch (60 minutes) that there are no shoaling large pelagic fish within 500 m of the seismic source.
- In the case of shoaling 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
    - o Observation of slow swimming large pelagic fish (including whale sharks, basking sharks, and manta rays) within the 500 m mitigation zone.
    - o 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.
    - o 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).
- 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

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 Reconnaissance Permit area coincides with fishing grounds used by the large pelagic longline sector only. Thus, any spill within the Reconnaissance Permit application area, could impact this sector. The dominant wind and current direction will ensure that any spill in the Application Area is dispersed in a north-westerly direction away from the more actively fished areas inshore of the Reconnaissance Permit application area. An offshore spill is likely to disperse rapidly (days). Without the implementation of mitigation measures, the potential impact on the offshore fishing sectors is considered to be of local extent for small instantaneous spills, of regional for larger volume spills and of moderate magnitude in the short-term. The potential impact on commercial fishing operations is assessed to be of LOW NEGATIVE significance due to the improbable likelihood of such an event occurring.

In the case of a spill en route to the survey area (i.e. during a vessel accident), the spill may reach the coastline. Nearshore fishing (linefish and small-scale fisheries) and mariculture operations (abalone and mussel) would be at risk of the effects of an oil spill (refer to the marine fauna assessment report (Pulfrich, 2022)). The greatest risk of contamination is on sessile filter feeding (e.g. mussels and oysters) and grazing species (e.g. abalone) via physical clogging and or direct absorption of the contaminant, leading to mortality.

With the implementation of the above-mentioned intrinsic mitigation measures, the residual impact would be of LOW NEGATIVE significance for offshore or 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: o Wind force and sea state conditions of ≥6 on the Beaufort Wind Scale; o During any workboat or mobilisation boat operations; o During helicopter operations; o During the transfer of in-sea equipment; and o 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

These activities (or event) are described further below:

- Irretrievable loss of equipment to the seabed during seismic acquisition; and
- Accidental loss of paravanes, streamers, arrays, and tail buoys during seismic acquisition.

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. Airguns 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 airguns 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 Reconnaissance Permit 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 to be low and of LOW NEGATIVE significance to the large pelagic longline fishery.

The implementation of the mitigation measures will reduce the impact; however, the residual impact will remain of low magnitude and of LOW NEGATIVE 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.				

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
• 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[26].

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 (Evans et al., 2018), 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. In addition to the above, the following should also be considered to take account of catch variability and stock declines, which can be attributed to the following (Shomura et al 1995, Kuo-Wie Lan et al 2011, Lehodey et al 2006 and Punt et al 1996):

- Increasing fishing effort exacerbated by improved fish finding technology (vessel monitoring systems, use of sonar, sea surface temperature spatial mapping using satellite technology);
- Environmental variability such as cold and warm water events e.g. Benguela El Niño events have been shown to result in a change in the vertical distribution of tuna stocks within the water column, resulting in reduced catch rates;
- Migration and feeding patterns that change abundance levels annually and are linked to the environment; and
- Inconsistent or irregular catch reporting.

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 and mining activities commence (by other applicants or existing exploration right holders) in a relatively short period. There are a number of reconnaissance permit application and EIA / Basic assessments being undertaken for proposed seismic surveys off the West Coast, although it is unlikely that all these will be undertaken as they are targeting similar areas in the Deep Water Orange Basin.

Concurrent activities such as other planned speculative or proprietary seismic surveys in the southern Benguela region could add to the cumulative impact on fisheries. 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

[26] Refer to Augustyn *et al*. (2018) for a synopsis of climate change impacts on South African Fisheries.

magnitude of the impact on the large pelagic longline sector. The impact duration would remain unchanged[27]. 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 and of LOW NEGATIVE significance on the tuna pole-line 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 3.

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 Feb 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. Their culture and heritage historically had a physical manifestation in village layouts, boat building and the unique west coast architectural vernacular. This vernacular was appropriated by the rich to develop quasi-cultural village expressions in the modern expansions of West Coast towns such as Paternoster.

This uptake of the cultural heritage manifestations or elements of the indigenous communities by the public at large, provides a manner of legitimacy to their culture that is deeply entwined with the ocean and coastal landscape. It, unfortunately, does not translate into economic providence and brings no relief to their plight as subsistence communities. The changes in the fishing economies around the South African coast in the past four decades have resulted in a loss in income and livelihoods. It has inevitably impacted their community structures and activities which are a large part of their cultural heritage.

The public meetings and focused discussions with interlocutors 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 led 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

[27] Seismic surveys are undertaken within a window period of December to May as specified by DMRE as part of the EMP conditions to mitigate the impacts on sensitive migration periods for cetaceans.

available South African legislation. As such, the NHRA (section 3) (2)) 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				
• Implement recommended mitigation measures as listed in the other specialist reports for the project.				

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

- 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 this environmental impact process against quantified economic damage and losses and human development impacts in a follow-up socio-economic assessment. It will enable the heritage specialist to evaluate the link between the socio-economic changes induced by the proposed project as it relates to changes in the intangible cultural heritage practices of the 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. **It is anticipated that this can be achieved through the implementation of the mitigation measures in the Social Impact Assessment.**
- **3D seismic surveys have the potential to locate wrecks on the surface, and sometimes below sediments on the ocean floor. Any shipwrecks or pieces thereof noted during the survey must be shared with the SAHRA MUCH Unit for inclusion into the national database. These could then be identified and be incorporated into the EMPr.**

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 is not quantifiable at this stage for cultural heritage.

9.3.4 SOCIAL IMPACTS

This section provides a description of the Social Impacts identified by in the Social Impact Assessment (SIA). For a more detailed description of the impacts, please refer to the SIA undertaken by Equispectives Research & Consulting Services included in Appendix 3.

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 are uncertain about the impact that the seismic survey will have on their livelihoods. They feel that there is not enough information available to them to determine whether the surveys will have an impact on their activities. In the past year a number of companies approached them to participate in EIA processes about seismic surveys. They want to have some definitive answers about the potential impacts from specialists. They would like to engage with them for more than two hours to make sure that they understand exactly what the project entails and what the potential impacts are. Only then will they be able to make informed decisions. The fishing communities have made a living from the sea for hundreds of years and they have learned how to read the ocean and the weather to know where and when fish are moving. They are concerned that the surveys could disrupt the behaviour of snoek (that is endemic to the area and a major source of income) and other fish that they rely on. They have noticed changes in the patterns of the fish they catch due to industrial activities in the past. Some examples are the potato factory in Lambert's Bay that discharges warm water in the sea and the coffer dams constructed by the diamond mines. After a previous seismic survey at the Wild Coast, people observed dead Black Steenbras that were reported to have protruding nostrils. Furthermore, they also noticed changes in the patterns of the fish that they ascribed to climate change. For the fishing communities, the sea is an integral part of their identity, and they possess local knowledge that are not yet written up in scientific reports.

The marine fauna and fisheries reports indicate that low to negligible impacts on marine life and that all the impacts are reversible. However, the communities are not convinced. 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. They feel that 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 remains 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 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				
• TGS should develop a community engagement protocol that is based on the San Code of Research Ethics. This should be done in consultation with the affected communities. This should include a communication strategy and grievance mechanism. • TGS should contribute to assisting with collaboration on independent research on how fish species on the West Coast such as snoek respond to seismic surveying. TGS 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**

In South Africa, claims for and access to natural resources are deeply embedded in people's histories, identities, and livelihood experiences. As in the case of land, access to and rights over fisheries resources is a highly contested issue where individuals and communities have equated such rights with human rights (Williams,2021).

Globally, fishing activities for many communities sees strong cultural and traditional links spanning many generations, and its value is seen beyond the means of earning a living (i.e. economic values). Whilst fishing takes place at sea, other activities related to fishing such as boat and net maintenance, the selling and trading of fish, etc. take place on land. Men and women are involved in fishing and indigenous knowledge and skills such as gutting and cleaning fish, reading the sea, and finding fish are transferred from generation to generation. The activities associated with fishing create a particular identity or characterise an area as a result of these activities (Williams,2021). Fishing is part of the cultural identity of the people living in fishing villages on the West Coast.

Many of the people on the West Coast belong to the Nama, Khoi or San people. Most of the Khoi 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 (https://foreignpolicy.com/2018/10/19/south-africas-first-nations-have-been-forgotten-apartheid-khoisan-indigenous-rights-land-reform/). The process of land distribution instituted by the Government since 1994 has largely excluded the Khoi 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 Khoi 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 Khoi 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 Khoi 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 a previous application for a seismic survey by another company in the area the Khoi and San felt that they were not consulted with. Therefore, they are sceptic about the intentions of any company doing seismic surveying. They felt that they were discriminated against by not being consulted during that previous application, deepening their status as marginalised groups, and causing distraught to them as groups. Many of the fishers are of Khoi 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. From their perspective, an EIA application is also viewed as a form of research. This guideline can be applied to the Khoi 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).

The San Code of Research Ethics states that lack of care can be demonstrated by talking down to communities, confusing them with complicated scientific language, or treating communities as ignorant. It further states that a lack of care is also represented by failing to ensure that something is left behind that improves the lives of the San.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
Further marginalization	Operation	High	Medium	Medium

Mitigation Measures

- TGS should develop a community engagement protocol that is based on the San Code of Research Ethics. This should be done in consultation with the affected communities. This should include a communication strategy and grievance mechanism.
- TGS should contribute to assisting with collaboration on independent research on how fish species on the West Coast such as snoek respond to seismic surveying. TGS 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.
- A representative from TGS should consult with the traditional leadership of the affected communities to establish what their understanding of meaningful consultation is and how communities should be consulted in future. This will assist with adjusting the relationship between TGS and the traditional communities. Given the socio-political environment, opposition to the project and associated non-technical risks, further meaningful engagement with the leadership and communities are critical from a social perspective.
- TGS 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 CONCERNS ABOUT CUMULATIVE 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. There are also existing mining activities, significant shipping traffic and commercial fishing taking place in the ocean. 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. Although cumulative impacts are assessed as part of the EIA process, there are limitations associated with budgets, timeframes, and access to resources. 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 from a strategic perspective. There must be a balance between the contribution these activities can make to South Africa's economy and sustaining the livelihoods of the vulnerable communities on the West Coast. The communities are clear that they do not necessarily want to stop development, they want to make sure that their livelihoods and heritage are protected, and that the rights of future generations will not be compromised. Once these have been affected negatively, it may not be possible to easily undo the damage.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
Cumulative social impact concerns	Operation	High	Medium	Medium
Mitigation Measures				
• TGS should approach the authorities and enter into conversation regarding a strategic impact assessment for the area that should be contributed to by all the production/ exploration companies involved.				

9.3.4.4 **PERCEIVED 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 (Vanclay *et al*., 2015). 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. Their skill sets are strongly linked to the sea and cannot be transferred to other economic activities without skills development, training activities and the economic diversification of the area. Men and women rely on the sea for their livelihoods, and it is closely linked to the culture and identity of the people. This makes these communities extremely vulnerable. Furthermore, an increase in poverty in the area will place an additional burden on tax payers.

The small-scale fishers can travel approximately 15 nautical miles offshore with their boats. Some of them have indicated that they already sometimes need to go further to be able to catch enough fish, 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. However, with reference to the assessment of the impacts on the catch rates from the fisheries assessment undertaken by CapMarine (2022), the impact on livelihoods is not because of the actual impact on catch rates, but because of the perceived impact of the oil/gas industry on fishing industry.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
Perceived impact on livelihoods	Operation	Medium	Medium	Medium
Mitigation Measures				
• TGS should develop a community engagement protocol that is based on the San Code of Research Ethics. This should be done in consultation with the affected communities. This should include a communication strategy and grievance mechanism.				

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
• TGS should contribute to assisting with collaboration on independent research on how fish species on the West Coast such as snoek respond to seismic surveying. TGS 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. • A representative from TGS should consult with the traditional leadership of the affected communities to establish what their understanding of meaningful consultation is and how communities should be consulted in future. This will assist with adjusting the relationship between TGS and the traditional communities. Given the socio-political environment, opposition to the project and associated non-technical risks, further meaningful engagement with the leadership and communities are critical from a social perspective. • TGS 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.				

9.3.4.5 **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 living, and their remains have never been found. The sea kept their bones, making the ocean the graveyard where their loved one's 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. Although this cultural and spiritual connection with the sea might be difficult to understand for outsiders, it must be respected as a cultural right.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
Impact on sense of spirit and place	Operation	Medium	Medium	Medium

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
Mitigation Measures				
• TGS should develop a community engagement protocol that is based on the San Code of Research Ethics. This should be done in consultation with the affected communities. This should include a communication strategy and grievance mechanism. • Consult with communities on potential ways in which to make a positive contribution to the communities.				

9.3.4.6 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. It appears as if TGS does not currently have social licence to operate in the fishing communities. Based on the events surrounding previous applications and recent reports about seismic surveys in the media, the communities expressed that they do not trust TGS or any other company conducting seismic surveys. Applications for seismic surveys and community opposition to these surveys have been widely reported and debated in the media during the last year (Compare News 24, 13 Jan 2022; Mail and Guardian, 20 Jan 2022; Eye Witness News, 1 September 2022 amongst others). Numerous NGOs specialising in social and environmental justice have aligned with communities and assist them with opposing seismic surveys. Some community members think that 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.

Given that there are a number of applications for seismic surveys in the Orange Basin, and that each application is subjected to a Basic Assessment process, communities are confused and reaching saturation regarding consultation. From their perspective, with each new application, it is a new face standing in front of them, from a new company, but “basically everyone wants the same thing”. Communities do not distinguish between different seismic survey companies. They feel as if their questions are not answered, and concerns are not addressed – each consulting firm just repeat the same technical information about what a seismic survey entails to them. Although this is not TGS’s fault and they are following a prescribed legal process, it impacts on their social licence to operate and on the seismic survey industry as a whole.

The term “social fabric” embraces numerous complex and interrelated phenomena, including demographic and economic factors, behavioural issues (e.g. investment choices, political dynamics), social institutions (e.g. families), social organisations (e.g. municipalities and churches), and social networks, or relationships amongst people. The social fabric is underpinned by people’s beliefs and sentiments, including a sense of belonging and identification with a particular social unit (Atkinson *et al*, 2017).

The social fabric in the communities have been damaged through previous negative 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 aggravated the communities. Mines closed without proper rehabilitation plans. In some places, access to the areas where they earn their livelihoods are becoming increasingly restricted, especially 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 historically companies have in most cases not treated them fairly or with respect. It is unlikely that any company that would like to undertake an activity in the ocean will be given social licence to operate by the community. The community have been traumatised by historical events and behaviour of companies too many times. On the other hand, there are members in the community that welcome any new development and feel that living from the sea has its limitations and would soon be impossible. The dynamics between the different groups in the community, caused by the myriad of seismic survey applications, has already done significant harm to the social fabric of the fishing communities. People with individual agendas cause conflict in the community, and given the vulnerability of the community, the dire socio-economic conditions and high levels of poverty, illiteracy and unemployment, community members are susceptible to these forms of manipulation.

Another aspect that affects TGS's current social license to operate negatively, is that previous applicants such as Searcher and Shell failed to conduct sufficient meaningful consultation with the small-scale fishers in the past. The MPRDA Regulations as amended in 2020 define meaningful consultation as: consulting in good faith, in a way that gives the landowner, lawful occupier and/or interested and affected persons all the relevant information, and reasonable time and opportunity to make an informed decision regarding the impact of the proposed activities.

The communities feel disrespected and marginalised by the processes followed up to date by previous applicants in the area. Engaging with the communities in a meaningful way, following the appropriate structures and protocols, will go a long way in improving TGS's social license to operate. It does not guarantee that the communities will accept TGS or any other company wanting to conduct seismic surveys. 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				
• TGS should develop a community engagement protocol that is based on the San Code of Research Ethics. This should be done in consultation with the affected communities. This should include a communication strategy and grievance mechanism. • Consult with communities on potential ways in which to make a positive contribution to the communities. • A representative from TGS should consult with the traditional leadership of the affected communities to establish what their understanding of meaningful consultation is and how communities should be consulted in future. This will assist with adjusting the relationship between TGS and the traditional communities. Given the socio-political environment, opposition to the project and associated non-technical risks, further meaningful engagement with the leadership and communities are critical from a social perspective. • TGS 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.				

9.3.4.7 STAKEHOLDER FATIGUE AND DISILLUSIONMENT

Signs of stakeholder fatigue are visible in the communities. Stakeholder fatigue may occur where many stakeholder initiatives have taken place in the past, especially in circumstances where they did not lead to tangible outcomes for stakeholders. There are a number of applications for seismic surveying, exploration and mining in the area that the stakeholders were 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 are strongly supportive of or 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.

Related to stakeholder fatigue is stakeholder disillusionment, which can occur during a project or can be a legacy of past involvement in stakeholder participation. Disenchantment can result from failure to manage credibility, relevance and legitimacy, particularly when communication is poor or expectations are not met. Stakeholders can feel let down from previous involvement and disenchantment can also result from failure to keep promises. A number of stakeholders have already indicated that they feel their voices don't matter and participating in all the processes are not making a difference.

Credibility, relevance, and legitimacy can be enhanced when (www.i2insights.org):

- Other invited stakeholders are considered to be appropriate;
- Stakeholders with opposing views who are included are generally respected;
- There are clear objectives;
- The processes used are transparent and seen to be appropriate;
- There is continuity in the participation, allowing relationships to be maintained, trust to be developed, and stakeholder knowledge and skills to be built on;
- Attention is paid to appropriate timing of participation processes;
- Results are delivered in a timely manner;
- The participation and communication processes are effective and ongoing throughout the application process;
- Participation is adapted to changing circumstances;
- Understandable language is used;
- The process for participation for all stakeholders is clearly stated and appropriate;
- Stakeholders feel that their interests have been understood and taken into account;
- The multiple stakeholders involved are seen to be a balanced group; and
- Use unbiased facilitators where possible.

TGS can only influence what happens in their own application. By attending to issues discussed and keeping promises made to stakeholders, they give their own application process the best possible chance and make it more likely that stakeholders will participate in the future.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
Impacts on the social license to operate	Operation	Medium	Low	Medium
Mitigation Measures				
• TGS should develop a community engagement protocol that is based on the San Code of Research Ethics. This should be done in consultation with the affected communities. This should include a communication strategy and grievance mechanism.				

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.
- A representative from TGS should consult with the traditional leadership of the affected communities to establish what their understanding of meaningful consultation is and how communities should be consulted in future. This will assist with adjusting the relationship between TGS and the traditional communities. Given the socio-political environment, opposition to the project and associated non-technical risks, further meaningful engagement with the leadership and communities are critical from a social perspective.

9.3.4.8 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 want to know that they will benefit from the process that will be set in motion by the seismic surveys. 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 creating alternative livelihoods and obtaining the necessary skills and experience in that regard. Although TGS will be doing a survey to gather data that will be utilised by oil and gas companies, and TGS's activities will be of a temporary nature, with little benefit to the locals, 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 TGS.

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 as it may have 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

- TGS should develop a community engagement protocol that is based on the San Code of Research Ethics. This should be done in consultation with the affected communities. This should include a communication strategy and grievance mechanism.
- Consult with communities on potential ways in which to make a positive contribution to the communities.
- TGS should investigate opportunities for the employment of people from local communities and skills development.

9.3.4.9 **SOCIAL UNREST**

Generally, social unrest occurs when a group gathers publicly to express dissatisfaction or anger centred around a common cause and is usually accompanied by a demand for societal change. Poor socio-economic conditions caused by unemployment rates, corruption, inflation, and bad governance can contribute to social unrest. South Africa has a history of using protests to air grievances. Social unrest is often triggered by an event or action that provokes strong feelings amongst community members.

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 surveying vessels. Others have threatened that they will take action to fight seismic surveys, in any way that they seem 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				

- TGS should develop a community engagement protocol that is based on the San Code of Research Ethics. This should be done in consultation with the affected communities. This should include a communication strategy and grievance mechanism.
- Consult with communities on potential ways in which to make a positive contribution to the communities.
- A representative from TGS should consult with the traditional leadership of the affected communities to establish what their understanding of meaningful consultation is and how communities should be consulted in future. This will assist with adjusting the relationship between TGS and the traditional communities. Given the socio-political environment, opposition to the project and associated non-technical risks, further meaningful engagement with the leadership and communities are critical from a social perspective.
- TGS 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.

9.3.5 CUMULATIVE NOISE IMPACTS ASSOCIATED WITH MULTIPLE SURVEYS

Should other seismic survey campaigns be undertaken concurrently with TGS'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. Current pending applications at PASA include the Searcher Geodata seismic survey application (PASA ref 12/1/043), as well as the GX Technology Corporation[28] survey application (ref 12/1/042), which both overlap the area proposed for the TGS 3D survey (Figure 117). It is understood that there

28 It is understood that ION GXT has been declared bankrupt and have ceased operations - as such, the ION GXT Reconnaissance Permit is considered to be defunct.

is potentially another application that would overlap the same area, but for which a Reconnaissance Application has not been submitted.

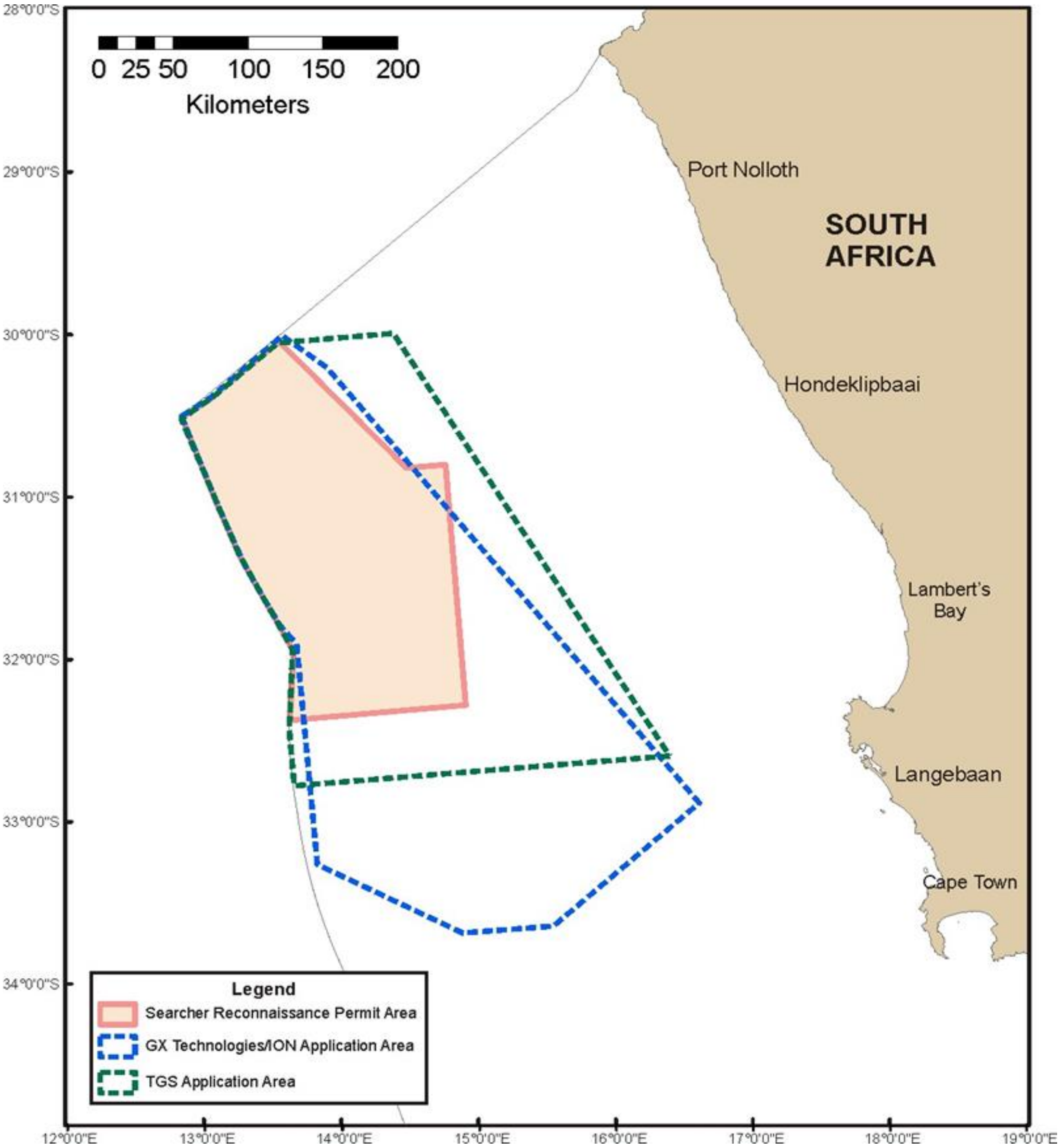


Figure 117: Application Areas for cumulative assessment in the unlikely event of multiple simultaneous surveys.

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 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.

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.
- Should surveys run simultaneously, it would be required to amend the EMPr, which would be subject to further assessment and consultation.

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 Application 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 6.

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 provides stakeholders with an opportunity to verify that the issues they have raised through the process had been captured and adequately considered.

The BA report aims to achieve the following:

- Provide an overall description 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 has been extensive, and every effort has been 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 180 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 90 m from the airgun array source.

The zones of potential mortal injuries for fish species with a swim bladder, fish eggs, and fish larvae are predicted to be within 30 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 80 m from the adjacent survey lines for fish with a swim bladder for all the operation scenarios considered. Fish without swim bladder are not expected to suffer or any potential injury. The zones of TTS effect for fish species with and without swim bladders are predicted to be within 2.9 km 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.

Three (3) long range modelling source locations are proposed for the 3D seismic survey. The modelling is representative of the noise propagation within the proposed 3D seismic area. Source location L1 is adjacent to the marine sensitive area, L2 represents the average depth of the south survey area and L3 is located towards the deeper water environment of the survey area. 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 in all locations for propagation paths towards shoreline directions.

For all source locations and except for downslope sections, 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.

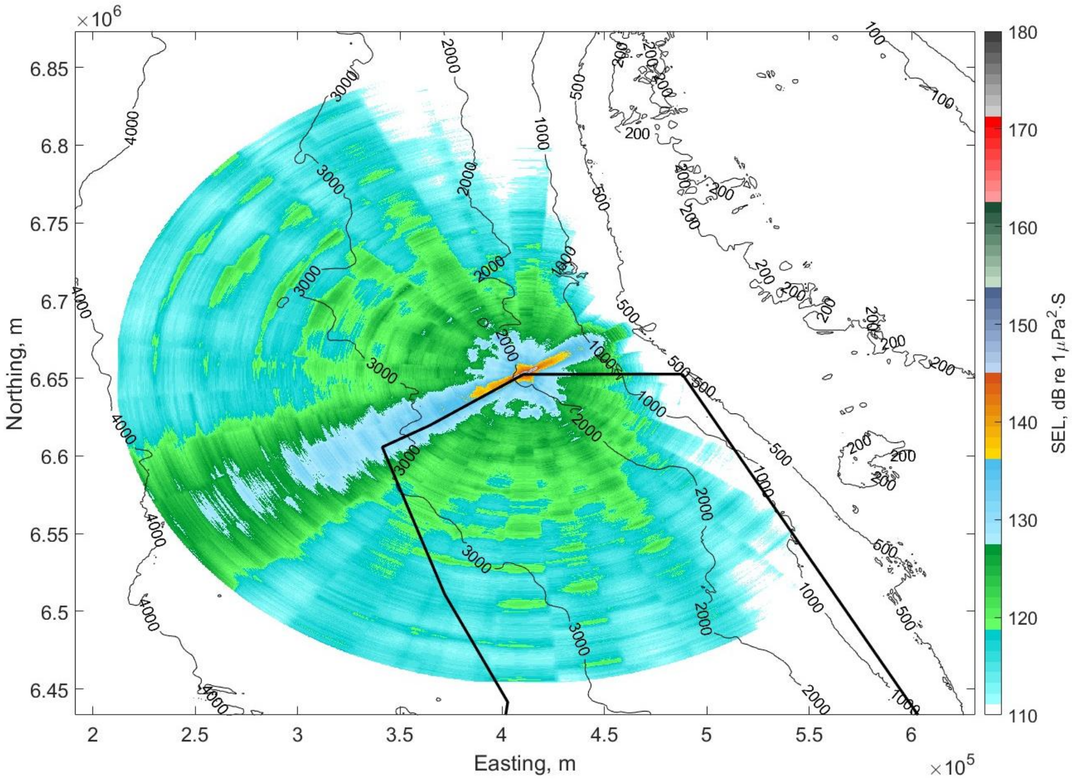


Figure 118: Modelled horizontal contour image of the predicted maximum SEL (unweighted and maximum level across water column) contours for source location L1 to a maximum range of 200 km, overlayed with bathymetry contour lines. Coordinates in WGS 84/UTM Zone 33S.

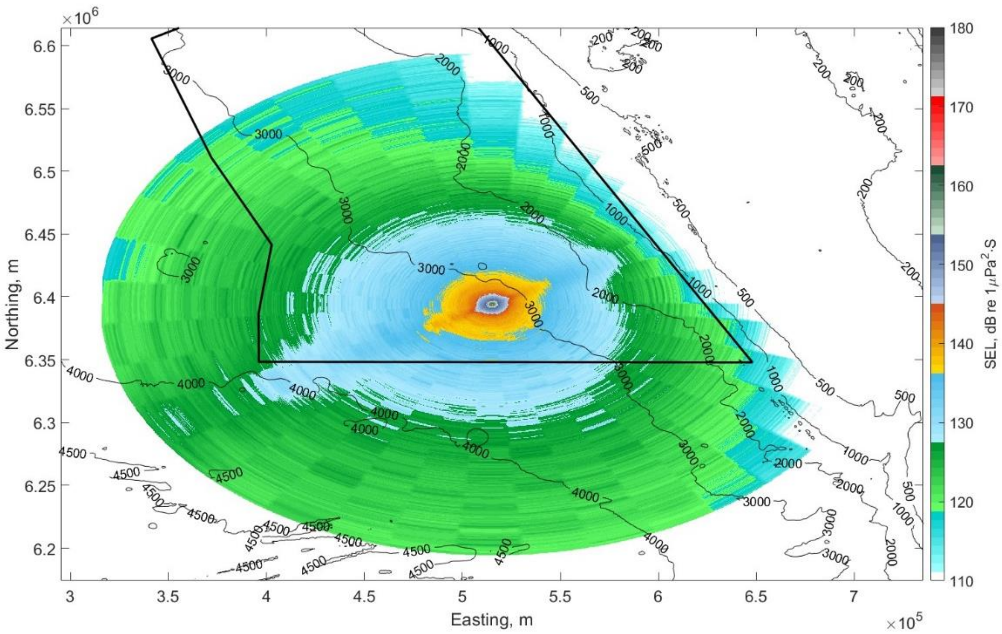


Figure 119: Modelled horizontal contour image of the predicted maximum SEL (unweighted and maximum level across water column) contours for source location L2 to a maximum range of 200 km, overlayed with bathymetry contour lines. Coordinates in WGS 84/UTM Zone 33S.

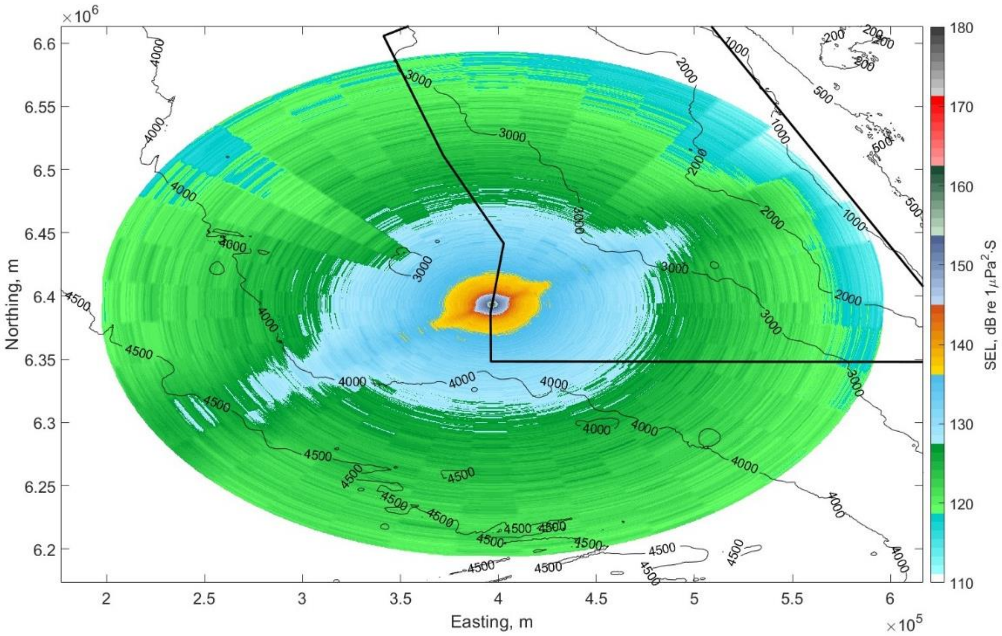


Figure 120: Modelled horizontal contour image of the predicted maximum SEL (unweighted and maximum level across water column) contours for source location L3 to a maximum range of 200 km, overlayed with bathymetry contour lines. Coordinates in WGS 84/UTM Zone 33S.

In terms of the impact from immediate exposure to individual airgun array pulses, the maximum zones of PTS effect for sea turtles are predicted to be within 19 m from the source location. On the other hand, the maximum zones of TTS effect for sea turtles are predicted to be within 24 m of the source array. The behavioural disturbance for sea turtles caused by the immediate exposure to individual pulses are predicted to be within 1.3 km of the source array.

In terms of the impact from cumulative exposure to multiple airgun array pulses, the 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 500 m of the source array. Further work will include the recommendation of underwater noise mitigation measures from seismic survey activities related to zones of impact and implementation of soft-starts if required.

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 shoaling large pelagic fish, turtles, seals, or cetaceans are observed within the zone of impact.
- Baseline noise measurements can provide useful information (prior to operations) when interpreting underwater noise predictions for the introduction of a new noise source. As such, it is recommended that underwater noise measurements be implemented that would include the deployment of underwater sound monitoring equipment to establish an actual baseline prior to the commencement of the survey and then operational levels of noise during the survey.

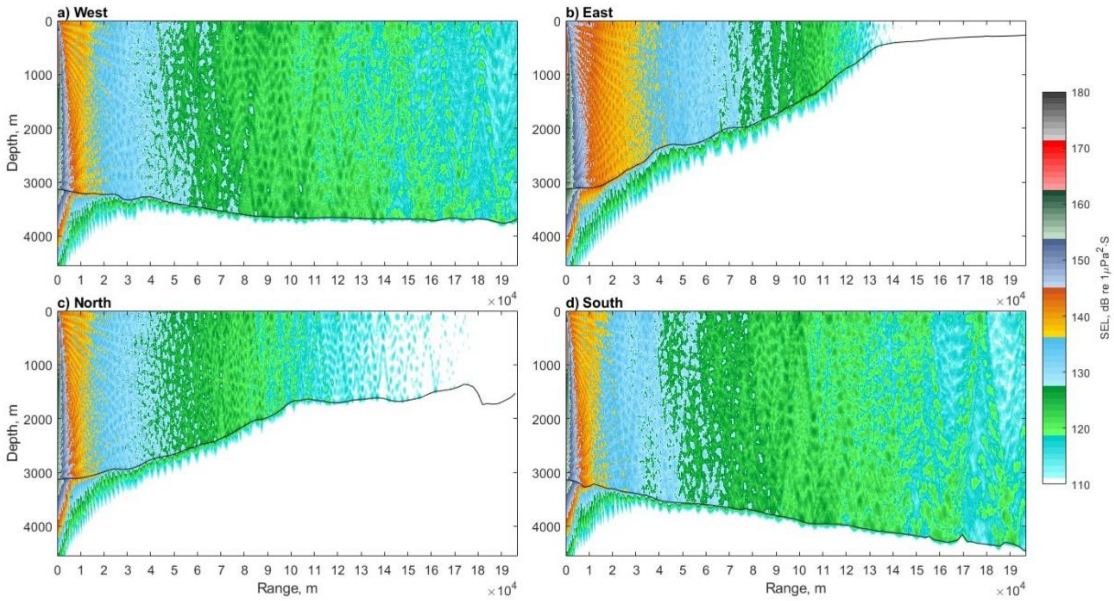


Figure 121: Modelled vertical contour images of the predicted SELs (unweighted) vs range and depth along the propagation path towards a) west b) east c) north and d) south direction from the source location L1. Black line shows the seabed depth.

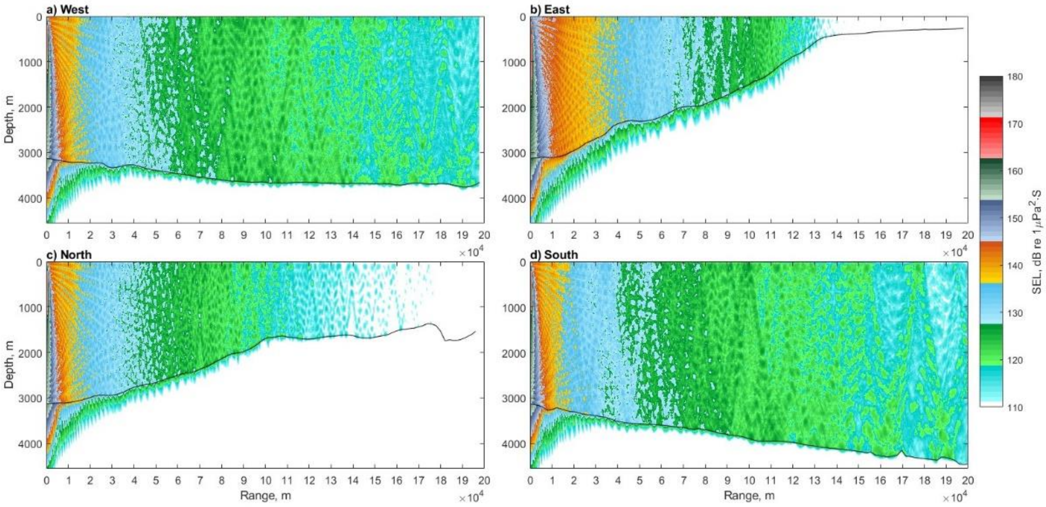


Figure 122: Modelled vertical contour images of the predicted SEL (unweighted) vs range and depth along the propagation path towards a) west b) east c) north and d) south direction from the source location L2. Black line shows the seabed depth.

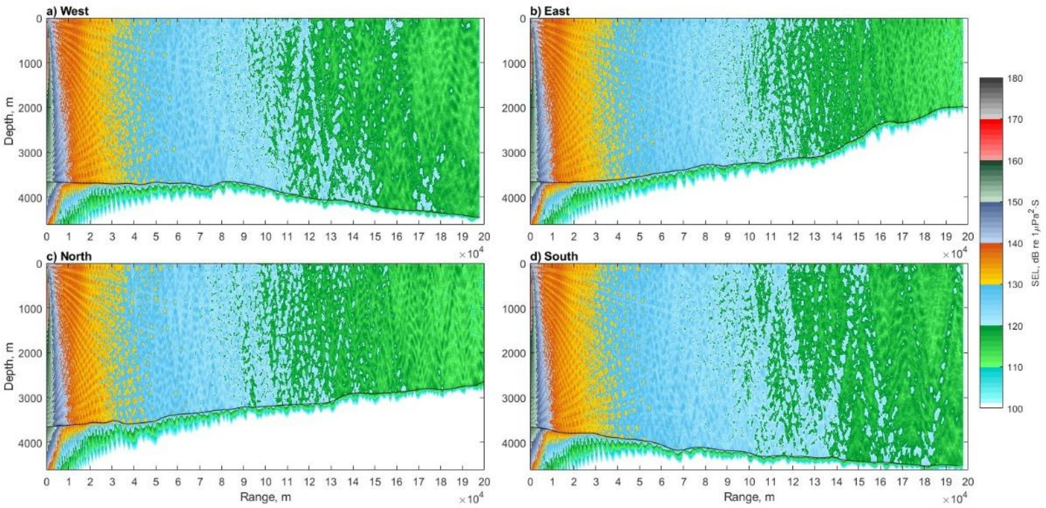


Figure 123: Modelled vertical contour images of the predicted SEL (unweighted) vs range and depth along the propagation path towards a) west b) east c) north and d) south direction from the source location L3. Black line shows the seabed depth.

In the unlikely event that up to three 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 40km 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 TGS 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 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.

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 an immediate impact that would endure for the duration of the proposed survey (~70 days). 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 Reconnaissance Permit area. With the implementation of the project controls and mitigation measures, the residual impact of the proposed survey is considered to be of LOW NEGATIVE significance to large pelagic longline and tuna pole-line sectors. There is no impact expected on the demersal trawl, midwater trawl, demersal longline, small pelagic purse-seine, linefish, west coast rock lobster, netfish and small-scale fishing sectors.

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. 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. A sound transmission loss modelling study (SLR 2022) identified predicted 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 airgun pulses or cumulative effects of exposure to multiple airgun pulses over a period of 24 hours. Based on the current project description, sound levels for the seismic survey could notionally be expected to attenuate to below levels for behavioural disturbance at a distance of 4 km from the source. The spatial extent of the impact of sound (produced by the airgun array) on catch rates is expected to be regional, although localised at any one time. The impact is considered to be of immediate duration and reversible without additional time or cost. Based on the distance of fishing grounds from the Reconnaissance Permit area, only the large pelagic longline and tuna pole-line sectors are considered to be susceptible to the effects 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 NEGATIVE significance. There is no impact expected on the demersal trawl, midwater trawl, demersal longline, small pelagic purse-seine, linefish, west coast rock lobster, netfish and small-scale fishing sectors.

The Reconnaissance Permit area is situated in the Orange Basin, offshore of the shelf break and offshore of grounds of importance for many of South Africa's commercial fishing sectors, as well as small-scale and recreational fisheries. The large pelagic longline sector operates across the extent of the Reconnaissance Permit area, with activity focussed along the continental shelf break. The Application Area does not overlap key spawning or nursery areas therefore the risk of noise disturbance to spawning behaviour and fishery recruitment is considered unlikely.

In order to mitigate the impacts on the large pelagic longline sector, it is recommended that the survey avoid taking place during June and July. 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 survey. 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 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.

11.1.4 HERITAGE ASSESSMENT

The scientific studies conducted for this project identified impacts on fishing stock as low for all 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 positively impact the potential negative impacts on the cultural heritage of the communities to be impacted.

A pre-mitigation negative impact on a regional scale over the long term with a moderate intensity is predicted 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 on heritage resources is rated as MEDIUM. The potential residual impact on heritage resources, 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

TGS'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, overfishing and businesses such as factories that come and go and often and do not leave in a socially responsible way.

TGS, 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 by previous applicants from a community perspective. If TGS 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 majority of local people are opposed to the project. 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. 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. From a social perspective it is recommended that the project proceed subject to the mitigation measures (i.e. meaningful consultation, local research, education, and awareness raising in the project-affected communities) forming part of the conditions for authorisation and being implemented prior to the commencement of the actual survey.

11.2 PREFERRED ALTERNATIVES

The preferred alternatives are discussed below. The final Sensitivity Map is provided in Figure 124 below which shows all identified sensitive areas including the MPA 5km buffer zones. No no-go areas were identified within the Application 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'.

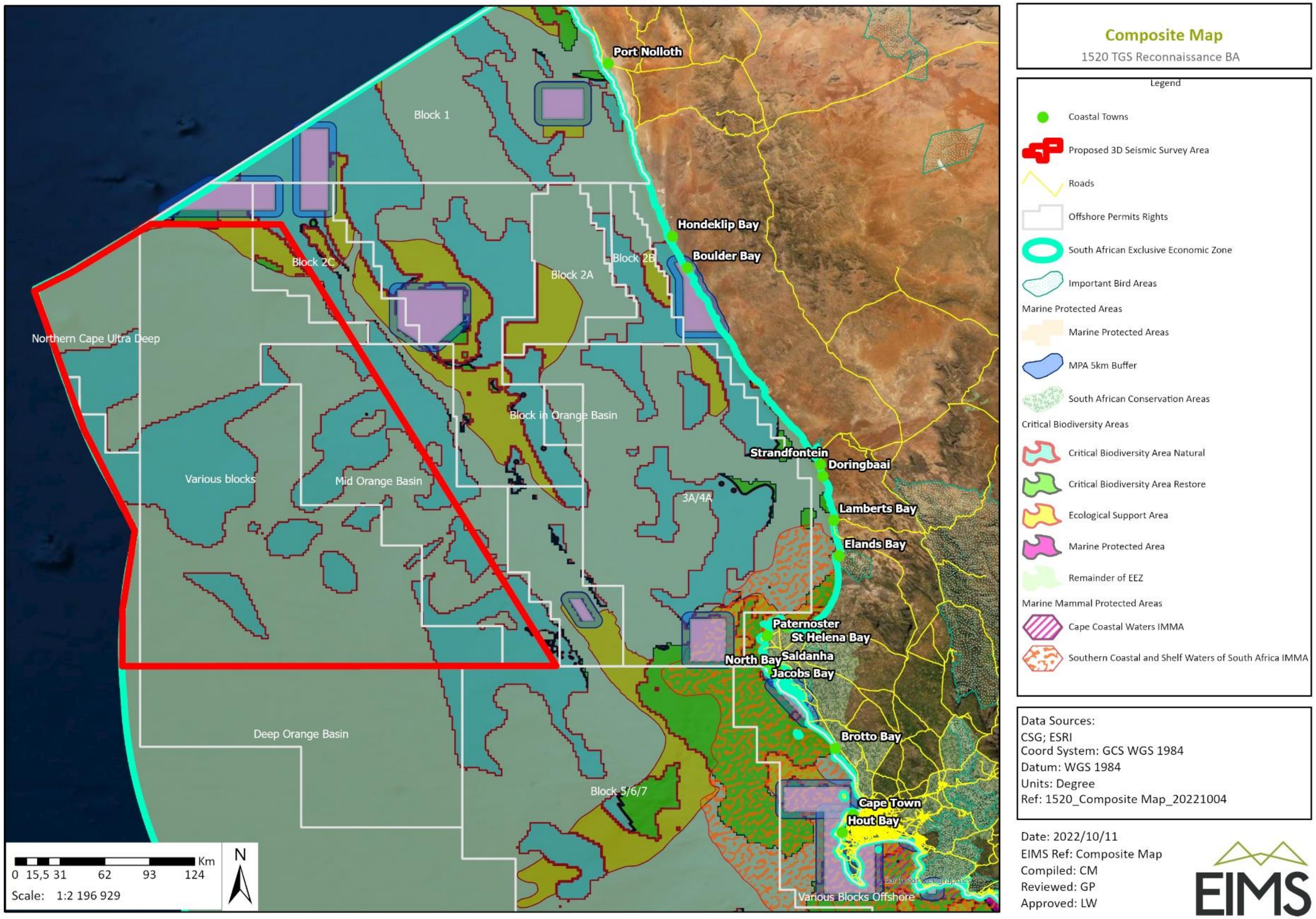


Figure 124: Final Composite Sensitivity Map

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 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. A sensitivity map is provided in Figure 124 above and a summary showing the number of impacts and the post-mitigation significance of these identified impacts is provided in Figure 125.

Based on the findings of the Acoustics, Marine Ecology and Fisheries recommendations, it is recommended that the survey window of January – May be utilised in order to:

- Avoid sensitive areas and periods for some marine fauna: Movement of migratory cetaceans (particularly baleen whales) from their southern feeding grounds into low latitude waters (June/July and late October/November), and their aggregation on the summer feeding grounds between St Helena Bay and Dassen Island from late October to late December and ensure that migration paths are not blocked by seismic operations;
- Avoid periods of peak fishing activity during June and July in order to reduce the probability of disruption to the large pelagic longline fishing sector and tuna pole line fishing sector.

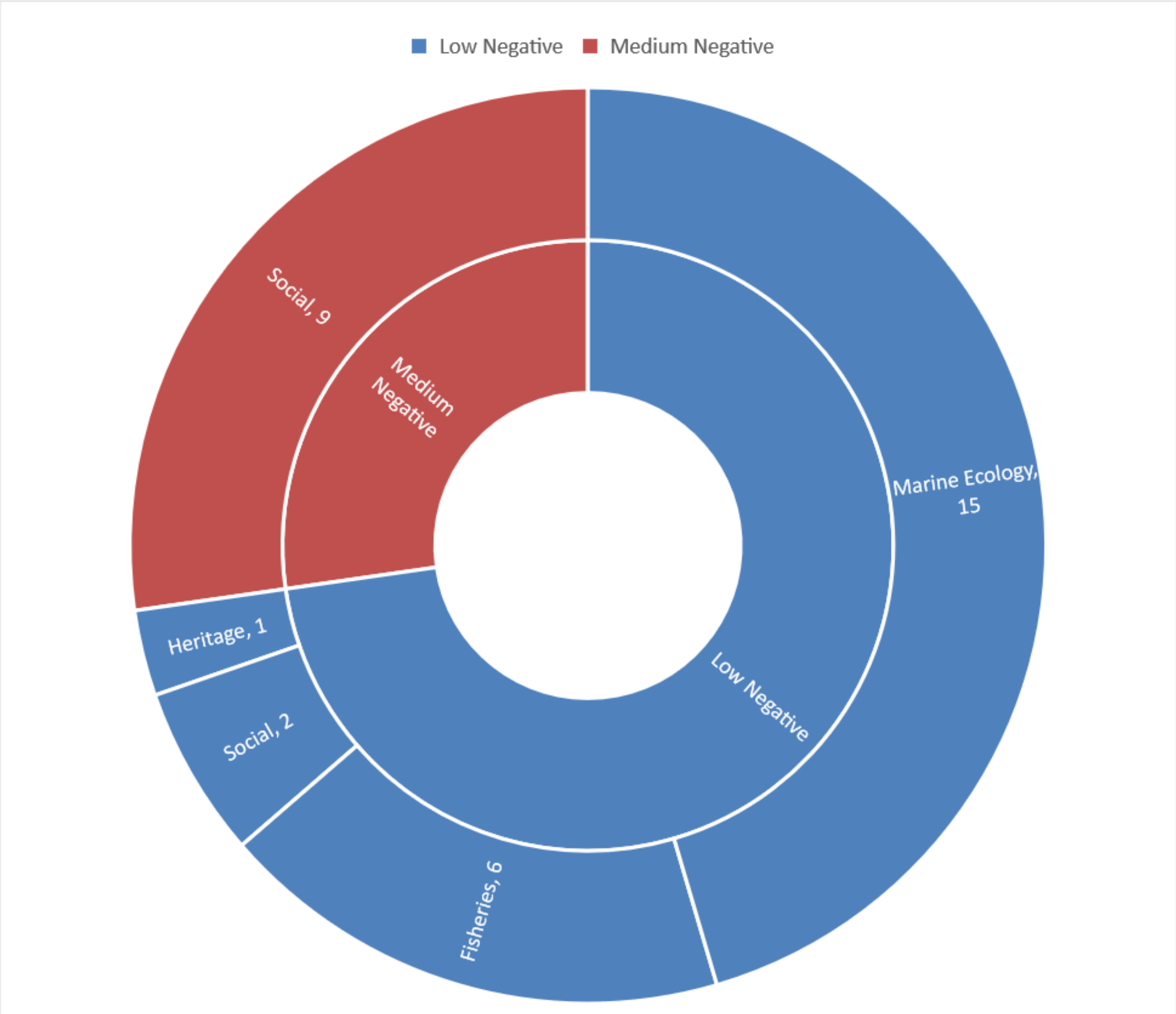


Figure 125: Impact Summary showing number and significance of impacts post mitigation

11.4 RECOMMENDATIONS FOR INCLUSION IN ENVIRONMENTAL AUTHORIZATION

This section contains recommendations from the various specialist studies for inclusion in the EA. It is recommended that these surveys and other drilling applications should be planned in such a way that the cumulative impacts would be minimised, and that the competent authority should carefully evaluate the cumulative impacts of this survey combined with other proposed seismic surveys in the same general area.

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 EIA 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 sensitive areas and periods for some marine fauna: Movement of migratory cetaceans (particularly baleen whales) from their southern feeding grounds into low latitude waters (June/July and late October/November), and their aggregation on the summer feeding grounds between St Helena Bay and Dassen Island from late October to late December and ensure that migration paths are not blocked by seismic operations. If possible, the survey should be undertaken from North to South to avoid these feeding aggregations.

- 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 (which includes line turns undertaken 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.
- As the Application 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 are readily available in the event that PAM breaks down, in order to ensure timeous redeployment.

Infra Red Cameras

- MMOs are to be equipped with infra-red cameras in order to observe mammals at night.

Seismic Source

- 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 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.

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 qualified MMOs on board the seismic vessel. As a minimum, sufficient MMOs must be on watch to cover all 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, and 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 of a 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.
- Consideration is to be given to the practicality (considering the weather conditions and costs) of aerial surveys to locate feeding aggregations. The use of drones could be considered (considering the weather conditions and costs) to supplement the observations of the MMO prior to soft starts.
- 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 all 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, shoaling 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, shoaling 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, shoaling 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. However, if this is not possible due to prolonged periods of poor visibility (e.g. thick fog) or unforeseen technical issue which results in a night-time start, the initial acoustic source activation (including seismic source 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) 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), terminate source until such time as the animals are outside of the 500 m mitigation zone (seismic "pause", no soft-start required).
    - 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

- Avoid operating during June and July, in order to avoid periods of peak fishing effort by the large pelagic longline sector.
- 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 this environmental impact process against quantified economic damage and losses and human development impacts in a follow-up socio-economic assessment. It will enable the heritage specialist to evaluate the link between the socio-economic changes induced by the proposed project as it relates to changes in the intangible cultural heritage practices of the communities. It is anticipated that this can be achieved through the implementation of the mitigation measures in the Social Impact Assessment.
- 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. It is anticipated that this can be achieved through the implementation of the mitigation measures in the Social Impact Assessment.
- 3D seismic surveys have the potential to locate wrecks on the surface, and sometimes below sediments on the ocean floor. Any shipwrecks or pieces thereof noted during the survey must be shared with the SAHRA MUCH Unit for inclusion into the national database. These could then be identified and be incorporated into the EMPr.

11.4.4 SOCIAL

Based on the findings, the following recommendations are made:

- TGS should develop a community engagement protocol that is based on the San Code of Research Ethics. This should be done in consultation with the affected communities. This should include a communication strategy and grievance mechanism.
- TGS should contribute to assisting with collaboration on independent research on how fish species on the West Coast such as snoek respond to seismic surveying. Collaboration across seismic operators with holders of hydrocarbon exploration and the industry as a whole to collectively fund pro-active research would provide opportunity for the development and implementation of a structured and experimentally sound acoustic study. This would quantitatively inform the authorities and stakeholders of acoustic impacts to the various faunal groups in South African Waters. It is recommended that the Department of Agriculture, Forestry and Fisheries, Oceans & Coasts, Research component be contacted for possible collaboration on further research on the impact so seismic surveys on the marine ecosystem.
- Consult with communities on potential ways in which to make a positive contribution to the communities.
- A representative from TGS should consult with the traditional leadership of the affected communities to establish what their understanding of meaningful consultation is and how communities should be consulted in future. This will assist with establishing the relationship between TGS and the traditional communities. Given the socio-political environment, opposition to the project and associated non-technical risks, further meaningful engagement with the leadership and communities are critical from a social perspective. Given the risk of stakeholder fatigue, it would be most beneficial if this can take place on an industry level.

- TGS 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.

11.4.5 ACOUSTICS

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 shoaling large pelagic fish, turtles, seals, or cetaceans are observed within the zone of impact.
- Baseline noise measurements can provide useful information (prior to operations) when interpreting underwater noise predictions for the introduction of a new noise source. As such, it is recommended that underwater noise measurements be implemented that would include the deployment of underwater sound monitoring equipment to establish an actual baseline prior to the commencement of the survey and then operational levels of noise during the survey.
- 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

12.1 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.

12.2 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 Marine Mammal Observer (MMO) Reports. The sources consulted are listed in the Reference chapter.

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 2022).
- 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.

12.3 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 Application 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 shown in Figure 2.1 of the Fisheries report). 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 Application 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.

12.4 HERITAGE

Not detracting from the stakeholder engagement completed, it is necessary to realise that the intangible heritage elements identified during engagements do not necessarily represent all 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 depends on peoples' relationship to the ocean and their feelings about the proposed project.

12.5 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 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 occurring 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.
- Limited time was available for conducting the assessment.

12.6 NOISE / ACOUSTICS

The assumptions made in the noise technical report are as follows:

- One survey line section is assumed to be acquired within the 24-hour period for each 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 airgun noise at a fixed location over the entire 24-hour period.

13 AFFIRMATION REGARDING CORRECTNESS OF INFORMATION

We **<u>Liam Whitlow and Gideon Petrus Kriel</u>**, herewith undertake that the information provided in the foregoing report is correct to the best of our 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:

Liam Whitlow

Date: 6 December 2022

Signature of the EAP:

Gideon Petrus Kriel

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15 APPENDICES

Appendix 1: EAP CV

Appendix 4: Impact Assessment Matrix