APPENDIX 12:

FISHERIES IMPACT ASSESSMENT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR EXPLORATION DRILLING AND ASSOCIATED ACTIVITIES IN BLOCK 5/6/7 OFF THE SOUTH-WEST COAST OF SOUTH AFRICA

FISHERIES IMPACT ASSESSMENT

OCTOBER 2022

Prepared for the Environmental Assessment Practitioner:

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On behalf of the applicant:

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EXPLORATION DRILLING AND ASSOCIATED ACTIVITIES

BLOCK 5/6/7, SOUTH-WEST COAST, SOUTH AFRICA

Fisheries Specialist Study

04 September 2022

EXPERTISE AND DECLARATION OF INDEPENDENCE

This report was prepared by Dave Japp and Sarah Wilkinson of Capricorn Marine Environmental (Pty) Ltd. Dave Japp has a BSc degree in Zoology from the University of Cape Town (UCT) and a MSc degree in Fisheries Science from Rhodes University. Sarah Wilkinson has a BSc (Hons) degree in Botany from UCT. Both have considerable experience in undertaking specialist environmental impact assessments relating to South African commercial fisheries and fish stocks. David Japp has worked in the field of fisheries science and resource assessment since 1987. His work has included environmental economic assessments and the evaluation of environmental impacts on commercial fisheries. Sarah Wilkinson has worked on marine resource assessments, specialising in spatial and temporal analysis (GIS) of fisheries.

This specialist report was compiled for SLR Consulting (South Africa) (Pty) Ltd (SLR) as part of the Environmental and Social Impact Assessment (ESIA) for Exploration Drilling and Associated Activities within Block 5/6/7, situated offshore South Africa. We hereby declare that we are financially and otherwise independent of TEEPSA and of SLR.

Dave Japp

Sarah Wilkinson

EXECUTIVE SUMMARY

TotalEnergies EP South Africa Block 567 (Pty) Ltd (TEEPSA) is the operator and holder of an existing Exploration Right for licence Block 5/6/7, situated off the south-west coast of South Africa. The Exploration Right and existing Environmental Management Programme (EMPr) allows for the undertaking of a number of exploration activities including two-dimensional (2D), three dimensional (3D) seismic surveys and controlled-source electromagnetic surveying (CSEM) across the entire extent of the licence block. Since the first granting of the Exploration Right, 2D and 3D seismic surveys have been undertaken in the block and TEEPSA intends to pursue further exploration drilling and associated activities. TEEPSA is now applying for Environmental Authorisation (EA) to include the drilling of up to 5 wells in a focus area within the block, including vertical seismic profiling (VSP), well testing and abandonment of wellheads.

SLR Consulting (South Africa) Pty Ltd has been appointed as the Independent Environmental Practitioner (EAP) to undertake a full Scoping and ESIA process as part of the EA application for the proposed exploration activities. Capricorn Marine Environmental (Pty) Ltd has been contracted to provide a specialist assessment of the impact of the proposed activities on the fishing industry. Several aspects of the proposed activities were identified as posing a potential risk to the fishing industry and these risks were assessed with respect to commercial and small-scale fisheries.

The following impacts on fisheries arising during normal operations were identified: 1) temporary 500 m safety zone around drilling unit; 2) presence of subsea infrastructure - permanent exclusion around wellhead(s) on the seafloor; 3) release of drill cuttings into the marine environment and the generation of underwater noise during 4) drilling and 5) VSP. The potential impact of unplanned (accidental) events were identified as: 6) low volume release of diesel or hydraulic fuel from vessels or drilling unit; 7) a large-scale, uncontrolled oil spill of hydrocarbons at the well due to a failure of pressure control systems; and 8) loss of equipment to sea.

The table below provides a summary of the impacts on fisheries of each of the identified project activities, where the impact significance range across fishing sectors is presented before and after the implementation of recommended mitigation measures.

Ref:	Potential Impact Source	Project Phase	Impact Significance	
			Pre-Mitigation Impact	Residual Impact
1	Temporary Safety Zone around Drilling Unit	Operation	LOW - NEGLIGIBLE	LOW - NEGLIGIBLE
2	Presence of Subsea Infrastructure - Permanent Exclusion around Wellhead(s)	Demobilisation	MEDIUM	NO IMPACT
3	Discharge of Drill Cuttings	Operation	NEGLIGIBLE	NEGLIGIBLE
4	Drilling Noise	Operation	LOW – VERY LOW	LOW – VERY LOW
5	VSP Noise	Operation	LOW – VERY LOW	LOW – VERY LOW
6	Accidental Oil Spill: Minor	Unplanned Event	LOW – MEDIUM	LOW
7	Accidental Oil Spill: Major	Unplanned Event	VERY HIGH	HIGH
8	Accidental Loss of Equipment at Sea	Operation	LOW	LOW

The impact of temporary and permanent exclusion from fishing ground was assessed on each fishing sector based on the type of gear used and the proximity of fishing areas in relation to the proposed project activities. The impact on catch rates due to sound elevation levels was assessed using the results of a Sound Transmissions Modelling Loss (STML) report and sensitivity / vulnerability differences amongst the targeted fish species identified for each sector. The results of drill cuttings discharge (planned) and hydrocarbon discharge (unplanned / emergency event) modelling scenarios were used to inform the impact assessment on commercial and small-scale fisheries. The impact magnitude (or consequence) was assessed based on a combination of the intensity, duration and extent of the impact. Magnitude was assigned to the pre-mitigation impact (i.e. before additional mitigation measures are applied, but taking into account embedded controls specified as part of the project description) and residual impacts after additional mitigation is applied. Thereafter the impact significance rating was determined as a function of the magnitude of the impact and the sensitivity of the fishery.

The temporary exclusion of vessels from operating within 500 m of the well drilling unit is likely to present a localised and short term impact on the demersal trawl, demersal longline, large pelagic longline and tuna pole-line sectors, which are active within the proposed well drilling area. Fisheries research surveys have also routinely operated within the area. The impact on these sectors is assessed to be of overall LOW significance to the large pelagic longline sector, VERY LOW significance to the demersal trawl, demersal longline and tuna pole-line sectors after the implementation of mitigation measures.

The abandonment of wellheads is likely to present an impact only to the demersal trawl fishery. The impact would materialise only if wells are drilled within the trawl footprint (i.e. in waters shallower than 780 m within the proposed well drilling area). The presence of abandoned wellhead(s) is deemed to be of MEDIUM significance within the ring fenced trawling grounds. The removal of wellhead(s) within the ring fenced trawling grounds would allow normal fishing operations to resume in the drilling area after decommissioning (no impact).

The discharge of well cuttings into the marine environment would result in the deposition of particulate matter around the wellhead and the suspension of fine particulate matter into the water column. The most significant envisaged environmental impact due to the release of drill cuttings is the smothering of benthic organisms as well as bio-chemical effects due to the settling out of drill cuttings on the seabed. The resulting plume and depositional footprint would be expected to coincide with spawning areas for hake, however due to the localised extent of the impact the overall significance of the impact to the fishery is considered to be NEGLIGIBLE.

Generation of noise during drilling operations (e.g. by drilling units and vertical seismic profiling (VSP)) has the potential to affect catch due to behavioural responses of fish to increased noise levels. Based on the distance of the affected area to fishing grounds, and short-term duration of the impact it is unlikely that significant changes in catch rates would be experienced for any of the fisheries assessed. The overall noise impact due to vessel and drilling noise is assessed to be of LOW to VERY LOW significance after the implementation of mitigation measures. The noise impact during VSP operations, was assessed to be of LOW to VERY LOW significance. Mitigation measures in this regard are aimed at advance notification to affected vessel operators so that fishing effort may be directed away from the drilling area.

Results of the oil spill modelling study indicated that hydrocarbons escaping from the well could form a subsurface plume that is transported in a north-westerly direction by the current, reaching the sea surface at distances between of several kilometers from the well site within a matter of hours. Seasonality seems to influence oil progression at surface, the probability of shoreline oiling, the minimum time for oil to come ashore, as well as the target areas for mobilization of response means to be considered in the oil spill contingency plan. Model results indicate a wide variation in probability of shoreline oiling attributable to seasonal effects and location of the well. The period of the year identified as the worst (in terms of extent of shoreline oiling) in the event of a blowout is June to August. Across the various scenarios considered for capping response only, oiling at a threshold above 10 g/m^2 could extend up to 2 640 km along the coastline from Plettenberg Bay to north of the Namibian border with up to 99% probability of oil reaching the shoreline on the Cape Peninsula and 88% probability of oiling along the West Coast north of Cape Town. Depending on the release start date and the observed metocean conditions, minimum time for oil to reach the shoreline can be as little as 0.6 days. (A full description is provided in Section 4.4 of this report). The impact on fisheries was assessed to be of VERY HIGH significance and of overall HIGH significance (assuming additional mitigation measures are implemented). Mitigation measures would require the implementation of an oil spill contingency plan including specialised well capping facilities for uncontained blow-outs. Oil spill contingency should consider the risk of this occurring and consider avoiding, as far as possible, drilling operations during June to August when the likelihood of shoreline oiling following the unlikely event of a blow-out is highest or additional response mitigation will need to be put in place. The use of dispersants, although appropriate for offshore areas are not likely to be suitable in the vicinity of mariculture / aquaculture facilities along the coastline.

In summary, a process of notification to the fishing industry should be implemented at least three weeks prior to the commencement of any project activity to allow adequate advance planning of fishing strategies. Affected parties should be informed of the timing, duration and location of the proposed drilling activities as well as any implications relating to the safety area that would be requested, as well as the movements of support vessels related to the project. The relevant fishing associations include FishSA, the SA Tuna Association; SA Tuna Longline Association, Fresh Tuna Exporters Association, South African Deepsea Trawling Industry Association (SADSTIA), South African Hake Longline Association (SAHLLA), South African Linefish Associations (various) and SA Marine Linefish Management Association (SAMLMA). In addition, the chair of the South African Small-scale Fisheries Collective and the South African United Fishing Forum. Other key stakeholders should be notified prior to commencement and on completion of the project. These include; DFFE Directive Small Scale Fisheries Management, the South African Navy Hydrographic Office (SANHO), South African Maritime Safety Association (SAMSA) and Ports Authorities. For the duration of the drilling operation, a navigational warning should be broadcast to all vessels via Navigational Telex (Navtext) and Cape Town radio (Channel 16 VHF; Call sign: ZSC.

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ACRONYMS, ABBREVIATIONS AND UNITS

BAT	Best Available Techniques
CapMarine	Capricorn Marine Environmental (Pty) Ltd
CPUE	Catch Per Unit Effort
dB	Decibel
DEFF	Department of Environment, Forestry and Fisheries
DMRE	Department of Mineral Resources and Energy
DFFE	Department of Forestry, Fisheries and Environment
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EMPr	Environmental Management Programme
ER	Exploration Right
EBSA	Ecologically or Biologically Significant Area
ESIA	Environmental and Social Impact Assessment
FLO	Fisheries Liaison Officer
GRT	Gross Registered Tonnage
Hz	Hertz
ICCAT	International Convention for the Conservation of Atlantic Tunas
IOTC	Indian Ocean Tuna Commission
kg	Kilogram
NEMA	National Environmental Management Act 107 of 1998, as amended
m	Metres
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002)
mt	Metric tonnes
SADSTIA	South African Deep-Sea Trawling Industry Association
SAHALLA	South African Hake Longline Association
SANHO	South African Navy Hydrographic Office
SAMLMA	South African Marine Linefish Management Association
SAPFIA	South African Pelagic Fishing Industry Association
SASMIA	South African Squid Management Industrial Association
SATLA	South African Tuna Longline Association
SECIFA	South Coast Inshore Trawl Fishing Association
SEL	Sound Exposure Level
SPL	Sound Pressure Level
SLR	SLR Consulting (Pty) Ltd
t	Tonnes
TAC	Total Allowable Catch
TAE	Total Allowable Effort
TEEPSA	TotalEnergies EP South Africa Block 567 (Pty) Ltd
ToR	Terms of Reference
VMS	Vessel Monitoring System
µPa	Micropascal

1 INTRODUCTION

1.1 BACKGROUND

TotalEnergies EP South Africa Block 567 (Pty) Ltd (TEEPSA) and its partners hold an Exploration Right over Block 5/6/7, which allows for the undertaking of various exploration activities within the Block, including two-dimensional (2D) seismic, three-dimensional (3D) seismic and controlled-source electromagnetic surveys. Since the first granting of the Exploration Right, a 2D and 3D seismic survey have been undertaken within the Block. Based on an analysis of acquired seismic data, TEEPSA is applying for Environmental Authorisation (EA) in order to drill one exploration well and, success dependent, up to four additional wells within an Area of Interest within the Block. The Area of Interest is 10 000 km^2 in extent and is located offshore roughly between Cape Town and Cape Agulhas, approximately 60 km from the coast at its closest point and 170 km at its furthest, in water depths between 700 m and 3 200 m (see Figure 1.1).

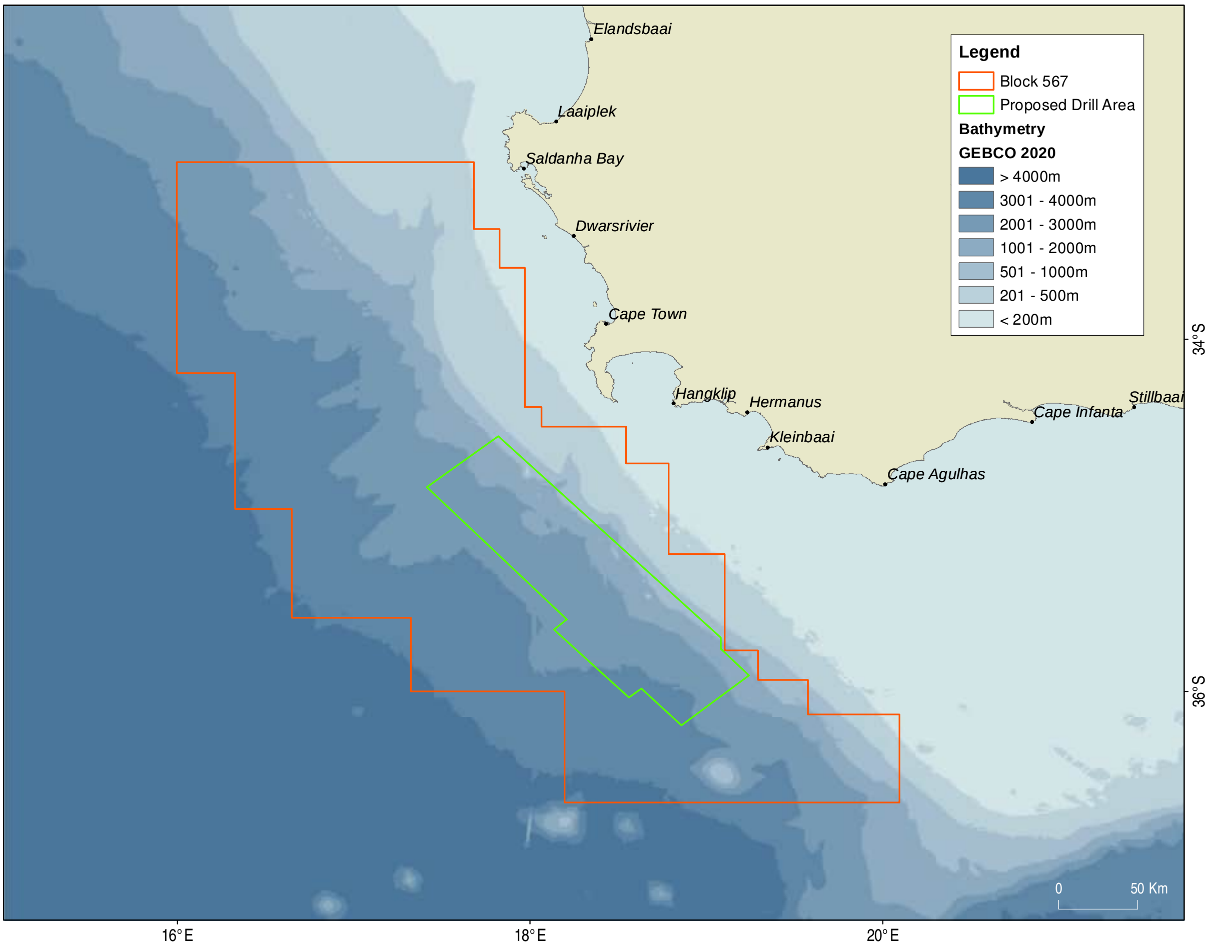


Figure 1.1: Locality of Block 5/6/7 and the area of interest for proposed drilling off the south-west coast.

In terms of the requirements of the Environmental Impact Assessment (EIA) Regulations of 2014 (as amended), published under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), the proposed exploration activities require an application for EA and the undertaking of a full Scoping and EIA process (hereafter collectively referred to as "Environmental and Social Impact Assessment" or "ESIA" process). TEEPSA appointed SLR Consulting (South Africa) (Pty) Ltd as the Environmental Assessment Practitioner (EAP) to undertake the ESIA process. Capricorn Marine

Environmental (Pty) Ltd (CapMarine) has been appointed to undertake the Fisheries Impact Assessment.

1.2 TERMS OF REFERENCE

The information from this study is intended to inform the ESIA process through providing fisheries baseline data for the licence area, Area of Interest and surrounds, an expert opinion on the relevant fisheries sectors including proposed mitigation measures to be implemented to manage/mitigate potential impacts of the proposed exploration activities.

The following general Terms of Reference (ToR) apply to the specialist studies:

- Describe the receiving environment and baseline conditions that exist in the study area and identify any sensitive areas that will need special consideration.
- Review the Scoping Comments and Responses Report to ensure that all relevant issues and concerns relevant to fields of expertise are addressed.
- Where applicable, identify and assess potential impacts of the proposed project activities and infrastructure following the impact assessment methodology (Appendix 1), including describing any associated cumulative impacts (qualitative assessment, to the extent that this is feasible).
- Describe the legal, permit, policy and planning requirements.
- Identify areas where issues could combine or interact with issues likely to be covered by other specialists, resulting in aggravated or enhanced impacts.
- Indicate the reliability of information utilised in the assessment of impacts as well as any constraints to which the assessment is subject (e.g. any areas of insufficient information or uncertainty).
- Where necessary consider the precautionary principle in the assessment of impacts.
- Identify management and mitigation actions using the Mitigation Hierarchy by recommending actions in order of sequential priority. Avoid first, then reduce/minimise, then rectify and then offset.
- Identify alternatives that could avoid or minimise impacts.
- Determine significance thresholds for limits of acceptable change, where applicable.

The specific ToR for the commercial and small-scale fisheries assessment are as follows:

- Provide a description of the fisheries sectors operating in South African coastal waters, focusing on the block.
- Undertake a spatial and temporal assessment of recent and historical fishing effort and catch in the licence area.
- Use available data to describe natural variability in historical trends and check monthly catches for seasonality.
- Assess the risk of impact of the exploration activities on specific commercial fish species and the consequential implications for fish catch by the different fishing sectors.
- Assess the potential impacts of normal operations and upset conditions (small accidental spills and large blow-out) on the fishing activities in terms of estimated catch and effort loss.
- Identify practicable mitigation measures to reduce any negative impacts on the fishing industry.

1.3 PROJECT DESCRIPTION

Since the first granting of the Exploration Right, a 2D and 3D seismic survey have been undertaken within the Block. Based on an analysis of acquired seismic data, TEEPSA proposes to drill one exploration well, and success dependent, up to 4 additional wells in total within an Area of Interest within the Block (i.e. up to 5 wells in total). The Area of Interest is 10 000 km^2 in extent and is located offshore roughly between Cape Town and Cape Agulhas, approximately 60 km from the coast at its closest point and 170 km at its furthest, in water depths between 700 m and 3 200 m (see Figure 1.1). The final well location would be based on a number of factors, including further detailed analysis of the seismic data, pre-drilling survey data, the geological target and seafloor obstacles.

It is expected that it would take approximately three to four months to complete the physical drilling and testing of each well (excluding mobilisation and demobilisation). The commencement date is not yet confirmed, but possibly between the fourth quarter of 2023 and second quarter of 2024 to drill the first well.

The key components and activities of the proposed well drilling programme are presented below and summarized in Table 1.1. A full description of project activities is included in the Final Scoping Report (SLR, 2022).

TEEPSA is proposing to utilise a semi-submersible drilling unit or a drill-ship, both with dynamic positioning system suitable for the deep-water harsh marine environment. A temporary 500 m safety zone around the drilling unit will be enforced at all times during operation. The drilling unit is expected to be supported by up to three support vessels and helicopter transfers between the drilling unit and Cape Town airport. The primary onshore logistics base will most likely be located at the Port of Cape Town (preferred option), or alternatively at the Port of Saldanha.

A well will be created by drilling a hole into the seafloor with a drill bit attached to a rotating drill string, which crushes the rock into small particles, called “cuttings”. After the hole is drilled, casings of steel pipe (which provide structural integrity to the newly drilled wellbore), are placed in the hole and permanently cemented into place. The diameter of the well decreases with increasing depth. Drilling is undertaken in two stages, namely the riserless and risered drilling stages (see Figure 1.2).

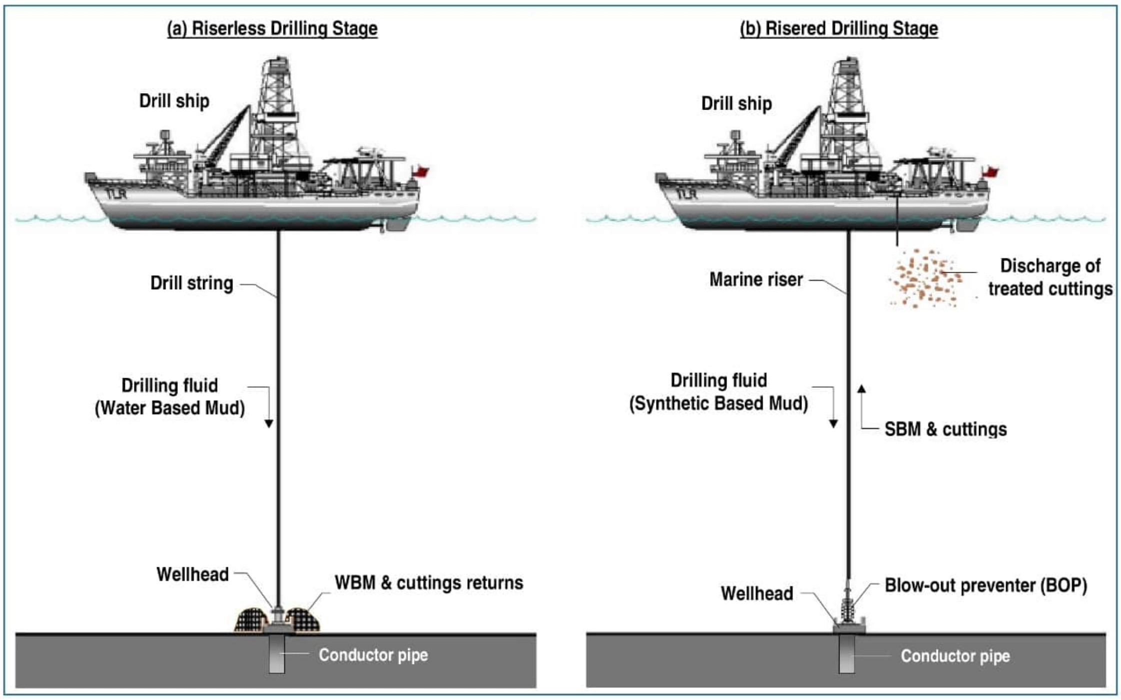


Figure 1.2: Drilling stages (left) Riserless Drilling Stage; and (right) Risered Drilling Stage.

- Initial (riserless) drilling stage: At the start of drilling, a 36 or 42 inch hole will be drilled approximately 70 m deep and the conductor pipe will be run into the hole and cemented into place, after which a low pressure wellhead will be placed on top of the conductor. Further sections are then drilled to diameter of 26 inches to a depth of approximately 1 070 m. These initial hole sections will be drilled using seawater (with viscous sweeps[1]) and Water Based Muds (WBMs). All cuttings and WBM from this initial drilling stage will be discharged directly onto the seafloor adjacent to the wellbore.
- Risered drilling stage: This stage commences with the lowering of a Blow-Out Preventer (BOP) and installing it on the wellhead, which seals the well and prevents any uncontrolled release of fluids from the well (a 'blow-out'). A lower marine riser package is installed on top of the BOP which isolates the drilling fluid and cuttings from the environment creating a "closed loop system". Drilling is continued by lowering the drill string through the riser, BOP and casing, and rotating the drill string. During the risered drilling stage, should the WBMs not be able to provide the necessary characteristics, a low toxicity Non-Aqueous Drilling Fluid (NADF) will be used. In instances where NADFs are used, cuttings will be treated to reduce oil content and discharged overboard.

Once the target depth is reached the well will be logged and possibly tested. Well logging involves the evaluation of the physical and chemical properties of the rocks in the sub-surface, and their component minerals, including water, oil and gas to confirm the presence of hydrocarbons and the petrophysical characteristics of rocks. Vertical Seismic Profiling (VSP) is an evaluation tool that is used when the well reaches target depth to generate a high-resolution seismic image of the geology in the well's immediate vicinity. The VSP images are used for correlation with surface seismic images and for forward planning of the drill bit during drilling. VSP uses a small airgun array, which is operated from the drilling unit. During VSP operations, receivers are positioned in a section of the borehole and the airgun array is discharged at intervals. This process is repeated for different stations in the well and may take up to nine hours to complete per well.

Well (flow) testing is undertaken to determine the economic potential of any discovery before the well is abandoned or suspended. One test could be undertaken per exploration well if a resource is discovered and up to two tests per appraisal well. Each testing may take up to seven days to complete (5 days of build-up and 2 days of flowing and flaring). If water from the reservoir arises during well flow testing, these would be separated from the oily components and treated onboard to reduce the remaining hydrocarbons from these produced waters. Treated produced water will then either discharged overboard or transferred to shore for treatment and disposal.

Once drilling and logging are completed, the exploration well(s) will be sealed with cement plugs, tested for integrity and abandoned according to international best practices.

The intention is to abandon the wellheads on the seafloor if deemed safe to do so based on a risk assessment. Where it is deemed to be safe, the wellhead will be left and fitted with an over-trawlable abandonment cap. Monitoring gauges to monitor pressure and temperature may be installed under the over-trawlable cap on wells where TEEPSA will return in the future for appraisal / production purposes.

A final clearance survey check will be undertaken using a Remote Operated Vehicle (ROV), after which the drilling unit and supply vessels will demobilise from the offshore licence area.

In addition to TEEPSA's own equipment and capabilities, it has contract agreements with global response companies to use globally advanced capping stacks in the event of a well blow-out. Capping stacks are designed to shut-in an uncontrolled subsea well in the unlikely event of a blow-out. One is located in Saldanha and others in the United Kingdom and Singapore. TEEPSA also has a capping

[1] Sweep is a special drilling fluid, formulated to transport cuttings from the hole.

stack in West Africa. The mobilisation of these and other incident response equipment and services will be contained in TEEPSA's Oil Spill Contingency Plan (OSCP) and Blow-Out Contingency Plan (BOCP).

Table 1.3: Summary of key project components.

Licence Block No.:	5/6/7
Exploration Right No.:	12/3/224
Number of exploration and appraisal wells	Up to 5 wells
Area of Interest for proposed drilling	10 000 km^2
Well depth (below seafloor)	Variable depending on depth of resource which is not currently known. A notional well depth of 3 570 m is assumed for the ESIA
Water depth range	• Water depth range for area of interest: 700 m to 3 200 m • Water depth range for most probable prospect(s): 2 000 m – 3 200 m
Duration to drill each well	• Mobilisation phase: up to 45 days • Drilling phase: o Exploration well: Up to three months o Appraisal well: Up to four months • Well abandonment: up to 15 days • Demobilisation phase: up to 10 days
Commencement of drilling and anticipated timing	Commencement is not confirmed, but possibly between fourth quarter of 2023 (Q4 2023) and second quarter of 2024 (Q2 2024) to drill first well.
Proposed drilling fluids (muds)	Water-based Muds (WBM) will be used during the riserless drilling stage and Non-Aqueous Drilling Fluid (NADF) during the risered drilling stage
Drilling and support vessels	• Semi-submersible drilling unit or drillship • Three support vessels during mobilisation and two during the risered drilling phase. These vessels will be on standby at the drilling unit, as well as moving equipment and materials between the drilling unit and the onshore base
Operational safety zone	Minimum 500 m around drilling unit
Flaring	Possibly, if hydrocarbons are discovered – up to 2 drill stem tests per appraisal well, with each test taking up to 2 days to flow and flare (24-hours a day).
Logistics base	Port of Cape Town, but alternatively at the Port of Saldanha
Logistics base components	Office facilities, laydown area, mud plant
Support facilities	Crew accommodation in Cape Town
Staff requirements:	• Specialised drilling staff supplied with hire of drilling unit • Additional specialised international and local staff at logistics base
Staff changes	Rotation of staff every three to four weeks with transfer by helicopter to shore

1.4 SUMMARY OF KEY POTENTIAL FISHERIES IMPACTS

The key potential fisheries impacts are presented below, as identified during the Scoping Phase.

Activity Phase	Activity	Aspect	Potential Impacts
1. Mobilisation Phase	Transit of drilling unit and supply vessels to drill site	Safety zone	Exclusion of fishing operations from safety zone around drillship
2. Operation Phase	Well drilling (including ROV site selection, installation of conductor pipes; well head, BOP and riser system, well logging, and plugging)	Increased underwater noise levels	Disturbance / behavioural changes to marine fauna
		Safety zone	Exclusion of fishing operations from safety zone around drillship
	Discharge of cuttings and drilling fluid, and residual cement	Accumulation of cuttings and cement on seafloor and sediment disturbance	Smothering disturbance and mortality of benthic fauna
			Toxicity and bioaccumulation or other physiological effects on marine fauna
			Loss of habitat
		Sediment plume and water column disturbance	Increased water turbidity, reduced light penetration and physiological effects on marine fauna
	Vertical Seismic profiling	Increase in underwater noise levels	Disturbance / behavioural changes to marine fauna
			Physiological effect on marine fauna
			Masking or interfering with other biologically important sounds
3. Demobilisation Phase	Abandonment of well on seafloor	Safety zone	Exclusion of fishing operations from safety zone around abandoned wellhead
4. Unplanned Activities	Accidental hydrocarbon spills / releases (minor) (e.g. vessel accident, bunkering and pipe rupture)	Loss of hydrocarbons to sea	Effect on faunal health or mortality (e.g. suffocation and poisoning)
			Avoidance of fisheries operations from contaminated areas
	Dropped objects / Lost equipment	Obstruction on seafloor or obstruction in water column	Risk of snagging with fishing gear and/or risk of vessel collision with free floating equipment
	Loss of well control / well blow-out	Uncontrolled release of oil / gas from well	Effect on health of marine fauna or mortality (e.g. suffocation and poisoning)
			Avoidance of fisheries operations from contaminated areas

2 APPROACH AND METHODOLOGY

2.1 DATA SOURCES

The description of the baseline environment in the study area is based on a review and collation of existing information. Catch and effort data were sourced from the Department of Forestry, Fisheries and Environment (Branch: Fisheries) (DFFE) record for the years 2000 to 2019 for those sectors it has data[2]. All data were referenced to a latitude and longitude position and were redisplayed on a 60x60, 10x10 or 5x5 minute grid. Additional information was obtained from the Marine Administration System from DFFE and from the *South Africa, Namibia and Mozambique Fishing Industry Handbook 2019 (47th Edition).*

2.2 ASSESSMENT METHODOLOGY

This study has adopted a 'desktop' approach based on primary fisheries catch and effort data obtained from DFFE. The description of the baseline environment in the study area is therefore based on a review and collation of existing information. The information for the identification of potential impacts on marine fauna (specifically fish and ichthyoplankton) was drawn from the marine ecology impact assessment for this project (Pisces Environmental Services (Pty) Ltd). The spatial distribution of fisheries catch and effort was mapped in relation to the area of each of these identified impacts. The convention used to evaluate the significance of the impact is provided in Appendix 1.

2.3 ASSUMPTIONS, LIMITATIONS AND INFORMATION GAPS

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 government 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).
- The effects of underwater sound (specifically vertical seismic profiling) on the catch per unit effort (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 of the South-West Coast. 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. For fish species, based on the noise exposure criteria provided by Popper et al. (2014), relatively high to moderate behavioural risks are expected at near to intermediate distances (tens to hundreds of meters) from the source location. Relatively **low behavioural risks** are expected for fish species at far field distances (**thousands of meters**) from the source location. For the current report, a conservative distance of **5 km** has been used to calculate the catch and effort within the zone of noise disturbance.

[2] There is no catch and effort data for SSF, only a list of communities by district municipality and number of registered fishers per community. The distribution of fishing grounds for SSF is derived from the catch and effort information provided for the linefish, squid, oyster, West Coast rock lobster and netfish sectors.

3 DESCRIPTION OF RECEIVING ENVIRONMENT: FISHERIES BASELINE

3.1 OVERVIEW OF FISHERIES SECTORS

South Africa has a coastline that spans two ecosystems[3] over a distance of 3 623 km, extending from the Orange River in the west on the border with Namibia, to Ponta do Ouro in the east on the Mozambique border. The western coastal shelf has highly productive commercial fisheries similar to other upwelling ecosystems around the world, while the east coast is considerably less productive but has high species diversity, including both endemic and Indo-Pacific species. Licence block 5/6/7 is located within the southern Benguela Large Marine Ecosystem.

South Africa's fisheries are regulated and monitored by the DFFE. The DFFE is responsible for rights allocations, the setting of sustainable total allowable catch (TAC) and total allowable effort (TAE), and the development of Operational Management Procedures (OMPs – "harvest control rules") which are flexible enough to take into account possible fluctuations in abundance. 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 are monitored and managed by DFFE. Table 3.1 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 3.1. Fisheries are generally divided into commercial and non-commercial fishing. The largest and most valuable commercial sectors include the deep-sea trawl fishery, 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.

Seaweed is also regarded as a fishery, with harvesting of kelp (*Ecklonia maxima)* and (*Laminaria pallida)* in the Western and Northern Cape and hand-picking of Gelidium sp. in the Eastern Cape. The seaweed

[3] The Benguela Current Large Marine Ecosystem off the west coast of the country is characterised by cold water currents which support high biomass of fish stocks, whereas the Agulhas Current Large Marine Ecosystem off the east coast is characterised by warm waters and high species diversity.

industry employs over 1700 people, most of whom are previously disadvantaged. *E. maxima* is primarily used by the abalone aquaculture industry as abalone feed.

Marine aquaculture is still in its infancy in South Africa but has been identified by government as a growth industry worthy of support.

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 Gqeberha 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, Hondeklipbaai, Dooringbaai, Laaiplek, Hout Bay and Gansbaai harbours. On the East Coast, Durban and Richards Bay are deployment ports for crustacean trawl and large pelagic longline sectors.

In addition to commercial sectors, recreational fishing includes shore and boat-based anglers and spear-fishers (Brouwer et al. 1997) who target a wide range of line fish species, some of which are also targeted by commercial operators, skin divers who collect rock lobsters and other subtidal invertebrates, bait collectors (collecting mussels, limpets, red bait) and net fisheries including cast, drag and hoop net techniques.

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.

Small-scale fisheries is a relatively new sector that permits the harvesting of a variety of species for commercial and consumptive use through the allocation of rights to co-operative groups. Management co-operatives represent more than 230 small-scale fishing communities along the South African coastline (DAFF, 2016), comprising over 10 000 individual fishers.

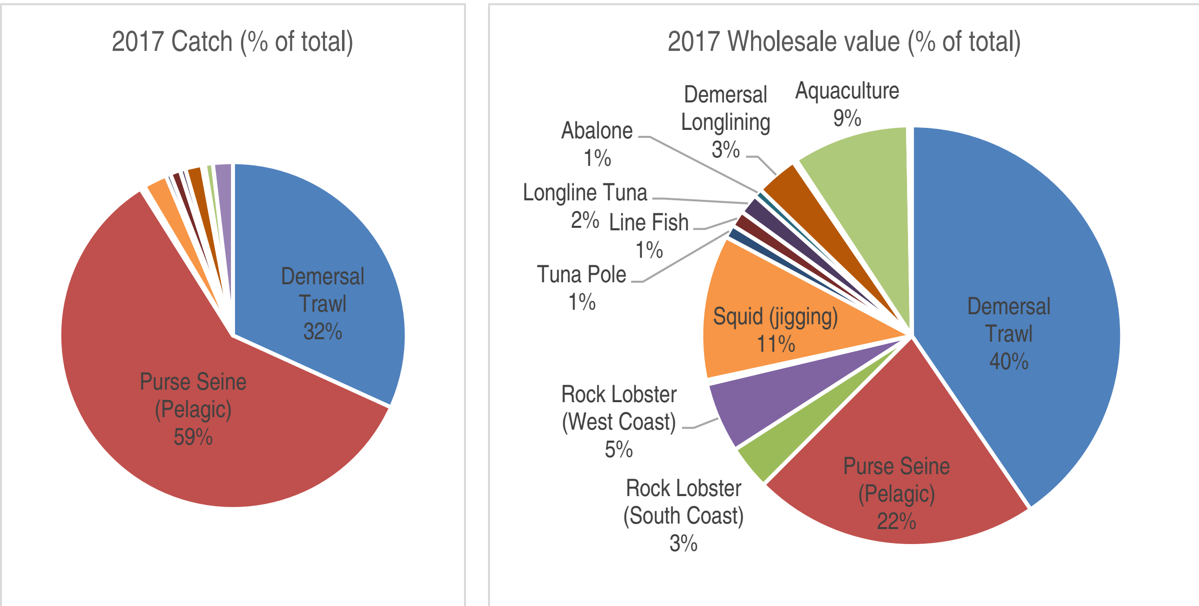


Figure 3.1: Pie chart showing percentage of landings by weight (left) and wholesale value (right) of each commercial fishery sector as a contribution to the total landings and value for all commercial fisheries sectors combined (2017). Source: DEFF, 2019.

Table 3.1: 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)	313 476	313 476	2 164 224	22.0
Demersal trawl (offshore)	50 (45)	163 743	98 200	3 891 978	39.5
Demersal trawl (inshore)	18 (31)	4 452	2 736	90 104	0.9
Midwater trawl	34 (6)	19 555			
Demersal longline	146 (64)	8 113	8 113	319 228	3.2
Large pelagic longline	30 (31)	2 541	2 541	154 199	1.6
Tuna pole-line	170 (128)	2 399	2 399	97 583	1.0
Traditional linefish	422 (450)	4 931	4 931	122 096	1.2
Longline shark demersal		72	72	1 566	0.0
South coast rock lobster	13 (12)	699	451	337 912	3.4
West coast rock lobster	240 (105)	1 238	1 238	531 659	5.4
Crustacean trawl	6 (5)	310	310	32 012	0.3
Squid jig	92 (138)	11 578	11 578	1 099 910	11.2
Miscellaneous nets	190 (N/a)	1 502	1 502	25 589	0.3
Oysters	146 pickers	42	42	3 300	0.0
Seaweeds	14 (N/a)	9 877	6 874	27 095	0.3
Abalone	N/a (N/a)	86	86	61 920	0.6
Aquaculture		3 907	3 907	881 042	9.0
Total		**528 966**	**458456**	**9 841 417**	**100**

Table 3.2: South African offshore fishing sectors, areas of operation and target species (DEFF, 2019).

Sector	Areas of Operation	Main Ports in Priority	Target Species
Small pelagic purse-seine	West, South Coast	St Helena Bay, Saldanha, Hout Bay, Gansbaai, Mossel Bay	Anchovy (*Engraulis encrasicolus*), sardine (*Sardinops sagax*), Redeye round herring (*Etrumeus whiteheadi*)
Demersal trawl (offshore)	West, South Coast	Cape Town, Saldanha, Mossel Bay, Gqeberha	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*)
Midwater trawl	West, South Coast	Cape Town, Gqeberha	Adult horse mackerel (*Trachurus capensis*)
Demersal longline	West, South Coast	Cape Town, Saldanha, Mossel Bay, Gqeberha, Gansbaai	Shallow-water hake (*Merluccius capensis*)
Large pelagic longline	West, South, East Coast	Cape Town, Durban, Richards Bay, Gqeberha	Yellowfin tuna (*T. albacares*), big eye tuna (*T. obesus*), Swordfish (*Xiphius gladius),* southern bluefin tuna (*T. maccoyii*)
Tuna pole-line	West, South Coast	Cape Town, Saldanha	Albacore tuna (*T. alalunga*), yellowfin tuna
Linefish	West, South, East Coast	All ports, harbours and beaches around the coast	Snoek (*Thyrsites atun*), Cape bream (*Pachymetopon blochii)*, geelbek (*Atractoscion aequidens)*, kob (*Argyrosomus japonicus)*, yellowtail (*Seriola lalandi),*

Sector	Areas of Operation	Main Ports in Priority	Target Species
			Sparidae, Serranidae, Carangidae, Scombridae, Sciaenidae
South coast rock lobster	South Coast	Cape Town, Gqeberha	*Palinurus gilchristi*
West coast rock lobster	West Coast	Hout Bay, Kalk Bay, St Helena	*Jasus lalandii*
Crustacean trawl	East Coast	Durban, Richards Bay	Tiger prawn (*Panaeus monodon*), white prawn (*Fenneropenaeus indicus*), brown prawn (*Metapenaeus monoceros*), pink prawn (*Haliporoides triarthrus*)
Squid jig	South Coast	Gqeberha, St Francis	Squid/chokka (*Loligo vulgaris reynaudii)*
Gillnet	West Coast	False Bay to Port Nolloth	Mullet / harders (*Liza richardsonii*)
Beach seine	West, South, East Coast	Coastal	Mullet / harders (*Liza richardsonii*)
Oysters	South, East Coast	Coastal	Cape rock oyster (*Striostrea margaritaceae*)
Seaweeds	West, South, East	Coastal	Beach-cast seaweeds (kelp, *Gelidium* spp. and *Gracilaria* spp.
Abalone	West Coast	Coastal	*Haliotis midae*
Small-scale fishery	West, South, East	Coastal	Various

3.2 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 broadcast spawners, producing large numbers of eggs 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 in spring (September to November) 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 timing also reduces the loss of spawn due to offshore drift. The spawn moves southwards with the Agulhas current before drifting northwards in the Benguela current across the shelf. As the eggs drift, hatching takes place followed by larval development. Settlement of larvae occurs in the inshore areas of the West Coast, in particular the bays that are used as nurseries. The settlement and development of larvae in the west coast nursery grounds takes place from October to March. Juveniles shoal and then begin a southward migration. It is at this stage that anchovy and sardine are targeted by the small pelagic purse seine fishery. Demersal species such as hake migrate offshore into deeper water where they are targeted by commercial fisheries. Snoek is targeted in the nearshore waters during this period by the linefishery and small-scale fishers. It is also landed by the demersal trawl fishery as a by-catch species. The spawning of key species are presented in more detail below.

Spawning patterns of the two hake species differ in both depth and timing. 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.). Spawning of the “shallow-water” hake (M. capensis) occurs primarily over the shelf (<200 m) whereas that by the “deep-water” hake (M. paradoxus) occurs in deeper waters off the shelf. Although spawning occurs throughout the distributional range of the two species, areas of high spawning concentrations are thought to occur mid-shelf off Cape Columbine and on the western Agulhas Bank. Jansen et al (2015) observed peak spawning areas at 31.0°-32.5°S and 34.5°-36.0°S. *M. paradoxus* spawns at bottom depths between 200 m and 650 m whereas the average depth of *M. capensis* spawning is 180 m. Hake eggs are present in the area between Cape Agulhas and Cape Columbine (see Figure 3.2, left panel) over bottom depths ranging from ~150 m to ~1500 m. Eggs of *M. paradoxus* are distributed over greater bottom depths (340 m – 1500 m bottom depth) with *M. capensis* egg distribution occurring predominantly at the 120 m to 300 m bottom depth range (Stenevik *et al*., 2008). The distribution of hake larvae follows that of egg distribution but extends further northwards towards the Namibian maritime border (Figure 3.2, right panel). Hake make use of water currents as a transport mechanism to carry their spawning products from the upstream spawning areas on the western Agulhas Bank and southwestern Cape coast to the nursery grounds on the west coast. North of Cape Columbine, the coastal jet divides into an offshore and an inshore branch. The offshore drift route follows the outer shelf and results in the loss of eggs and larvae away from the coast into the deep ocean. Inshore drift transports larvae along the west coast northward onto the Orange Banks. The main nursery areas of *M. paradoxus* are located between Hondeklip Bay and Orange Banks (Stromme et al., 2015), with concentrations around the 100 m depth contour. Eggs of M. capensis spawned inshore are likely to be transported in the slower inshore branch of the current from the western Agulhas Bank towards inshore areas farther north (Grote et al., 2012 in Jansen et al., 2015). The vertical distribution of hake eggs and larvae in the water column is between the surface and 200 m depth with the highest concentrations in the 50 – 100 m depth range (Stenevik et al., 2008). The eggs and larvae of the Cape hakes are found deeper than the eggs and larvae of pelagic species, making them less vulnerable to Ekman transport (Sundby et al., 2001; Hutchings *et al*., 2002 in Stenevik *et al*., 2008). These key spawning areas coincide with Block 5/6/7 and the Area of Interest for drilling.

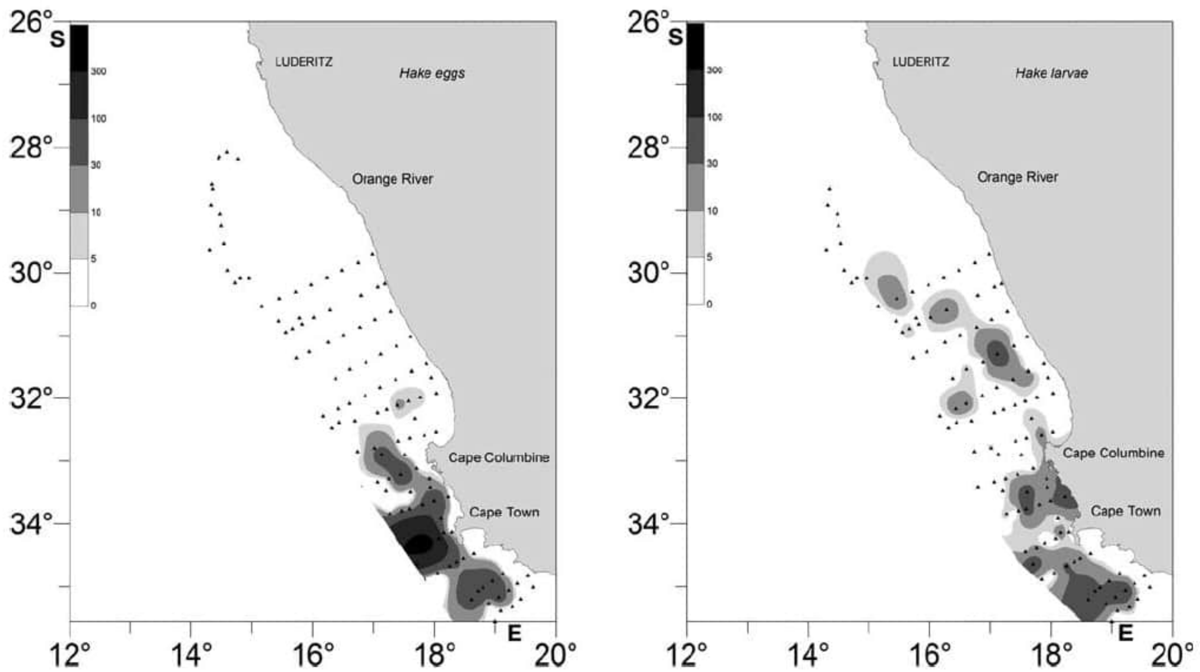


Figure 3.2: Station map showing the distribution of eggs (left) and larvae (right) of Cape hakes (both species combined) during a research survey conducted between September and October 2005. Numbers per 10 m^2 (Stenevik *et al*., 2008).

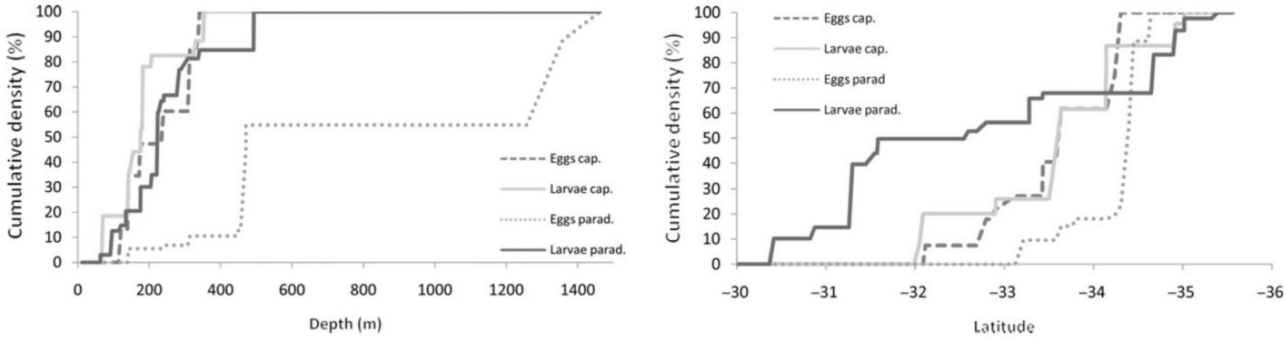


Figure 3.3: Cumulative density plots of Cape hake eggs and larvae sorted by (left panel) increasing seafloor depth and (right panel) increasing latitude (degrees south) (Source: Stenevik *et al*., 2008).

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. 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.

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 a*l., 2002).

Figure 3.4 and Figure 3.5 show composite distribution maps for eggs of sardine and anchovy (species targeted by the small pelagic purse-seine fishery) collected during spawner biomass surveys by DFFE over the period 1984 to 2006.

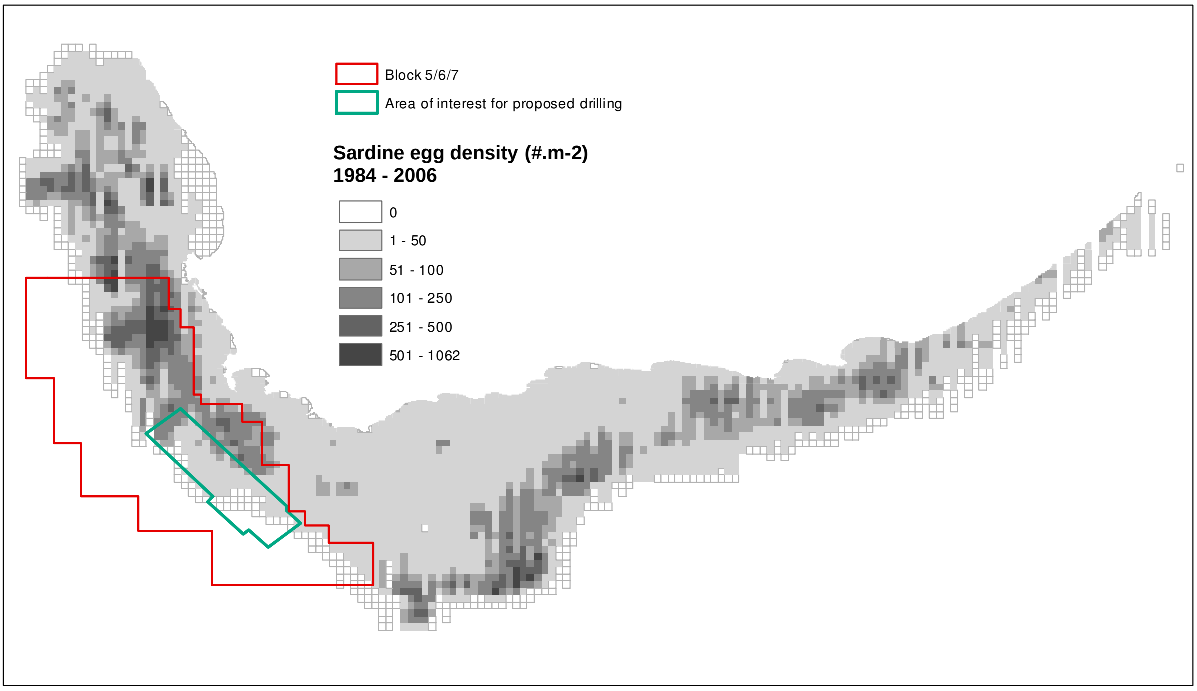


Figure 3.4: **Block 5/6/7 and the area of interest in relation to the distribution of sardine spawning areas, as measured by egg densities (Source DFFE).**

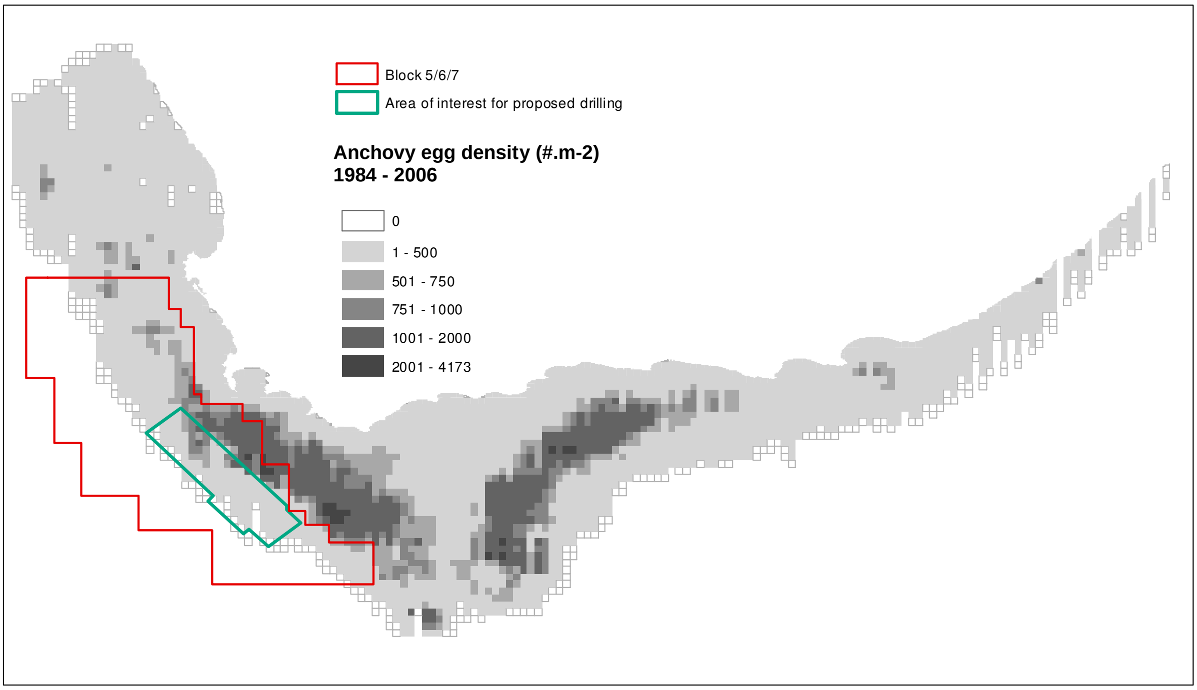


Figure 3.5: **Block 5/6/7 and the area of interest in relation to the distribution of anchovy spawning areas, as measured by egg densities (DFFE).**

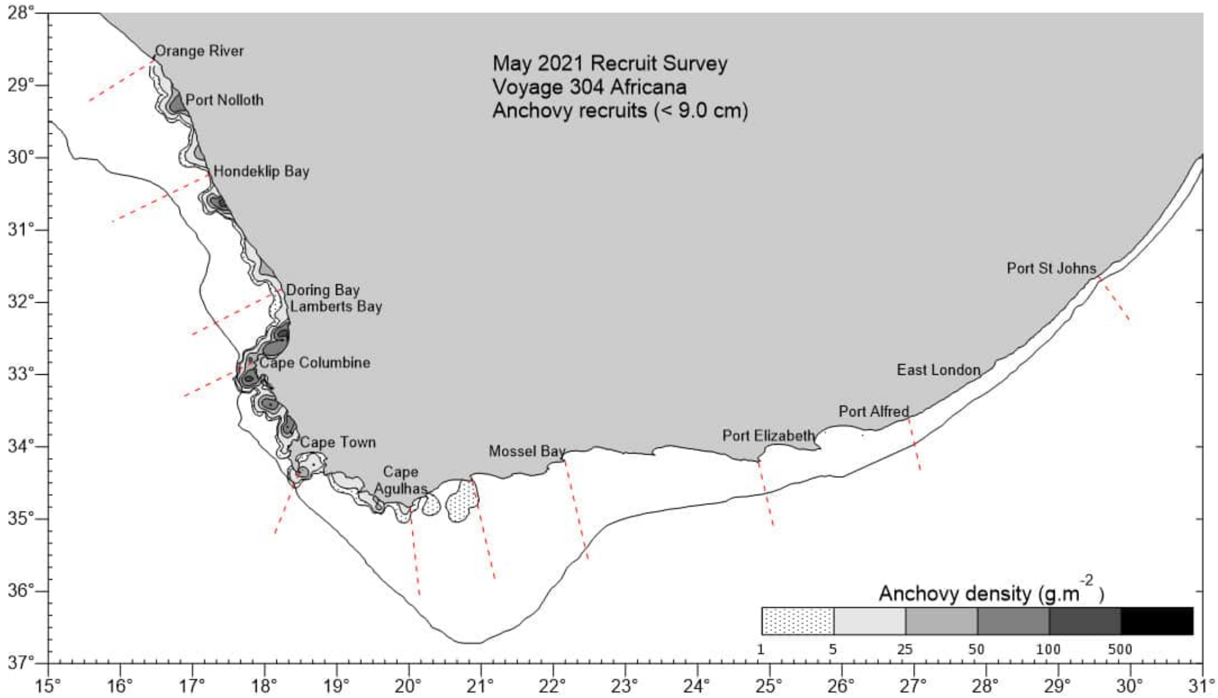


Figure 3.6: **Distribution and relative abundance of anchovy recruits (< 9 cm) (DFFE Small Pelagic Scientific Working Group FISHERIES/2021/JUL/SWG-PEL/51draft**

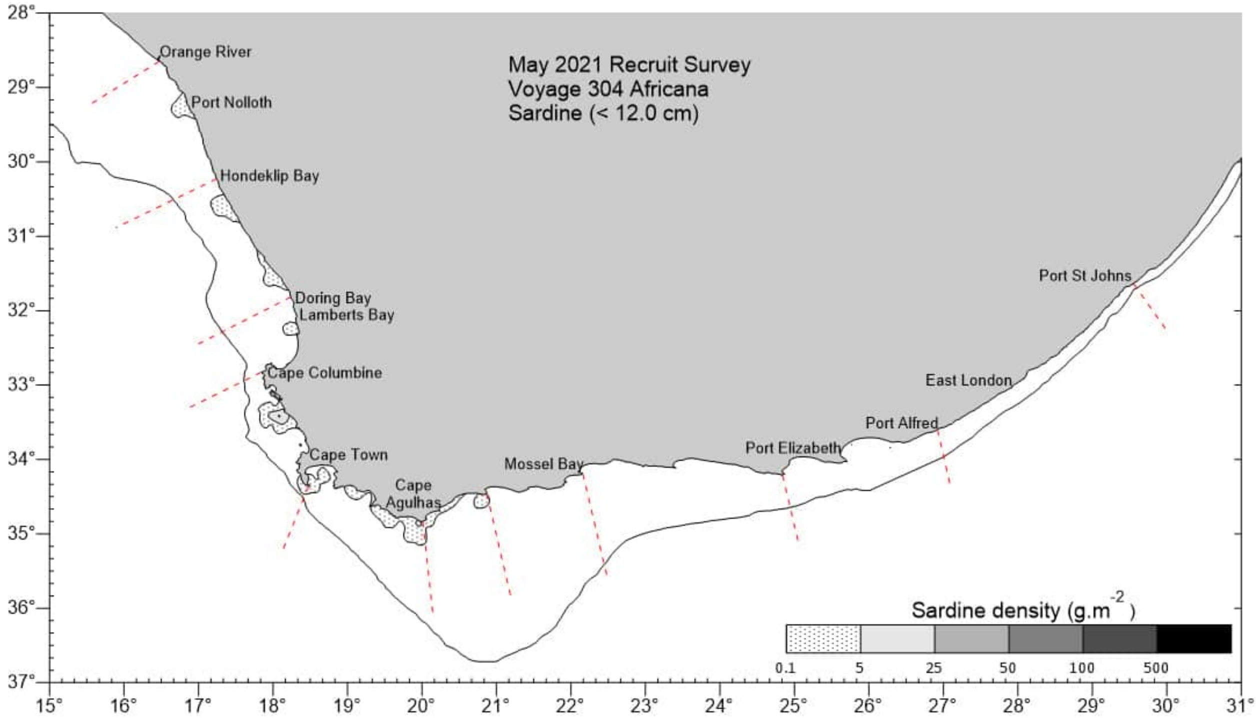


Figure 3.7: **Distribution and relative abundance of sardine recruits (< 12 cm) (DFFE Small Pelagic Scientific Working Group FISHERIES/2021/JUL/SWG-PEL/51draft**

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 3.8 for the spawning grounds and nursery areas for snoek (left) and anchovy (right).

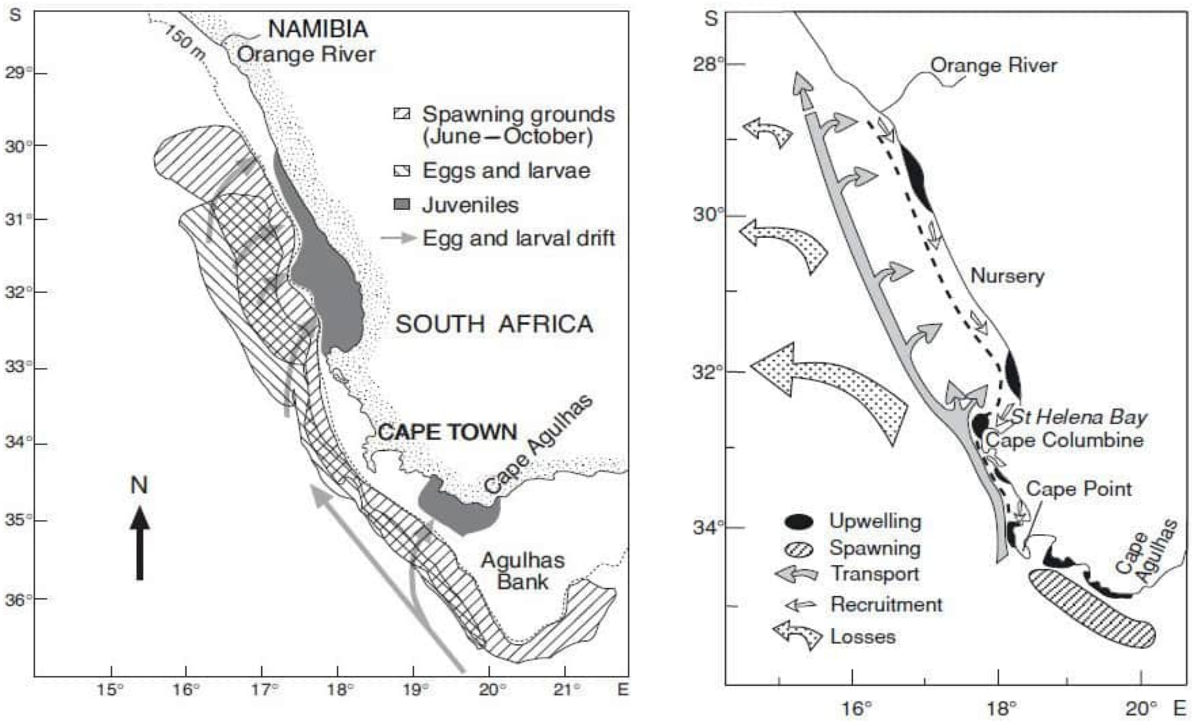


Figure 3.8: **Conceptual model depicting the life history of snoek (left; Source: Griffiths, 2002) and anchovy (right; Hutchings et al., 1992) in the southern Benguela ecosystem, including spawning grounds, distribution and transport of eggs and larvae, and the nursery areas.**

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.

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).

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 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).

Refer to Figure 3.9 for an overview of the main fish spawning grounds and nursery areas off the West and South Coasts of South Africa in relation to the area of interest for drilling. Table 3.3 shows known spawning periods of key commercial species off the West Coast of South Africa.

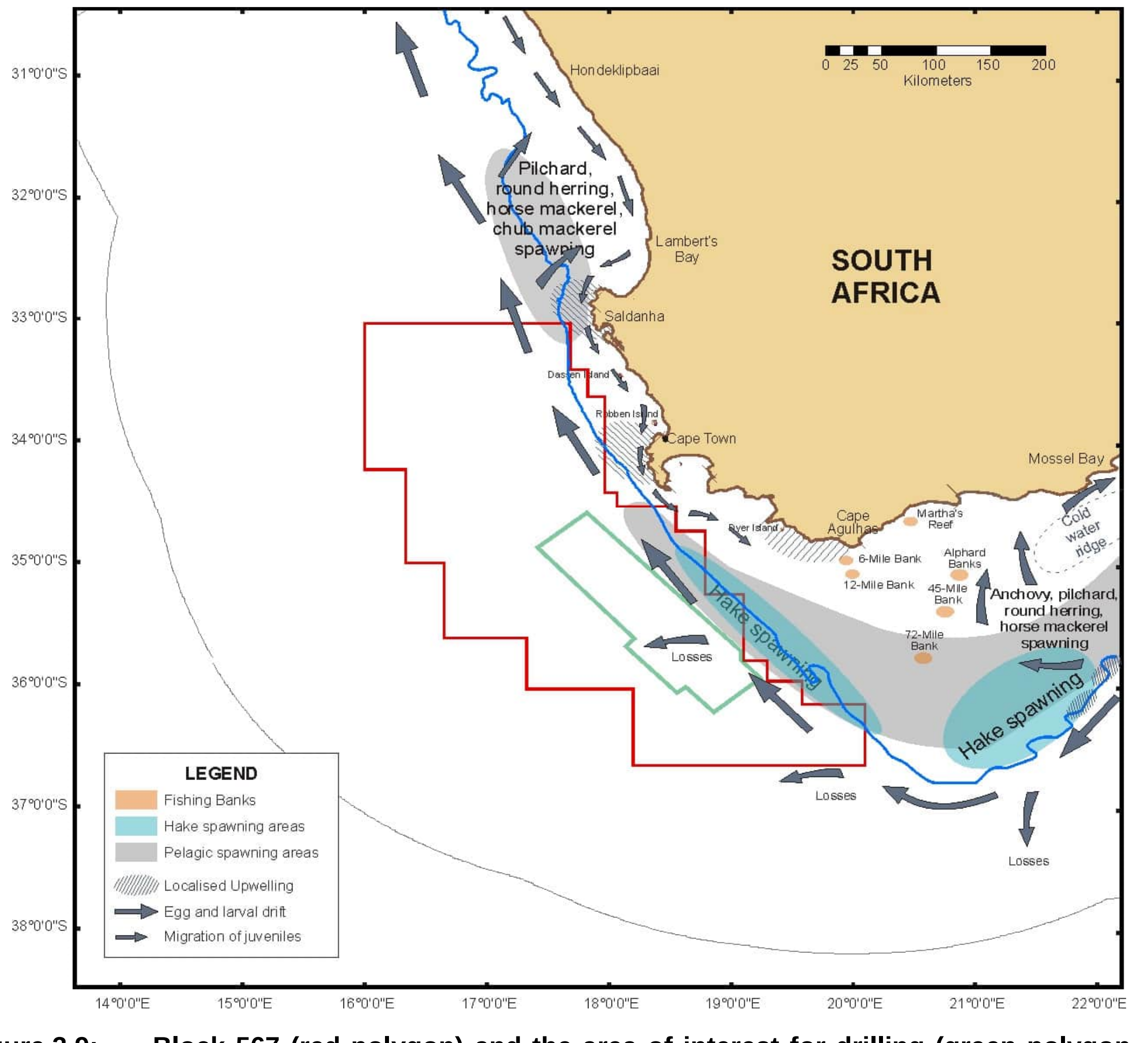


Figure 3.9: Block 567 (red polygon) and the area of interest for drilling (green polygon) in relation to major spawning areas in the southern Benguela region (Pulfrich, 2021 adapted from Cruikshank, 1990).

Table 3.3: 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												
Anchovy												
Sardine												
Snoek												
West Coast rock lobster												

3.3 RESEARCH SURVEYS

Swept-area trawl surveys of demersal fish resources are carried out twice a year by DFFE in order to assess stock abundance. Results from these surveys are used to set the annual TACs for demersal fisheries. First started in 1985, the West Coast survey extends from Cape Agulhas (20°E) to the Namibian maritime boarder and takes place over the duration of approximately one month during January/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. Figure 3.10 shows the spatial distribution of research trawls in relation to the licence block and the proposed area of interest for drilling. Over the period 2013 to 2021, 169 research trawls were reported within the licence block. These were situated across the inshore extent of the block ranging to a maximum seafloor depth of 830 m. Surveys in the licence block take place over the period January to March. Over the period 2013 to 2021 no demersal research trawls were undertaken within the area of interest for well drilling. The DFFE conducted research activity immediately inshore of the nearshore boundary of the area of interest.

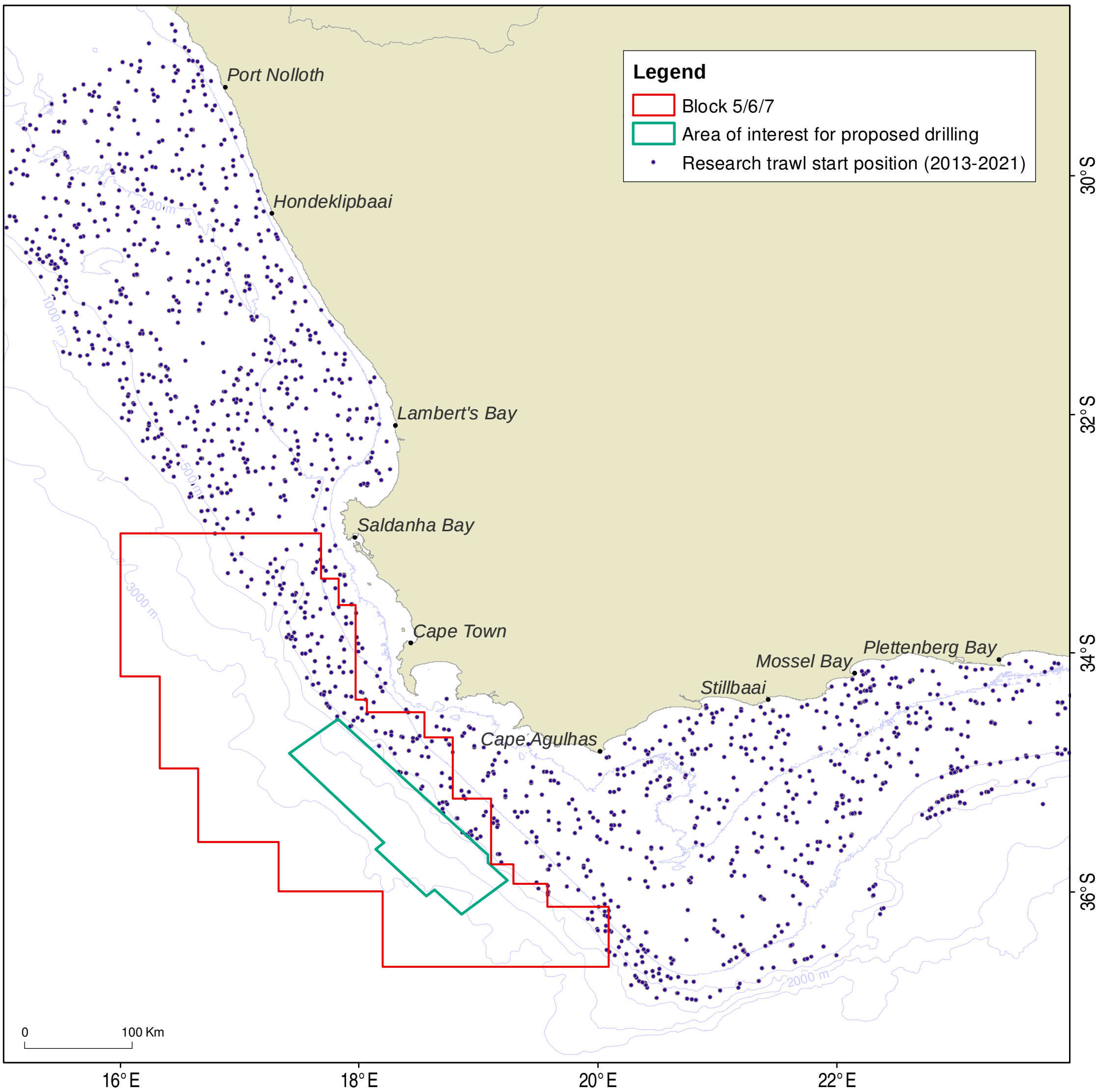


Figure 3.10: Spatial distribution of trawling effort expended by DFFE over the period 2013 to 2021 in assessing the biomass of demersal fish species.

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. 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. During these surveys the survey vessels travel pre-determined transects (perpendicular to bathymetric contours) running offshore from the coastline to approximately the 200 m isobath. There are a few occasions that the transects off Cape Point will just extend to about 1000m, with the shelf being so narrow there and the offshore fish distribution being dictated by strong frontal features, there would be occasions where the survey would go even further offshore than the 1000m. Figure 3.11 shows the research survey transects undertaken by DFFE in November 2020 and May 2021 in respect to the licence block and area of interest for proposed drilling. One survey transect coincided with the inshore area of interest for well drilling.

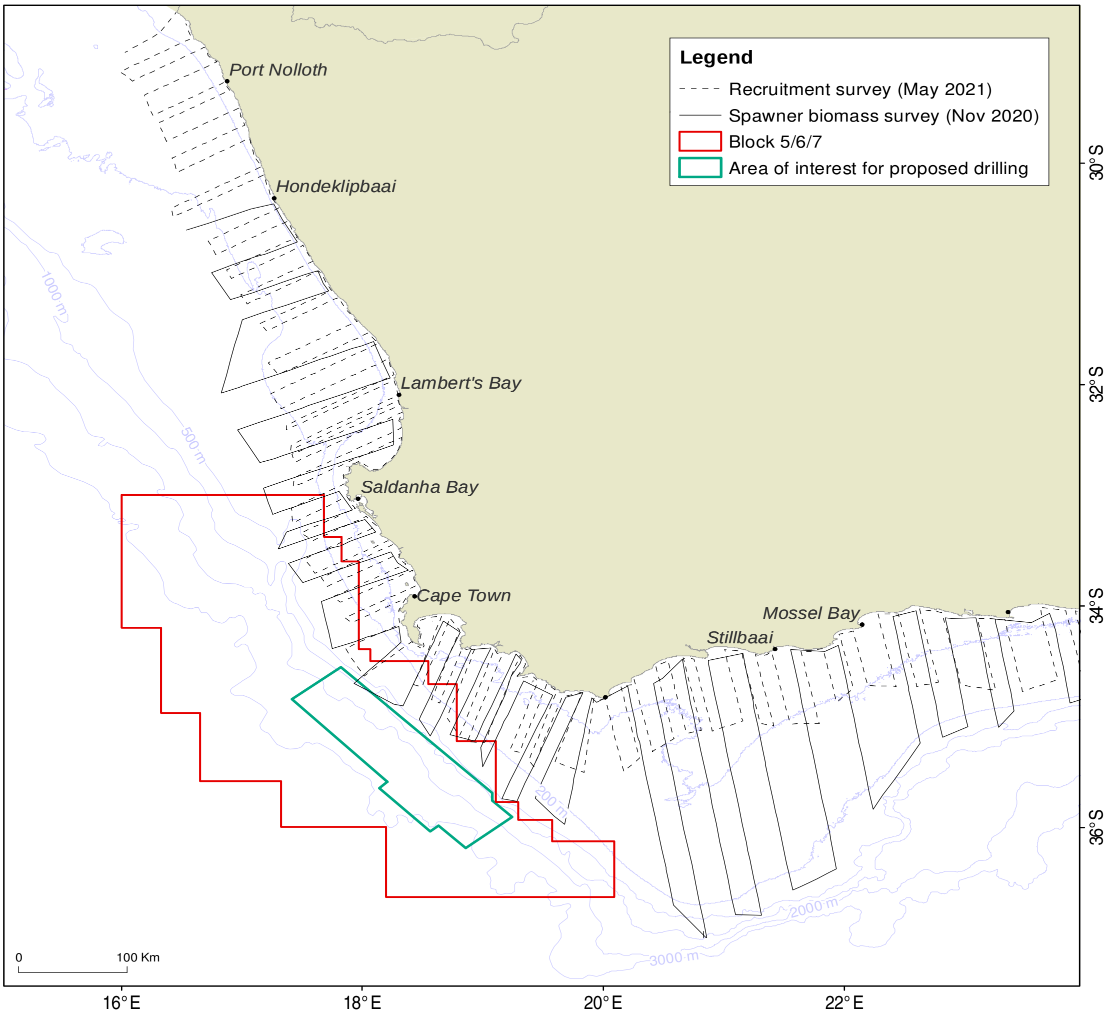


Figure 3.11: Spatial distribution of survey transects undertaken by DFFE during November 2020 and May 2021 during the research surveys of recruitment and spawner biomass of small pelagic species, respectively. This is shown in relation to the licence block and area of interest for proposed drilling.

3.4 COMMERCIAL FISHERIES SECTORS

3.4.1 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 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 3.3.3).

The annual TAC limits and landings of hake (both species) by the trawl and longline sectors is listed in Table 3.4. A time-series of total hake catch as well as hake catch by sector is shown in Figure 3.12.

Table 3.4: 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[4]).

Year	TAC	*M. paradoxus*					*M. capensis*						TOTAL (both species)
		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
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												

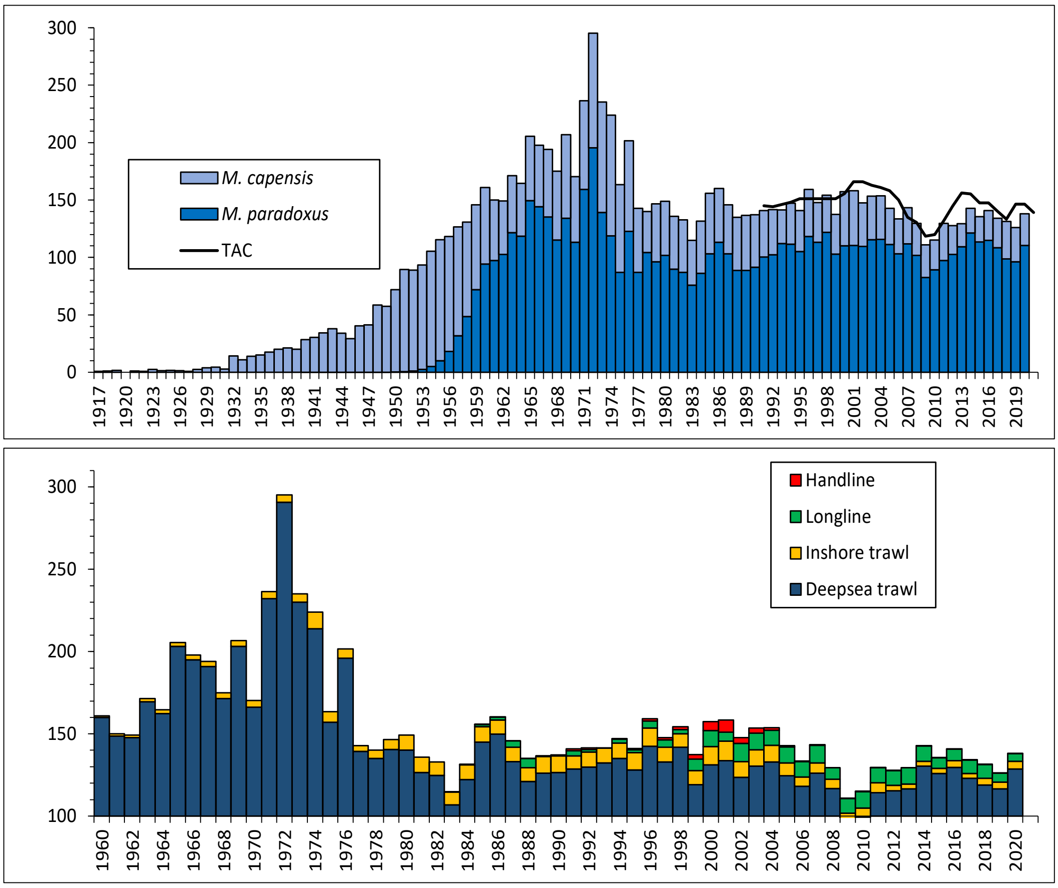


Figure 3.12: (Top panel) Total catches ('000 tonnes) of Cape hakes split by species over the period 1917–2020 and the TAC set each year since the 1991. (Bottom panel) Catches of Cape hakes per fishing sector for the period 1960–2020. Prior to 1960, all catches are attributed to the deep-sea trawl sector. Note that the vertical axis commences at 100 000 tonnes to better clarify the contributions by each sector (Source DEFF, 2022).

[4] *FISHERIES/2021/OCT/SWG-DEM/21rev*

The offshore fishery is comprised of 45 vessels operating from most major harbours on both the West and South Coasts. On the West and South-West Coasts, these grounds extend in a continuous band along the shelf edge between the 200 m and 1 000 m bathymetric contours although most effort is in the >300 m to 600 m depth range. Monkfish-directed trawlers tend to fish shallower waters than hake-directed vessels on mostly muddy substrates. Trawl nets are generally towed parallel to the depth contours (thereby maintaining a relatively constant depth) in a north-westerly or south-easterly direction. Trawlers also target fish aggregations around bathymetric features, in particular seamounts and canyons, where there is an increase in seafloor slope and in these cases the direction of trawls follow the depth contours. The deep-sea sector is prohibited from operating in waters shallower than 110 m or within five nautical miles of the coastline. See Figure 3.13 for a photograph of a wetfish trawler operating in South Africa's offshore demersal trawl fishery.

The inshore fishery consists of 31 vessels, which operate on the South Coast mainly from the harbours of Mossel Bay and Gqeberha. 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.

Figure 3.13: Photograph of MFV *Harvest Mzansi*, a wetfish vessel operating in the South African offshore demersal trawl sector (source: www.sadstia.co.za).

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 3.14).

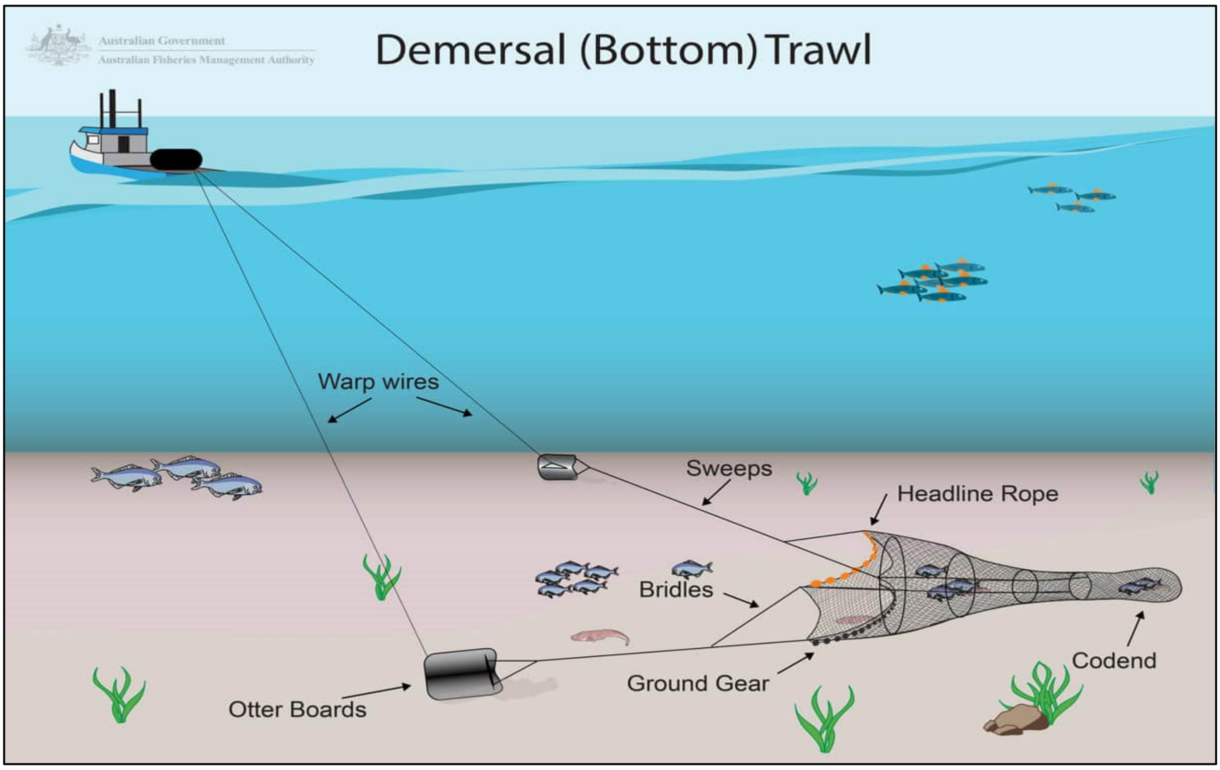


Figure 3.14: Gear configuration similar to that used by the offshore demersal trawlers targeting hake (Source: www.afma.gov.au/fisheries-management/methods-and-gear/trawling).

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.

Trawl depth records ranged from approximately 20 to 980 m, though very few trawls were recorded deeper than 800 m (Currie *et al*, 2021).

The activity of the fishery is restricted by permit condition to operating within the confines of a historical “footprint” – an area of approximately 57 300 km^2 and 17 000 km^2 for the offshore and inshore fleets, respectively. Figure 3.15 shows the demersal trawling footprint (effort) in relation to the licence block and proposed drilling area.

The licence block coincides with demersal trawling grounds extending offshore from Saldanha Bay to Cape Agulhas at a depth range of approximately 200 m to 980 m, which equates to 15 403 km^2 of trawling ground (i.e. 26.88% of the total extent of the offshore demersal trawling footprint within the South African EEZ). Trawling on rough ground near the Cape Canyon (off Saldanha Bay) started in the late 1990s and has been fished regularly since then. With improvements in technology and experience, rough ground in areas such as “the Blades” off Cape Point (an area of irregular hard ground near the Cape Valley) became more frequently trawled with less damage or loss of gear. At present, the Cape Valley, the southern canyon off Cape Point, has a high trawling effort in the South African context, and this area has been quite intensively fished for the last 25 years (Sink et al., 2012). Over the period 2017 to 2019, an average of 14 767 trawls per year were reported within the licence block area yielding 47

238 tonnes of catch. This is equivalent to 38.37% and 39.76% of the overall effort and catch, respectively, reported nationally by the sector.

The proposed drilling area is situated offshore of the main trawl grounds in the area; however there the area does coincide with the outer depth range of fishing effort. Over the period 2017 to 2019, an average of 60 trawls per year were reported within the proposed drilling area yielding 317 tonnes of hake. This is equivalent to 0.16% and 0.27% of the overall effort and catch, respectively, reported nationally by the sector. The area coincides with a number of commercial grid blocks, which has a maximum reported trawling depth of 773 m. The proposed drilling area covers 364 km^2 of trawling ground, which amounts to 0.64% of the total extent of the offshore demersal trawling footprint within the South African EEZ. Towing speed within the area ranged from 2.9 to 4.3 knots and averaged at 3.6 knots. Fishing gear is towed along the bathymetric contours (rather than across) with the direction of tows ranging between 142° and 197° or between 282° and 349° (true course heading). Average trawl distance was 15 Nm but ranged between 5 Nm and 25 Nm. Up to 20 different vessels were recorded as having operated within the area, although the majority of the effort was expended by six particular vessels. Although the fishery operates continuously throughout the year, effort within the Area of Interest for proposed drilling shows a seasonal trend of higher effort in December and over the period April to August than during the remaining months (refer to Figure 3.16).

The 500 m safety zone around the drilling unit would exclude fishing from an area of 0.79 km^2, which is equivalent to 0.001% of the offshore trawl footprint. Placed across the area of highest fishing activity (within the Area of Interest for proposed drilling) the safety zone overlaps ground that yielded 40 tons of catch from 9 drags per year (0.02% and 0.03% of the overall national catch and effort figures, respectively). There is overlap of fishing grounds with the estimated zone of noise disturbance[5] which could result in an affected area of approximately 78.5 km^2 around the drilling unit. Placed across the area of highest fishing activity within the Area of Interest for proposed drilling, this area yielded 212 tons of catch from 46 drags per year (0.17% and 0.12% of the overall national catch and effort figures, respectively).

Figure 3.17 shows the location of the trawl ringfenced area in relation to the area of interest for well drilling as well as the position of demersal trawls (start of drag) for the period 2008 to 2019.

[5] For fish species, based on the noise exposure criteria provided by Popper et al. (2014), relatively high to moderate behavioural risks are expected at near to intermediate distances (tens to hundreds of meters) from the source location. Relatively **low behavioural risks** are expected for fish species at far field distances (**thousands of meters**) from the source location. A conservative distance of **5 km** has been used to calculate the catch and effort within the zone of noise disturbance.

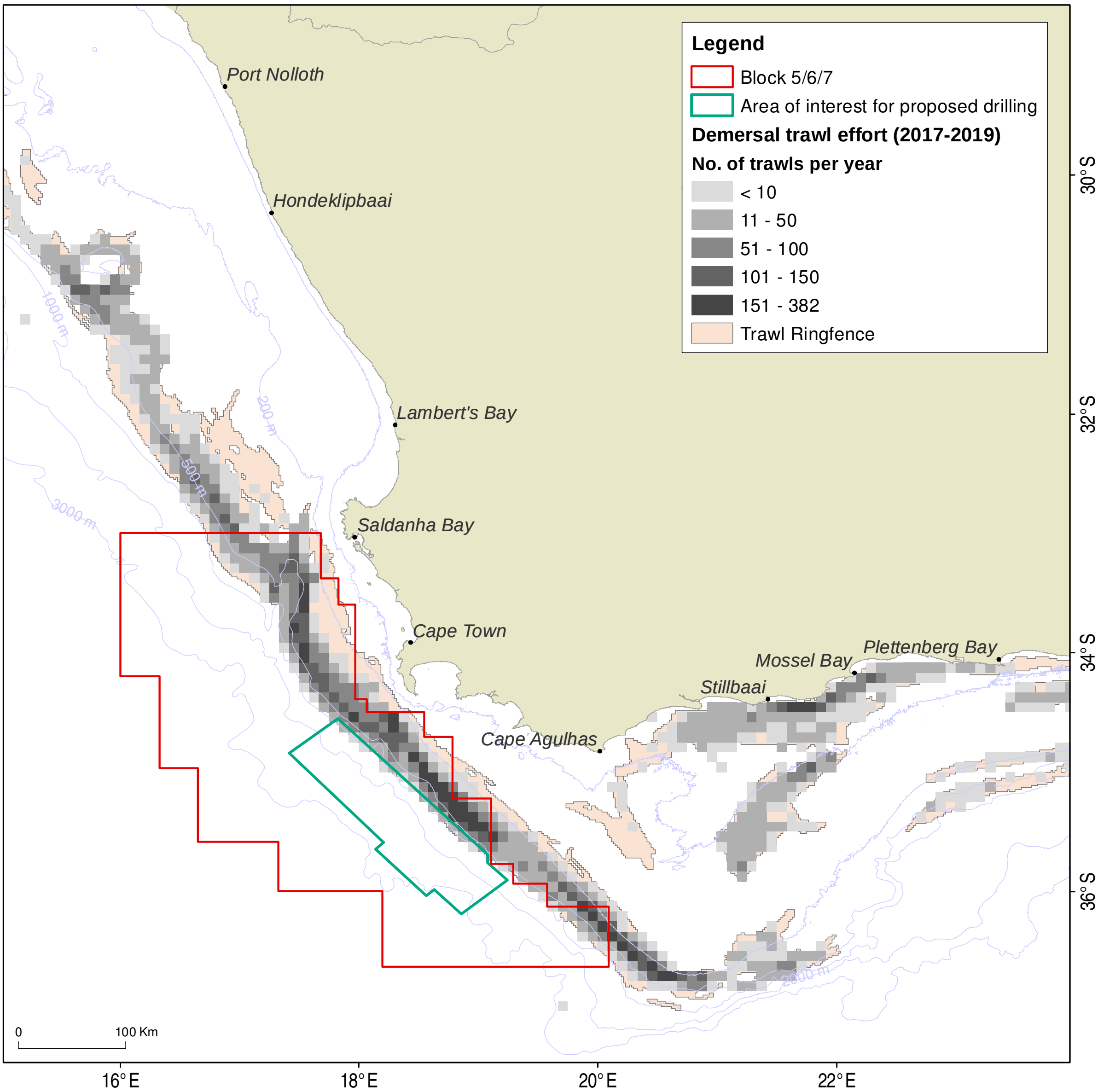


Figure 3.15: Overview of the spatial distribution of demersal trawl effort (2017 - 2019) in relation the trawl ringfence, licence block and area of interest for proposed drilling.

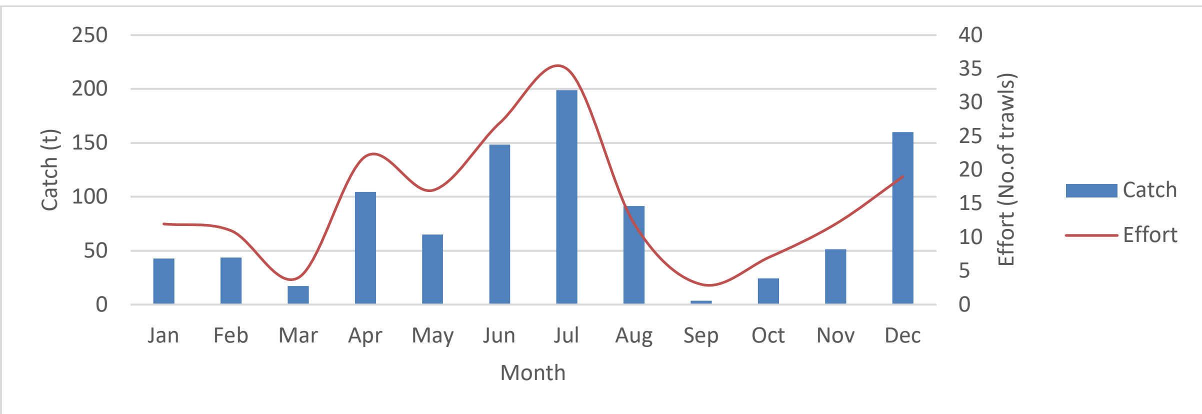


Figure 3.16: Demersal trawl catch and effort by month within the area of interest for proposed drilling (cumulative; 2017 to 2019).

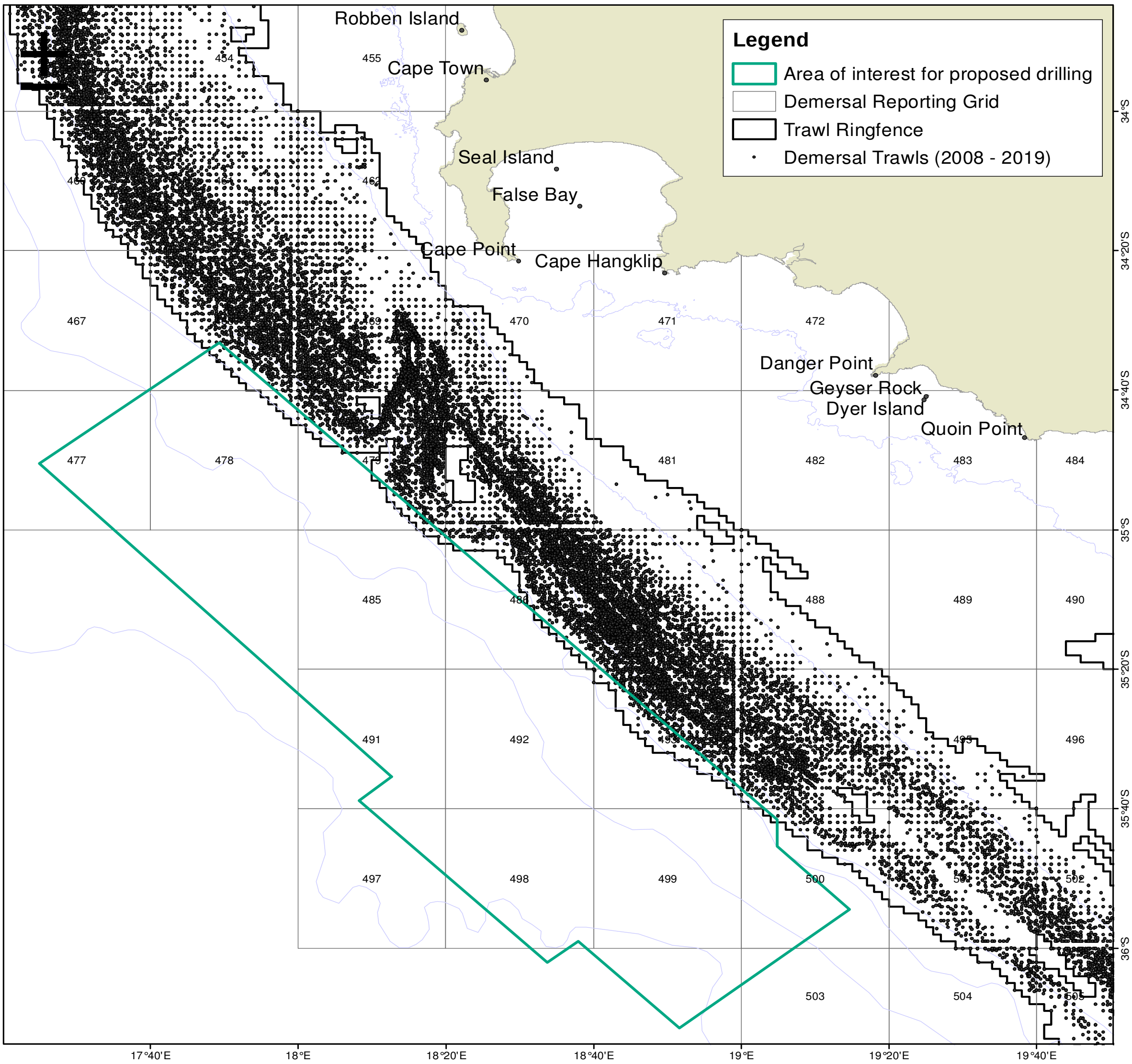


Figure 3.17: Spatial distribution of demersal trawling intensity in relation the proposed drilling area and commercial grid blocks (labelled). Depth contours indicated (100 m to 1000 m).

3.4.2 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 3.18 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 FV *Desert Diamond* – refer to Figure 3.19). 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.

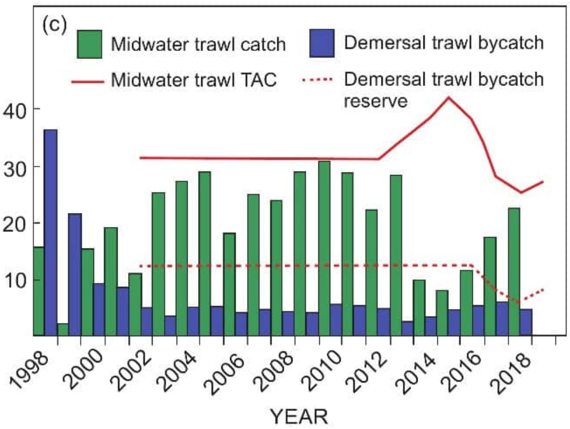


Figure 3.18: **Trawl catches (tons, 1998 – 2018) split into the demersal and midwater trawl components. The midwater trawl TAC (solid line) and demersal trawl bycatch reserve (dashed line) are also shown (Source: DEFF, 2020).**

Figure **3.19: Photograph of FMV *Desert Diamond* (midwater trawler).**

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 sea bed 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 3.20 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.

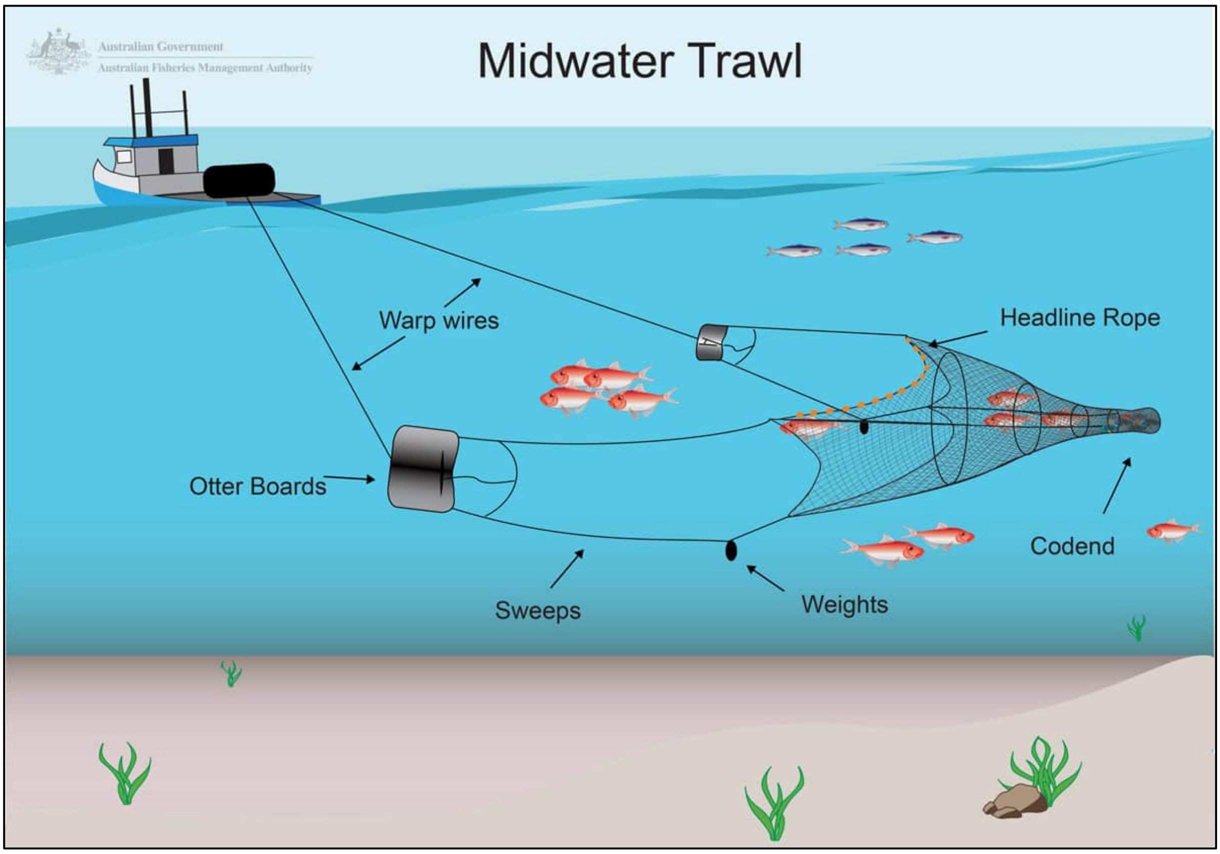


Figure 3.20: Schematic diagram showing the typical gear configuration of a midwater trawler. **Source: www.afma.gov.au/fisheries-management/methods-and-gear/trawling**

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 3.21 shows the spatial extent of grounds fished by mid-water trawlers in relation to the licence block and proposed drilling area. Fishing activity takes place within the licence block approximately between the 160 m to 530 m bathycontours. Over the period 2017 to 2019, an average of 256 trawls per year were reported within the licence block area yielding 1856 tonnes of catch. This is equivalent to 22.32% and 14.61% of the overall effort and catch, respectively, reported nationally by the sector. The proposed drilling area is situated approximately 10 km offshore of the closest expected fishing activity and there is no overlap of fishing grounds with the Area of Interest for proposed drilling. There is no overlap of fishing grounds with the estimated zone of noise disturbance (5 km) which is situated approximately 5 km offshore of the closest expected fishing activity.

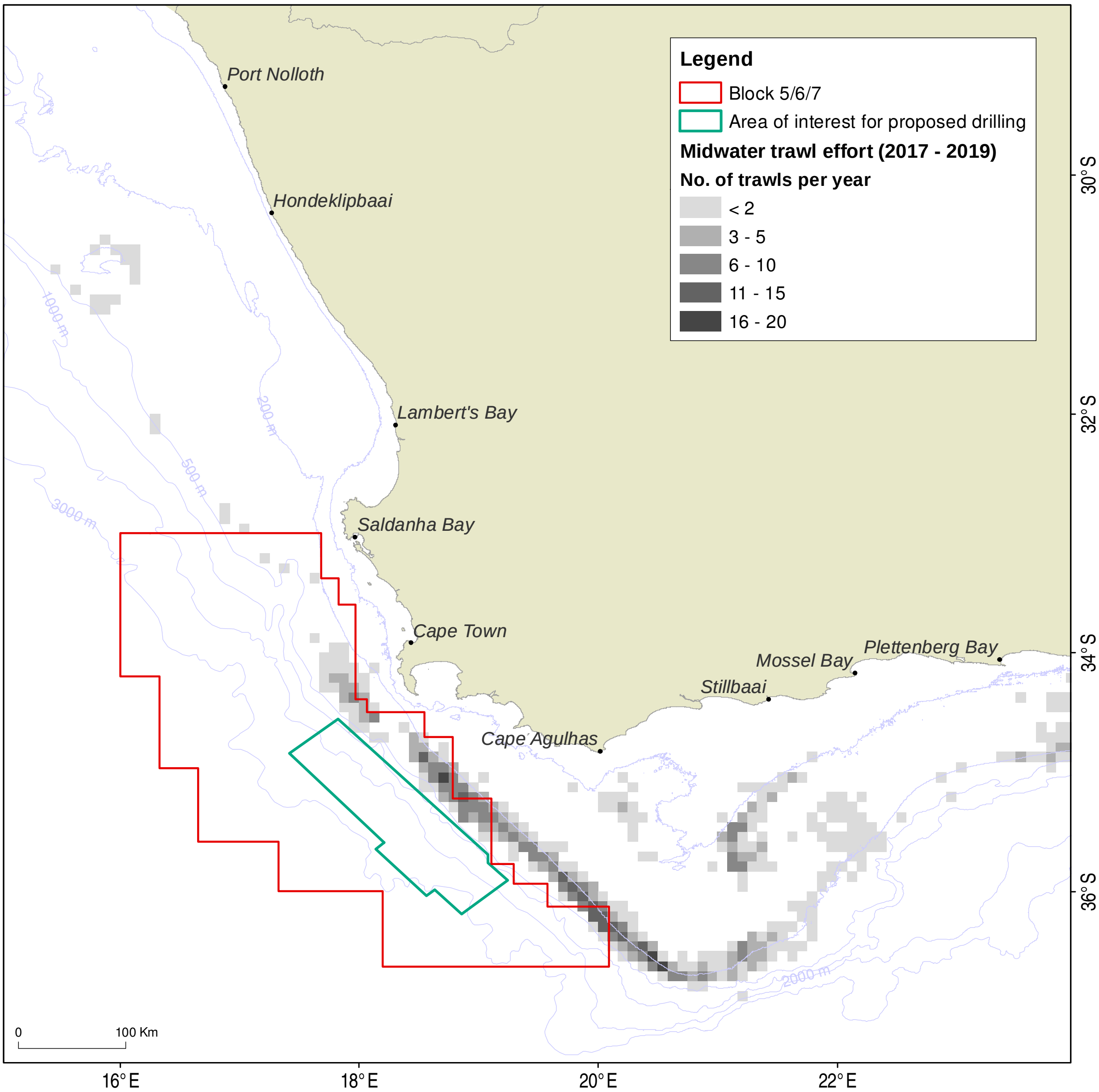


Figure 3.21: Overview of the spatial distribution of fishing effort expended by the midwater trawl sector targeting horse mackerel in relation to the area of interest for proposed drilling.

3.4.3 HAKE DEMERSAL 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. Refer to Table 3.4 for the landings of hake by the demersal longline fishery over the period 2010 to 2020.

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 3.22.

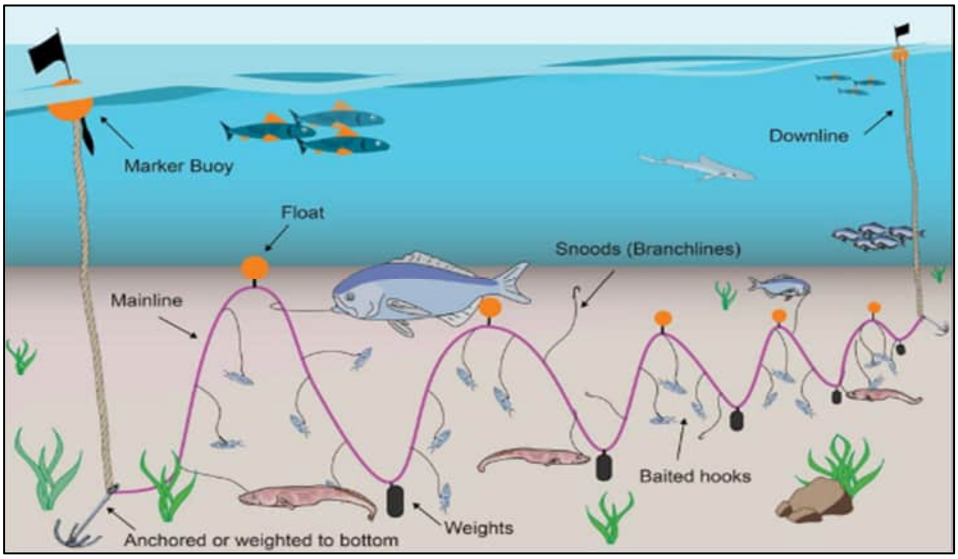
Currently 64 hake-directed vessels are active within the fishery, most of which operate from the harbours of Cape Town, Hout Bay, Mossel Bay and Gqeberha. Secondary points of deployment include St Helena Bay, Saldanha Bay, Hermanus, Gansbaai, Plettenberg Bay and Cape St Francis. Vessels based in Cape Town and Hout Bay operate almost exclusively on the West Coast (west of 20° E). Fishing grounds are similar to those targeted by the hake-directed demersal 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.

Figure 3.23 shows the spatial distribution of hake demersal longline fishing areas in relation to the licence block and proposed drilling area. The licence block coincides with longline fishing grounds situated between the 180 m and 700 m bathymetric contours. Over the period 2018 to 2020, an average of 1005 lines per year (14 million hooks) were set yielding 2336 tonnes of hake. This is equivalent to 51.79% of the overall effort and 51.99% of the overall catch reported nationally by the sector.

The Area of Interest for proposed drilling area is situated largely offshore of the main fishing grounds in the area; however there the area does coincide with the outer depth range of fishing effort. Over the period 2018 to 2020, an average of 2 lines per year were set within the proposed drilling area at a depth range of 620 m to 655 m, yielding 5.5 tons of hake. This is equivalent to 0.10% and 0.12% of the overall effort and catch, respectively, reported nationally by the sector. The 500 m safety zone around the drilling unit would exclude fishing from an area of 0.79 km^2, which when placed in the area of highest fishing activity would affect an average of 1 line per year yielding <1 ton of catch (0.02% and 0.02% of the overall national catch and effort figures, respectively). There is overlap of fishing grounds with the estimated zone of noise disturbance (5 km) which could result in an affected area of approximately 78.5 km^2 around the drilling unit. As a worst-case scenario this area of impact would coincide with an area that yielded 8.95 tons of catch from 9 lines (0.20% and 0.15% of the overall national catch and effort figures, respectively).

Figure 3.22: a) Photograph of a registered hake longline fishing vessel (above); b) Hauling operations (left);

c) Typical configuration of demersal longline gear used in the South African hake-directed fishery (Source: http://www.afma.gov.au/portfolio-item/longlining, pictured below).



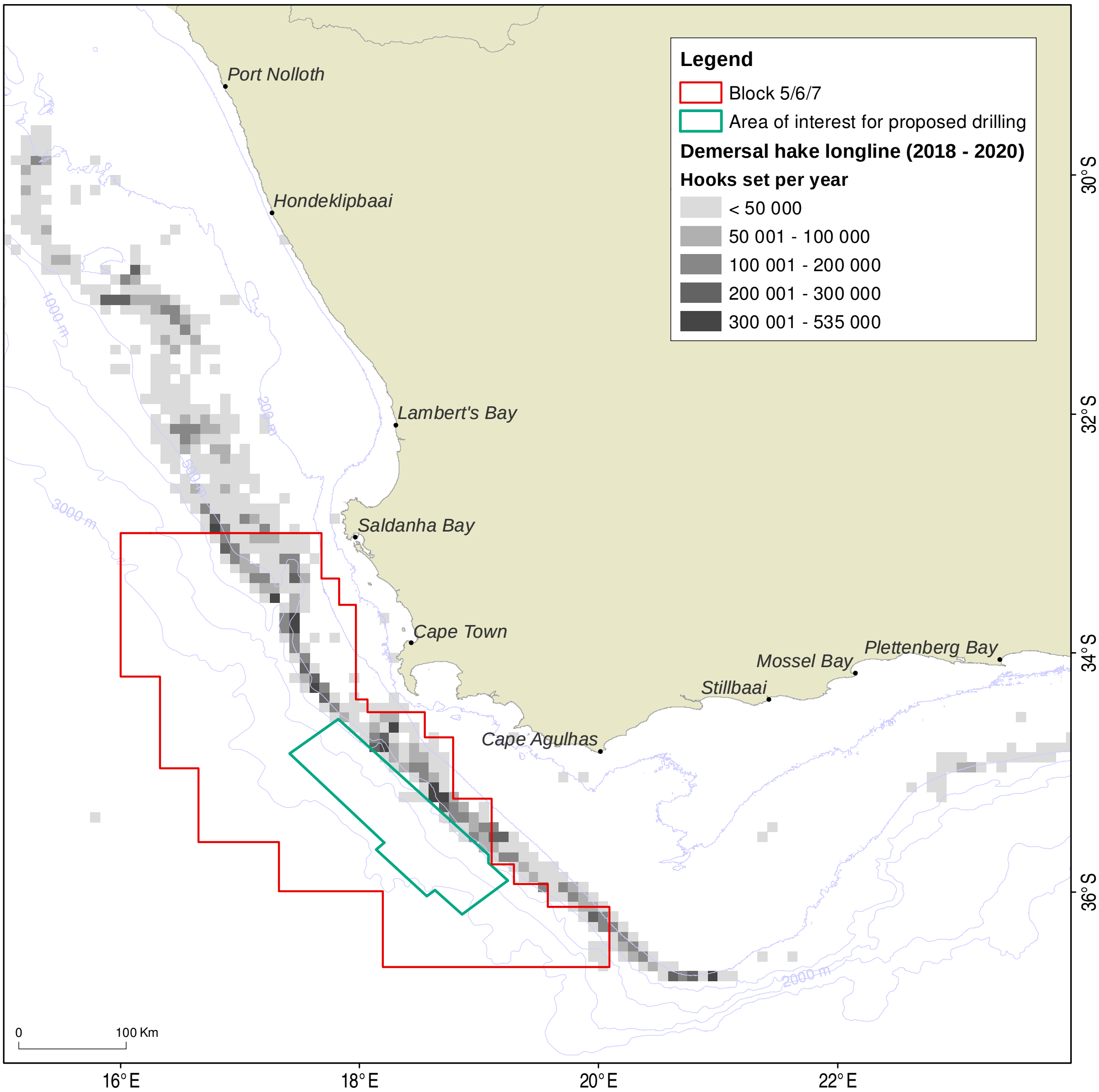


Figure 3.23: An overview of the spatial distribution of fishing effort expended by the hake demersal longline sector in relation to the licence block and area of interest for proposed drilling.

3.4.4 SHARK DEMERSAL 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 3.5 lists 2018 landings of the main demersal shark and skate species caught by line and Figure 3.24 shows the spatial distribution of catch between 2017 and 2019. Fishing effort would be directed inshore of the 100 m depth contour thus inshore of the licence block. The proposed drilling area is situated approximately 49 km offshore of the closest expected fishing activity and there is no overlap of fishing grounds with the Area of Interest for proposed drilling. There is no overlap of fishing grounds with the estimated zone of noise disturbance (5 km) which is situated approximately 47 km offshore of the closest expected fishing activity.

Table 3.5: 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

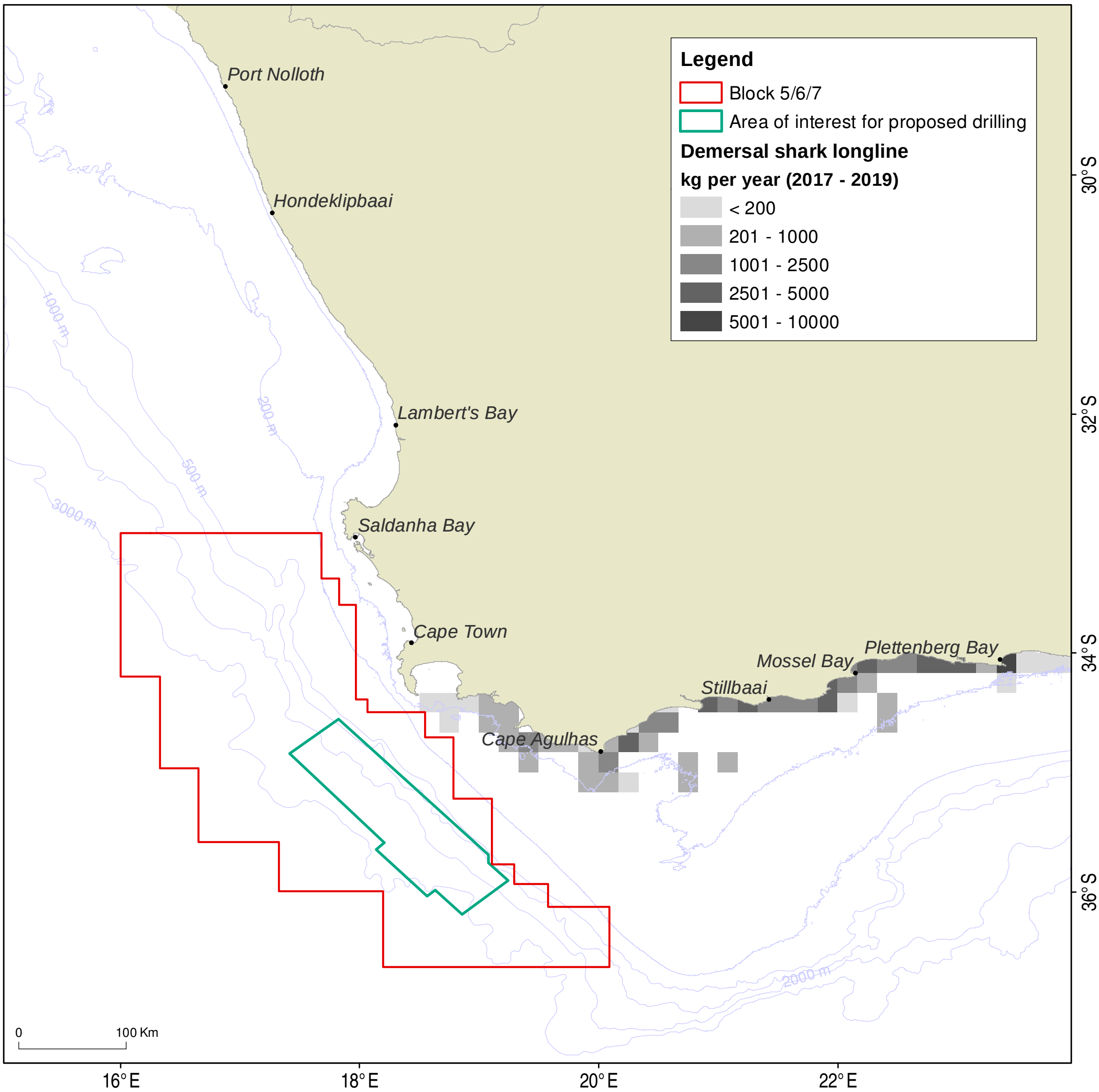


Figure 3.24: Spatial distribution of catch taken by the demersal shark longline fishery (2017 – 2019) in relation to the licence block and the area of interest for proposed drilling.

3.4.5 SMALL PELAGIC PURSE-SEINE

The pelagic-directed purse-seine fishery targets adult sardine (*Sardinops sagax)* and anchovy (*Engraulis encrasicolus*). Right Holders may also target round herring (*Etrumeus whiteadi*) 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 3.25). This is below both long-term (338 000 t) and short-term (294 000 t) averages.

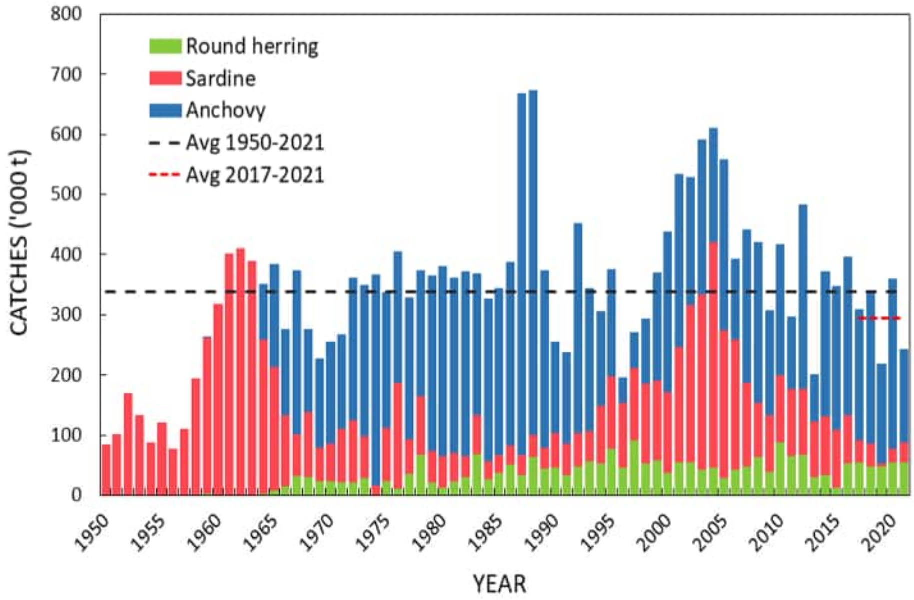


Figure 3.25: The annual combined catch of anchovy, sardine and round herring. Also shown is the average combined catch since the start of the fishery (1950-2021; black dashed line) and for the past five years (red solid line). Source DFFE, 2022.

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 3.26). 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.

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 Gqeberha. 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 Gqeberha. 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 at a resolution of 10 by 10 nm.

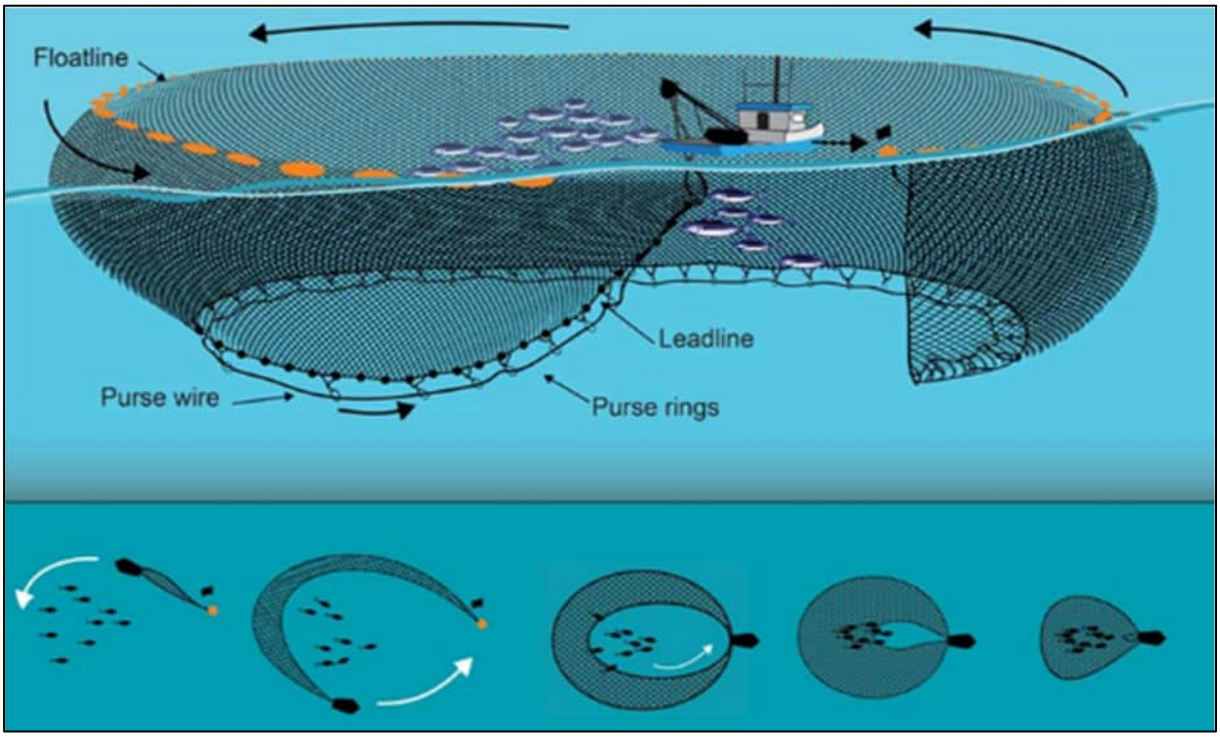


Figure 3.26: (Above) Photograph of a purse-seine vessel registered to fish for small pelagic species (credit C. Heinecken, CapMarine). (Below) Typical configuration and deployment of a small pelagic purse seine for targeting anchovy, sardine and round herring as used in South African waters. Source: http://www.afma.gov.au/portfolio-item/purse-seine.

The fishery operates throughout the year with a short seasonal break from mid-December to mid-January. Seasonality of catches is shown in Figure 3.27 with an increase in fishing effort and landings evident during the winter months.

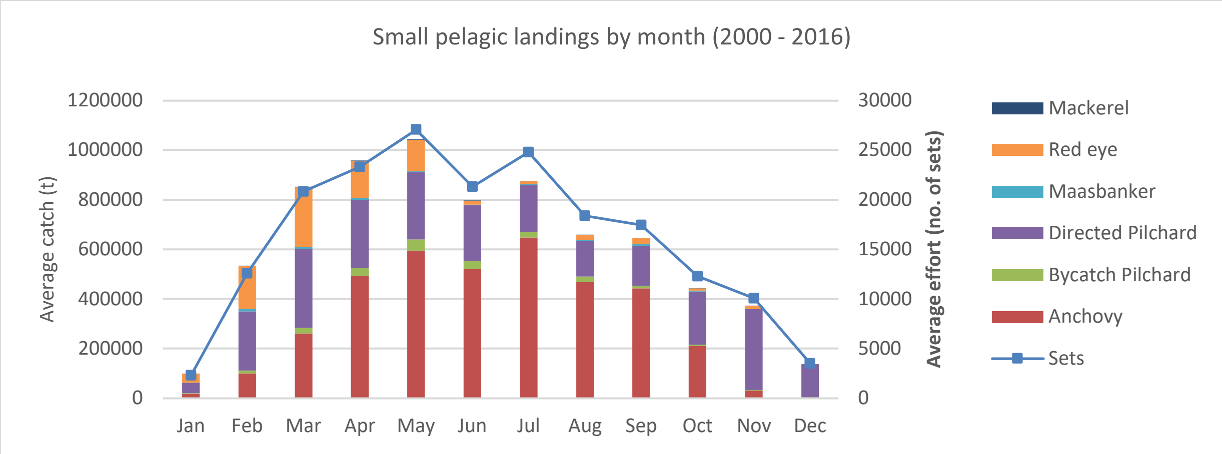


Figure 3.27: Graph showing monthly catch (tons) and effort (number of sets) reported for the small pelagic purse-seine fleet over the period 2000 to 2016 (cumulative). Source: DFFE.

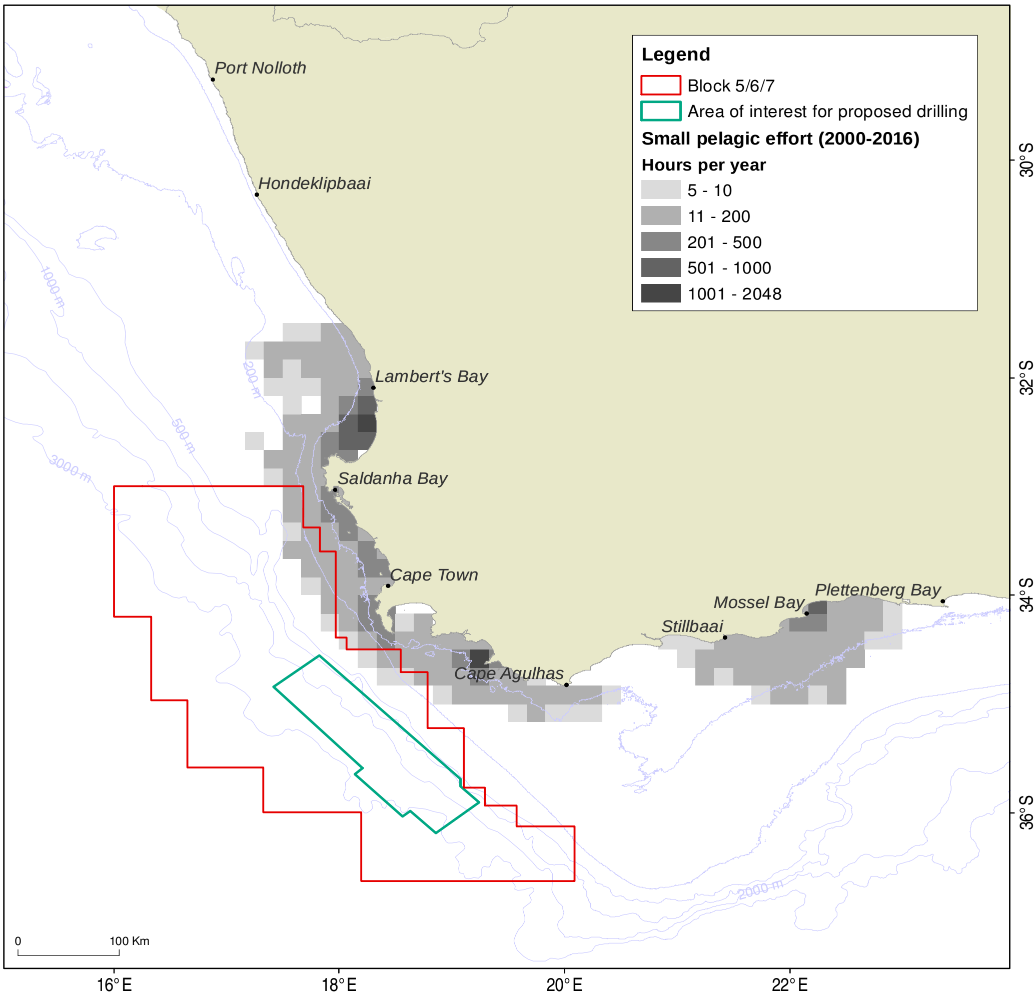


Figure 3.28: An overview of the spatial distribution of effort expended by the purse-seine sector targeting small pelagic species in in relation to the licence block and the proposed area of interest for drilling.

Figure 3.28 shows the spatial extent of fishing grounds in relation to the licence block and Area of Interest for proposed drilling. Over the period 2000 to 2016, an average of 418 hours per year (219 sets) were fished within the licence block yielding 9668 tonnes of catch. This is equivalent to 2.03% of the overall effort and 2.22% of the overall catch reported nationally by the sector. Favoured catch grounds lie inshore of the proposed drilling area and fishing activity expended beyond the 200 m depth contour is considered unlikely. The proposed drilling area is situated approximately 14 km offshore of the closest expected fishing activity and there is no overlap of fishing grounds with the Area of Interest for proposed drilling. There is no overlap of fishing grounds with the estimated zone of noise disturbance (5 km) which is situated approximately 9 km offshore of the closest expected fishing activity.

3.4.6 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*), swordfish (*Xiphias gladius*) and shark species. 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). Catch by species and number of active vessels for each year from 2005 to 2018 are given in Table 3.6.

Table 3.6: 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
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		

Total catch and effort figures reported by the fishery for the years 2000 to 2018 are shown in Figure 3.29. 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 3.30.

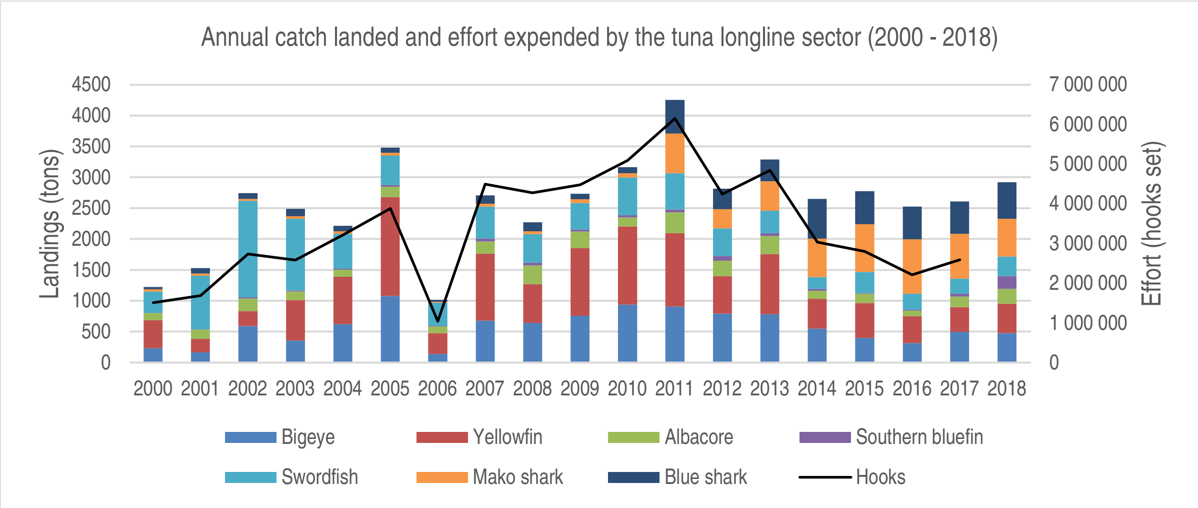


Figure 3.29: Inter-annual variation of catch landed and effort expended by the large pelagic longline sector in South African waters as reported to the two regional management organisations, ICCAT and IOTC (2000 – 2018; Source: DEFF, 2019).

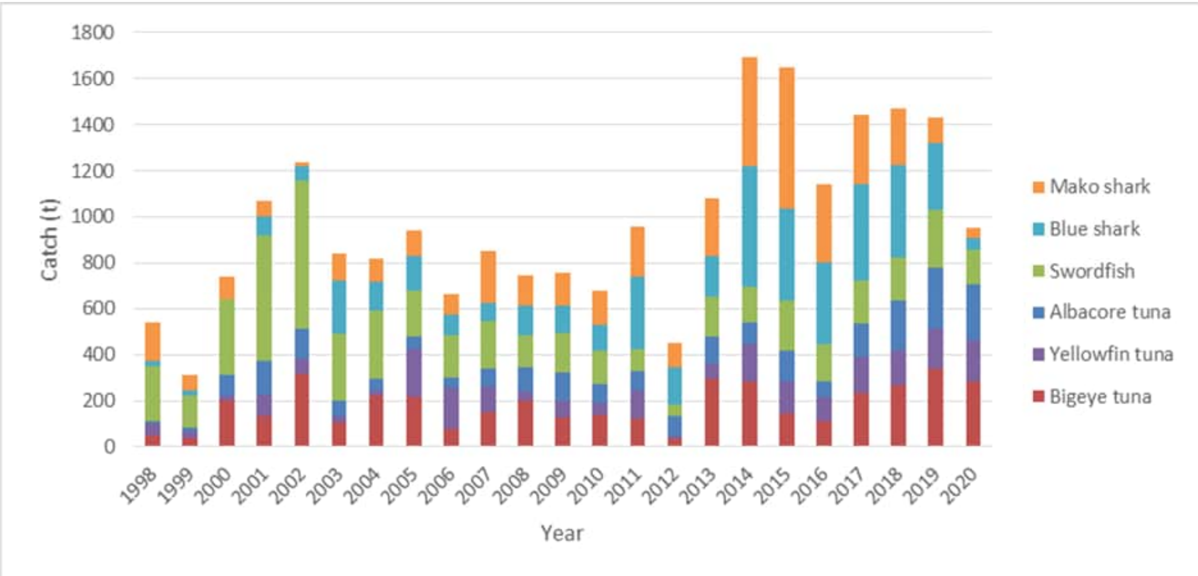


Figure 3.30: Inter-annual variation of catch landed by the large pelagic longline sector operating in the ICCAT region of South African waters (i.e. West of 20°E from 1998 – 2020).

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. 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 3.31 and photographs of monofilament fishing line and marker buoys are included in Figure 3.32 below. 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.

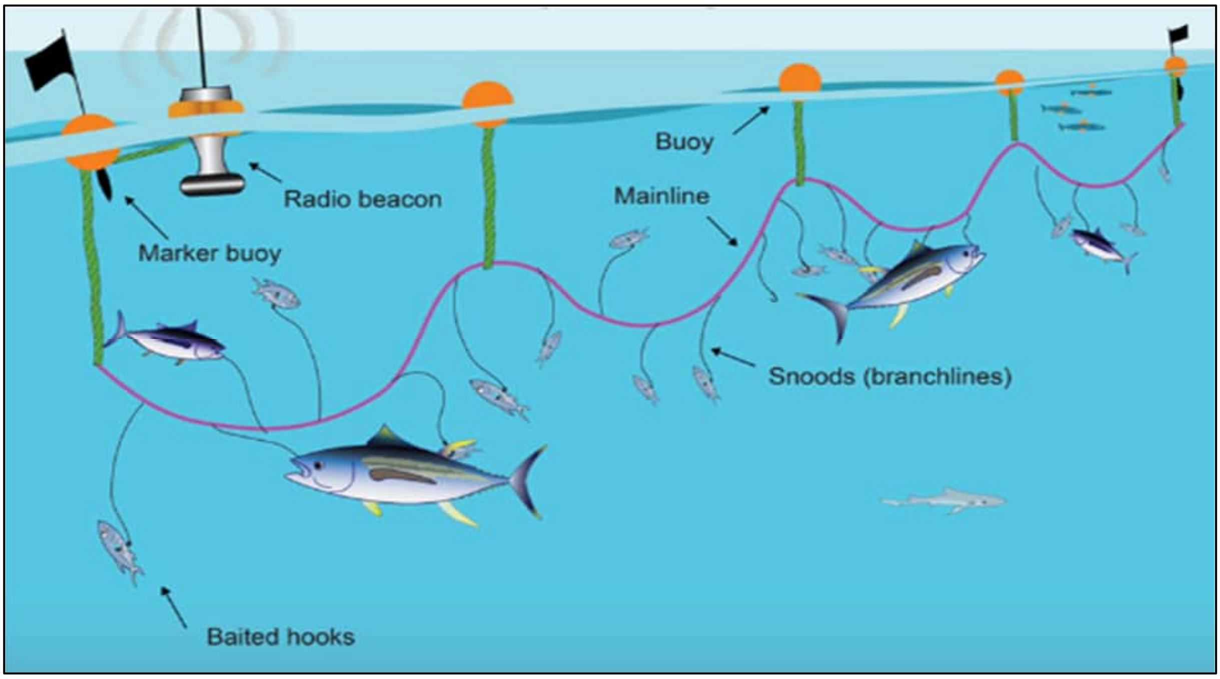


Figure 3.31: Typical large pelagic longline gear (Source: http://www.afma.gov.au/portfolio-item/longlining).

Figure 3.32: Photographs showing marker buoys (left), radio buoys (centre) and monofilament branch lines (right) (Source: CapMarine, 2015).

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 shown by foreign-flagged longliners (see Figure 3.33b). 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).

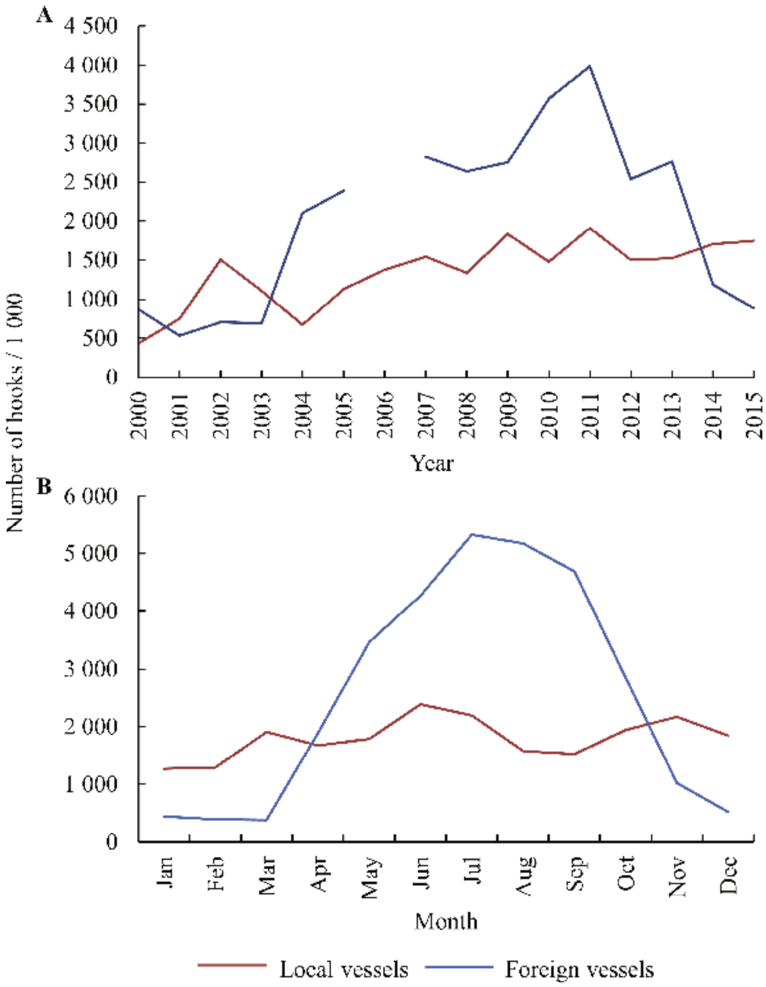


Figure 3.33: Numbers of hooks set per (A) year (2000–2015) and (B) per calendar month, as reported by local and foreign pelagic longliners (Jordaan *et al*., 2018).

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 in Figure 3.34. Bubble size is proportional to the numbers of hooks set per line.

The numbers of hooks set by foreign vessels peak between May and October each year, whereas local vessels fish throughout the year, with marginally fewer hooks set in January and February than other months (Figure 3.33b). Foreign vessels venture further southwards than local vessels, which tend to remain within the EEZ (Figure 3.34; 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 fish 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. 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.

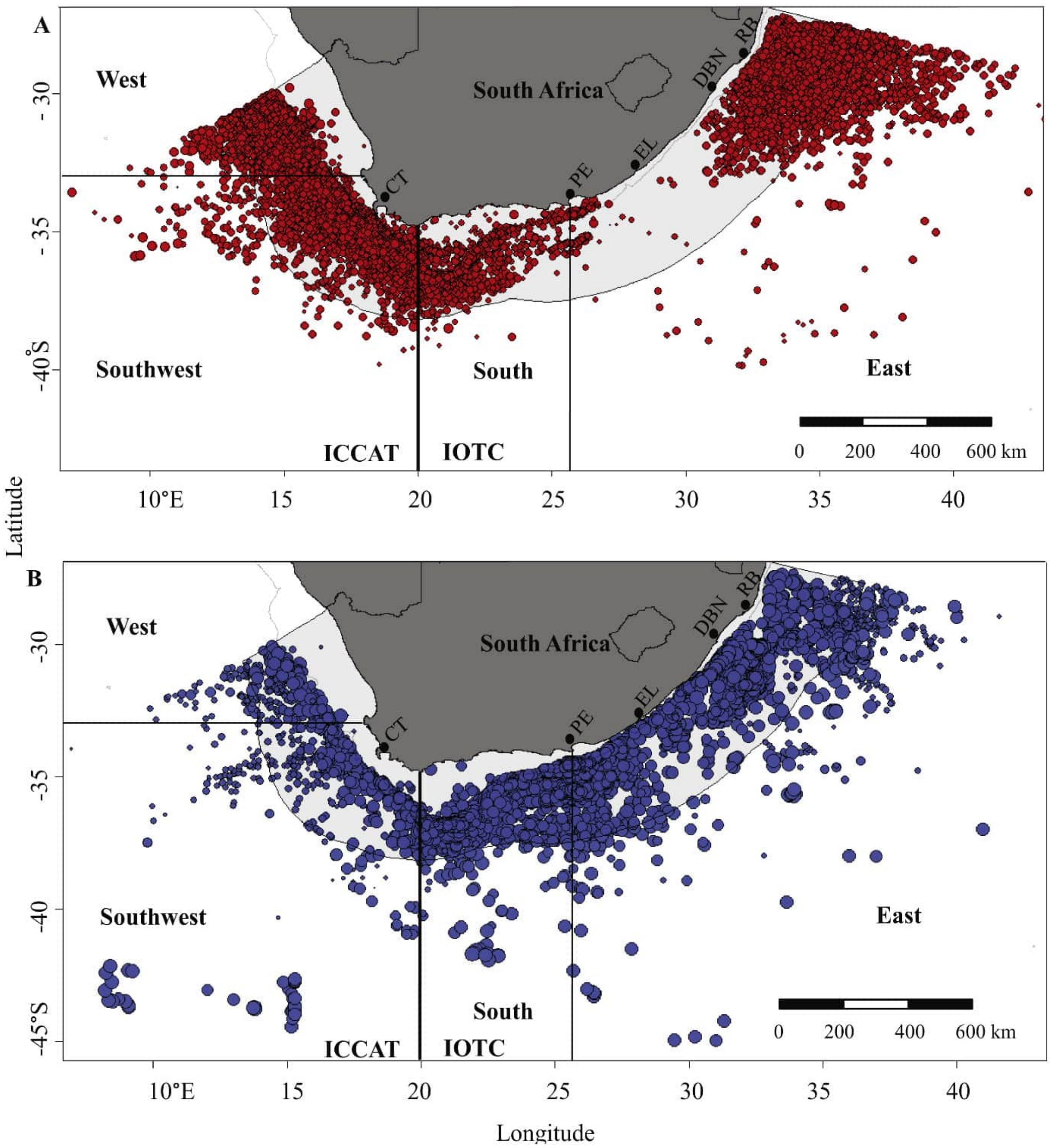


Figure 3.34: Geographical distribution of fishing effort by (A) local and (B) foreign pelagic longliners between 2000 and 2015, based on logbook data provided by vessel skippers (Jordaan *et al.*, 2018).

The fishery operates extensively within the South African EEZ, primarily along the continental shelf break and further offshore. Figure 3.35 shows the spatial extent of pelagic longline fishing grounds in relation to the licence block and Area of Interest for proposed drilling. Over the period 2017 to 2019, an average of 726 lines per year were set within the licence block yielding 1049 tonnes of catch. This is equivalent to 17.66% of the overall effort and 14.67% of the overall catch reported nationally by the sector (local and foreign fleets, cumulative). Fishing activity takes place over the entire proposed well drilling area where, over the period 2017 to 2019, an average of 298 lines per year were set yielding 414 tonnes of catch. This is equivalent to 7.25% and 5.79% of the overall effort and catch, respectively.

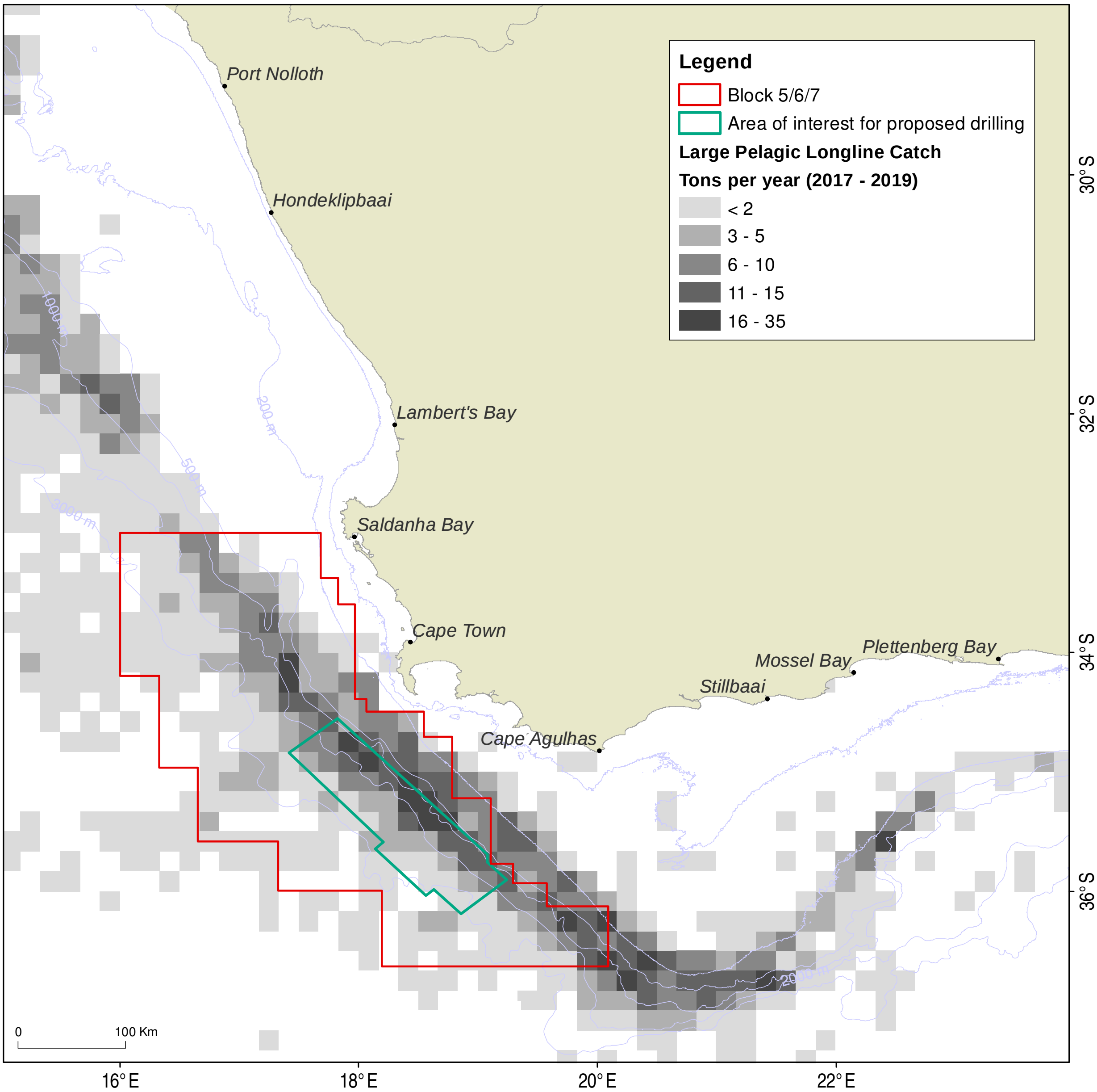


Figure 3.35: An overview of the spatial distribution of fishing effort expended by the longline sector targeting large pelagic fish species in relation to the licence block and area of interest for proposed drilling.

The 500 m safety zone around the drilling unit would result in an exclusion area of 0.79 km^2. Since surface longlines are buoyed and unattended, they drift in surface currents and cover a large area before they are retrieved. The potential area of exclusion to fishing operations would therefore not be limited to the 500 m safety zone around the drilling unit. Vessel operators would be obliged to take a precautionary approach in order to avoid gear entanglement with the (stationary) drilling unit by avoiding a much wider area. Based on an assumed average line length of 60 km, operators could be expected to avoid setting lines within a distance of 30 km of the drilling unit, in order to avoid potential gear entanglement. The maximum average annual catch and effort within this area amounts to 3.9% (105 tons) and 3.91% (70 lines), respectively, of the total catch and effort reported by the sector on a national scale.

The estimated zone of noise disturbance up to a distance of 5 km from the drilling unit could result in an affected area of up to 78.5 km^2. Placed across the area of highest fishing activity within the Area of Interest for proposed drilling, this coincides with an average annual catch of 4.9 tons from 4 lines (0.18% of the overall national catch and effort figures).

3.4.7 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, and skipjack tuna (*Katsuwonus pelamis*). The fishery is seasonal with vessels active predominantly between November and May 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 (commercial) 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. Landings of albacore in 2020 amounted to 3941 tons. A historical time series of catch and effort reported by the South African sector operating within the Atlantic region is shown in Table 3.7 and Figure 3.36. The total effort of 4131 catch days within the ICCAT convention area in 2019 represents an increase in effort of 9% compared to 2018.

Table 3.7: Total number of fishing days (effort), active vessels and total catch (t) of the main species caught by tuna pole vessels in the ICCAT region (West of 20E), 2008 – 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

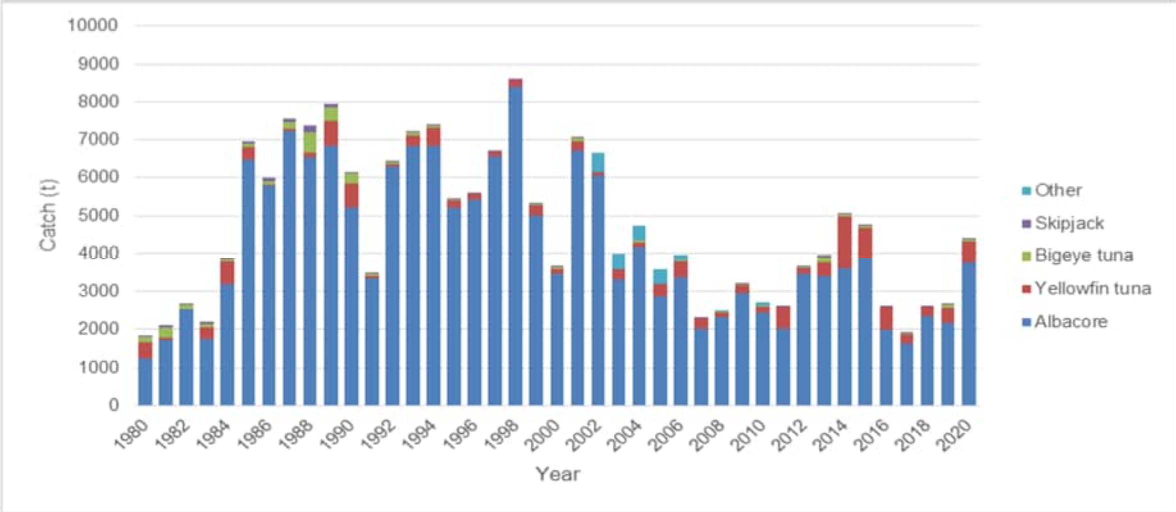


Figure 3.36: Catches (tons) of pelagic species by the South Africa pole-line ("Baitboat") fleet between 1980 and 2020 (ICCAT, 2022).

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 (185 km) 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 3.37).

Figure 3.37: 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.

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. 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.

Figure 3.38 shows the location of fishing activity in relation to the licence block and Area of Interest for proposed drilling. Fishing records received from DFFE for the reporting period 2017 to 2019 show tuna-directed fishing within the licence block, particularly over the Cape Canyon. An average of 1613 fishing events per year were reported having taken place within the licence block yielding 1955 tonnes of albacore. This is equivalent to 64.39% of the overall effort expended by the pole-line sector and 70.5% of the albacore catch landed by the sector.

The proposed drilling area is situated adjacent to Cape Canyon and there is evidence of fishing activity extending towards the 2000 m depth contour. Over the period 2017 to 2019, an average of 322 fishing events per year were reported within the proposed drilling area yielding 391 tonnes of albacore. This is equivalent to 12.54% and 13.74% of the overall effort and catch, respectively. The seasonality of catch from October to December within the proposed drilling area is shown in Figure 3.39.

The 500 m safety zone around the drilling unit would exclude fishing from an area of 0.79 km^2, which when placed in the area of highest fishing activity would affect an average of 2 events per year yielding 1.2 tons of catch (0.1% and 0.1% of the overall national catch and effort figures, respectively).

The estimated zone of noise disturbance (5 km) could affect an area of approximately 78.5 km^2 around the drilling unit. Placed across the area of highest fishing activity, this area yielded 35.3 tons of catch (albacore) from 18 fishing events which amounts to 1.24% and 0.7% of the overall national catch and effort figures, respectively.

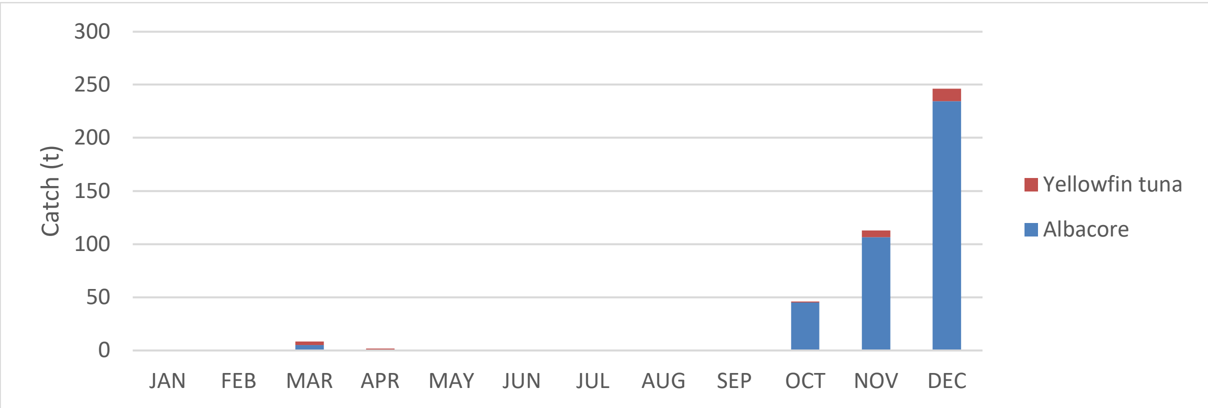


Figure 3.38 Average catch (t) per month (2017 – 2019) taken by the tuna pole-line sector within the proposed drilling area.

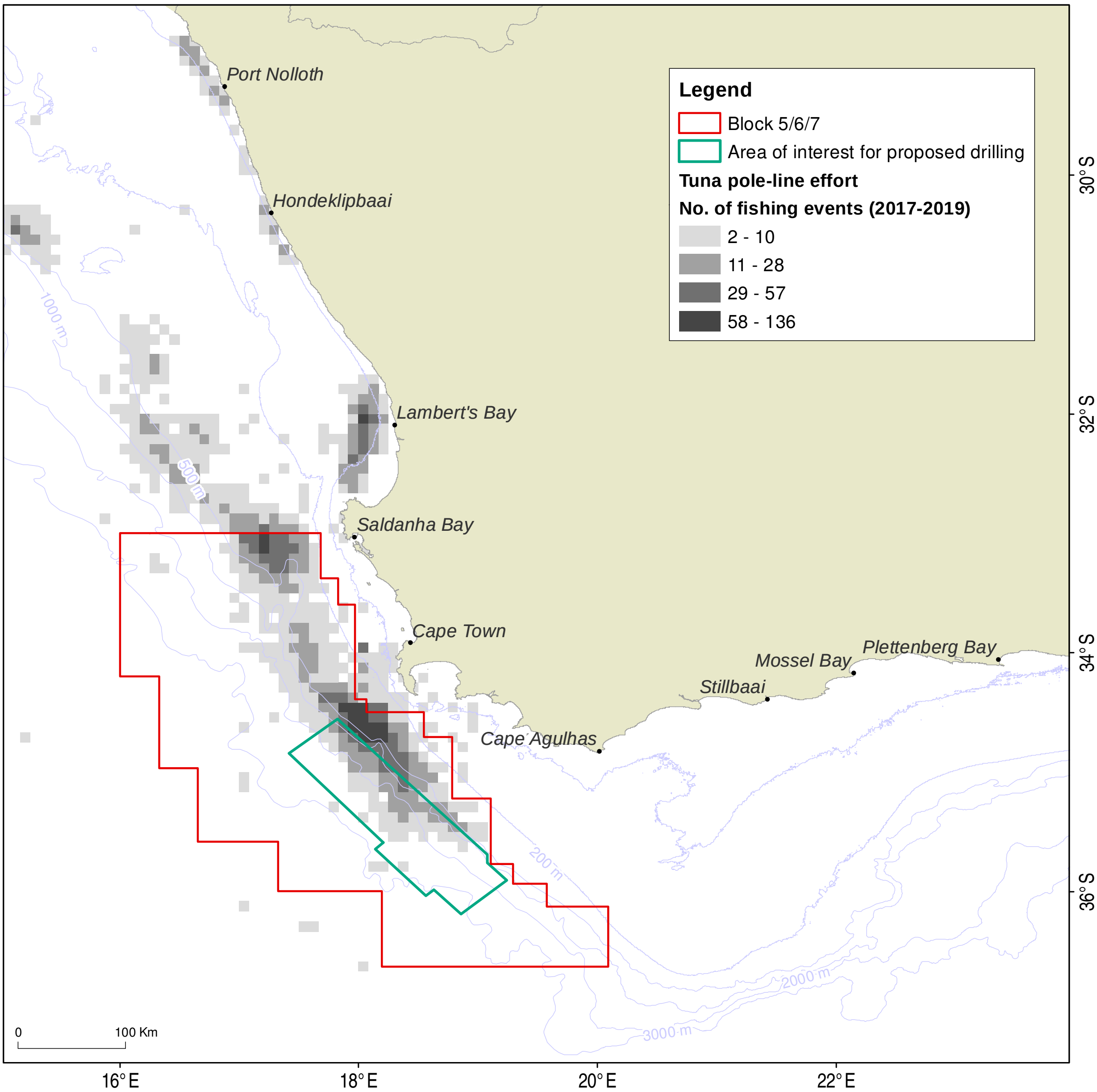


Figure 3.39: **An overview of the spatial distribution of fishing effort expended by the pole- line sector targeting pelagic tuna (offshore areas) and snoek (inshore areas) in relation to the licence block and the area of interest for proposed drilling.**

3.4.8 COMMERCIAL OR TRADITIONAL LINE FISH

The commercial linefish sector is one of the oldest fisheries in South Africa and 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 smaller 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 using hook and line, but excludes the use of longlines. Target species of the linefishery include temperate, reef-associated seabreams (e.g. carpenter, hottentot, santer and slinger), coastal migrants (e.g. geelbek and dusky kob) and nomads (e.g. snoek and yellowtail). More than 90% of the current linefish catch is derived from the aforementioned eight species. Almost all of the traditional line fish catch is consumed locally.

Of all South African marine fisheries, the linefishery is the most vulnerable to external impacts. Linefish recources are at risk of overcapacity as they area directly or indirectly exploited by other sectors, including the recreational, small-scale linefishery, inshore and offshore trawl fisheries, tuna pole-line fishery, the inshore netfishery 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 linefishery 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 3.8 lists the catch of important linefish species for the years 2010 to 2022. Figure 3.40 shows the variability in catches of the eight most importance species by the linefishery over the period 1985 to 2021.

Table 3.8: Annual catch (t) of the eight most important linefish species for the period 2010 to 2021 (DFFE, 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*

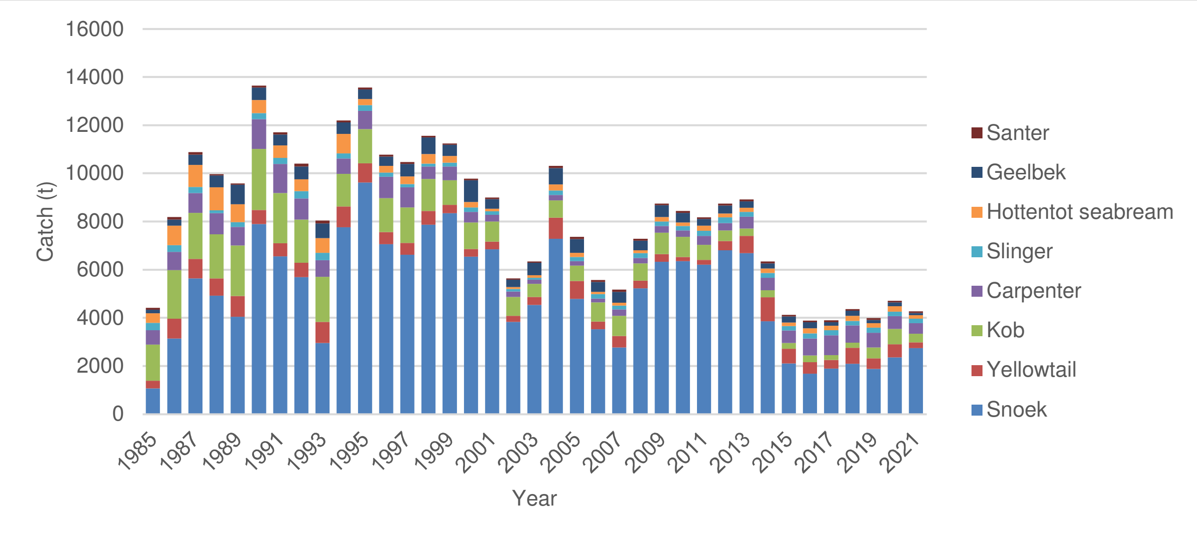


Figure 3.40: Annual catch (t) of the eight most important linefish species for the period 1985-2021 (DFFE, 2022).

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 linefishery 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. The number of rights holders[6] is currently 425. For the 2021/2022 fishing season, 325 vessels were apportioned to commercial fishing, whilst 122 vessels apportioned to small-scale fishing[7] (refer to Section 3.5).

A standard vessel is defined as a vessel that can carry a crew of 7. Vessels with a maximum length overall of 10 m and a maximum crewing capacity of 12, including the skipper. The maximum standard vessel allocation for the commercial linefishery within the three management Zones (2021/2022) is 340 vessels for Zone A (Port Nolloth to Cape Infanta), 64 vessels for Zone B (Cape Infanta to Port St Johns) and 51 vessels for Zone C (KwaZulu-Natal).

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.

[6] The Traditional Linefish sector was allocated 7-year rights during Fishing Rights Allocations Process (FRAP) in 2013. These were due to expire during 2020; however the Deputy Director-General exempted the current Right Holders from Section 18 of the Marine Living Resources Act, 1998 (Act no 18 of 1998), by granting them extensions of their current fishing rights until 31 December 2021. This extension was granted while the DFFE would conclude a FRAP in terms of Section 18 of the MLRA. At the time of this report the FRAP is still underway. Having regard for the decline in the resources caught in this fishery and the need to apportion these among this and the emerging Small-Scale fishery, fishing rights in the Commercial Traditional Linefish Sector will be granted for a period of 7 years, commencing on 1 March 2022 and terminating on 28 February 2029, whereafter they shall automatically terminate and revert back to the State.

[7] DFFE increased the apportionment of TAE to small-scale fishing from 13% in 2019/20 to 26% in 2021/22 in order to boost economic possibilities for coastal communities.

Table 3.9 lists the annual Total Allowable Effort (TAE) and activated effort per line fish management zone from 2007 to 2019. Most of the catch (up to 95%) is landed by the Cape commercial fishery, which operates on the continental shelf from the Namibian border on the West Coast to the Kei River in the Eastern Cape. Fishing takes place throughout the year but there is some seasonality in catches.

Table 3.9: Annual total allowable effort (TAE) and activated commercial line fish effort per management zone from 2007 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
2007	455	353	301	231	103	85	51	37
2008	455	372	301	239	103	82	51	51
2009	455	344	300	222	104	78	51	44
2010	455	335	298	210	105	82	51	43
2011	455	328	298	207	105	75	51	46
2012	455	296	298	192	105	62	51	42
2013	455	289	301	189	103	62	51	38
2014**	455	399	340	293	64	58	51	48
2015**	455	356	340	291	64	61	51	45
2016**	455	278	340	274	64	59	51	45
2017**	455	329	340	232	64	60	51	37
2018**	455	324	340	232	64	50	51	42
2019**	455	306	340	218	64	50	51	38

** In the finalisation of the 2013 commercial Traditional 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.

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 linefishery (see Figure 3.41). Snoek are not distributed offshore of the 1000 m depth contour and therefore not targeted or caught by the commercial linefishery in the area of interest for proposed drilling.

Figure 3.41: Fishermen landing snoek on board a vessel operating in the traditional linefishery (photo credit Jaco Barendse).

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

Figure 3.42 shows the spatial extent of traditional linefish grounds in relation to the licence block and Area of Interest for proposed drilling. Fishing effort is primarily coastal, with vessels operating in waters shallower than 100 m. Activity in deeper waters are reflected in the vicinity of Cape Canyon at a distance of 55 km offshore of Saldanha Bay, as well as and Hope Canyon due South of Cape Point. Over the period 2017 to 2019, an annual average of 21.3 tonnes of albacore and yellowfin tuna and 4.4 tonnes of yellowtail was caught within the licence block. Catch within the area amounted to 0.5% of the total (effort figures unavailable). Fishing within this area is seasonal – October to May.

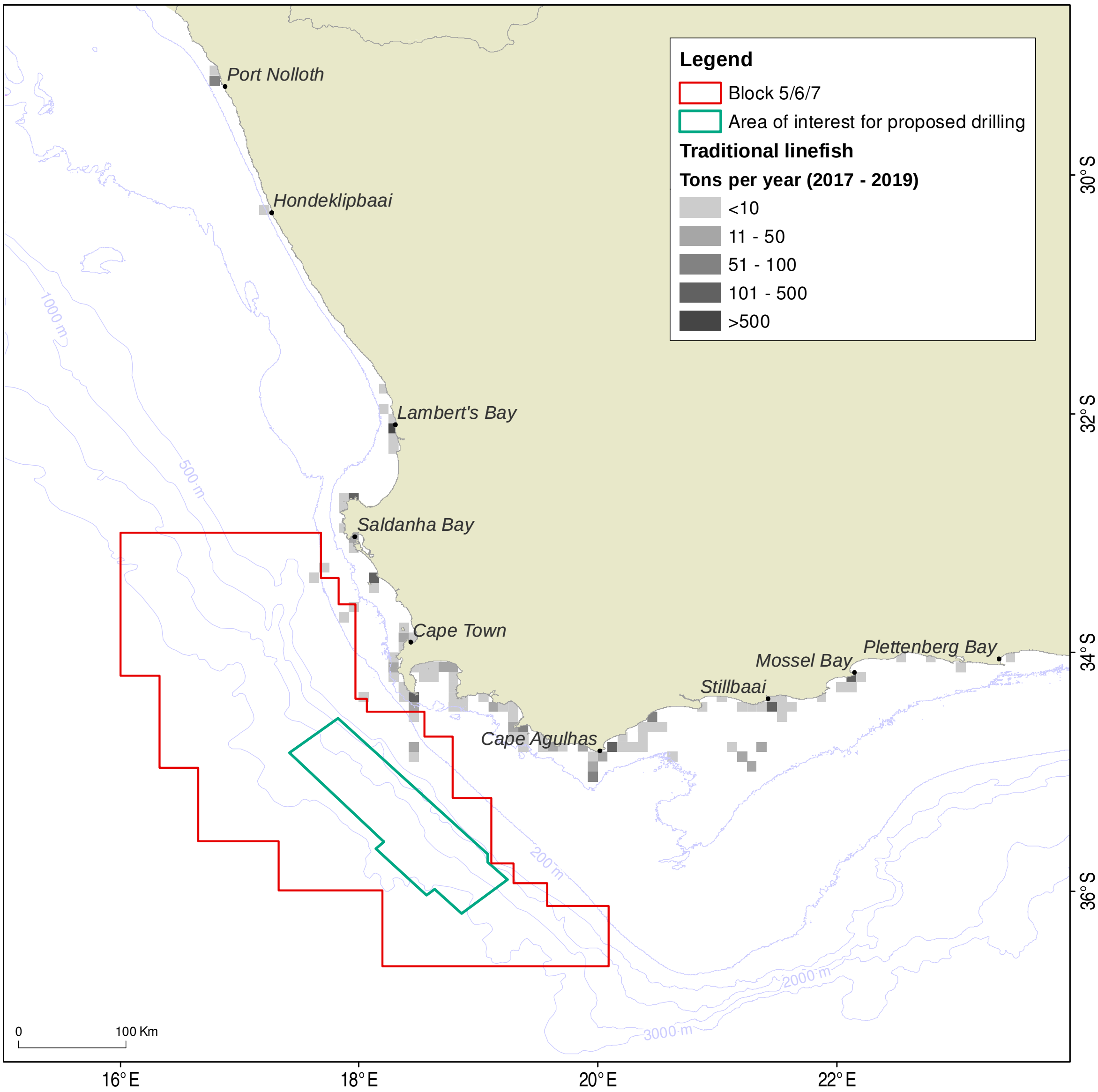


Figure 3.42: An overview of the spatial distribution of catch taken by the line fish sector in relation to the licence block and the area of interest for proposed drilling.

There is no activity expected within the Area of Interest for proposed drilling, which is situated approximately 18 km from fishing locations. There is no overlap of fishing grounds with the estimated zone of noise disturbance (5 km), which is situated approximately 13 km offshore of the closest expected fishing activity.

3.4.9 WEST COAST ROCK LOBSTER

The West Coast rock lobster (*Jasus lalandii*) is a valuable resource of the South African West Coast and consequently an important income source for West Coast fishermen. The resource occurs inside the 200 m depth contour along the West Coast from Namibia to East London on the East Coast of South Africa. Fishing grounds stretch from the Orange River mouth to east of Cape Hangklip in the South-Eastern Cape.

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 3.10. 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[8] 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 Figures 3.43 and Figure 3.44, respectively. A historical time-series of TACs and landings is listed in Table 3.11.

Table 3.10: 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 Small-scale fishing sector (nearshore)	170.25	131.03	100.92
Small-scale fishing sector (offshore)	140.83	108.97	75.32
Total	1084	837.0	600

Table 3.11: Total allowable catch, fishing sector landings and total landings for West Coast rock lobster (DEFF, 2020).

			TAC (t)			
Season	Global TAC	Offshore allocation	Nearshore allocation	Interim Relief	Recreational	Total catch
1999/00	2 156	1720		145	291	2152
2000/01	2 018	1614		230	174	2154
2001/02	2 353	2151		[1]	202	2410
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

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

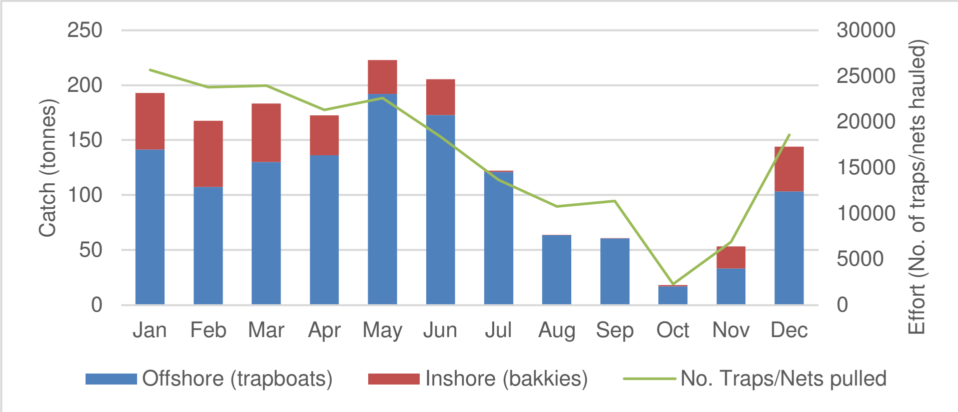


Figure 3.43: Graph showing the average monthly catch (tonnes) and effort (number of traps hauled) reported by the offshore (trapboat) and inshore (bakkie) rock lobster sectors over the period 2006 to 2020.

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 3.12.

Table 3.12: 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	Catch period	
	Commercial nearshore, interim relief, small-scale: nearshore	Commercial offshore, small-scale: offshore
Area 1 + 2	15 Oct, Nov, Dec, Jan, 15 Feb	
Area 3 + 4	15 Nov, Dec, Jan, Feb, 15 Mar	15 Nov, Dec, Jan, Feb, 15 Mar
Area 5 + 6	15 Nov, Dec, Jan, Feb, 15 Mar	
Area 7		Dec, Jan, Feb, Mar
Areas 8 and 11	15 Nov, Dec, Jan, Feb, 15 Mar	Jan, Mar, Apr, May
Area 8 (deep water)		Jun, Jul
Areas 12, 13 and 14	15 Nov, Dec, Jan, Feb, 15 Mar	

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

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

The delineation of management zones is shown in Figure 3.45. 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 3.46 shows rock lobster catch by area for the commercial offshore and nearshore sub-sectors over the period 2005 to 2016.

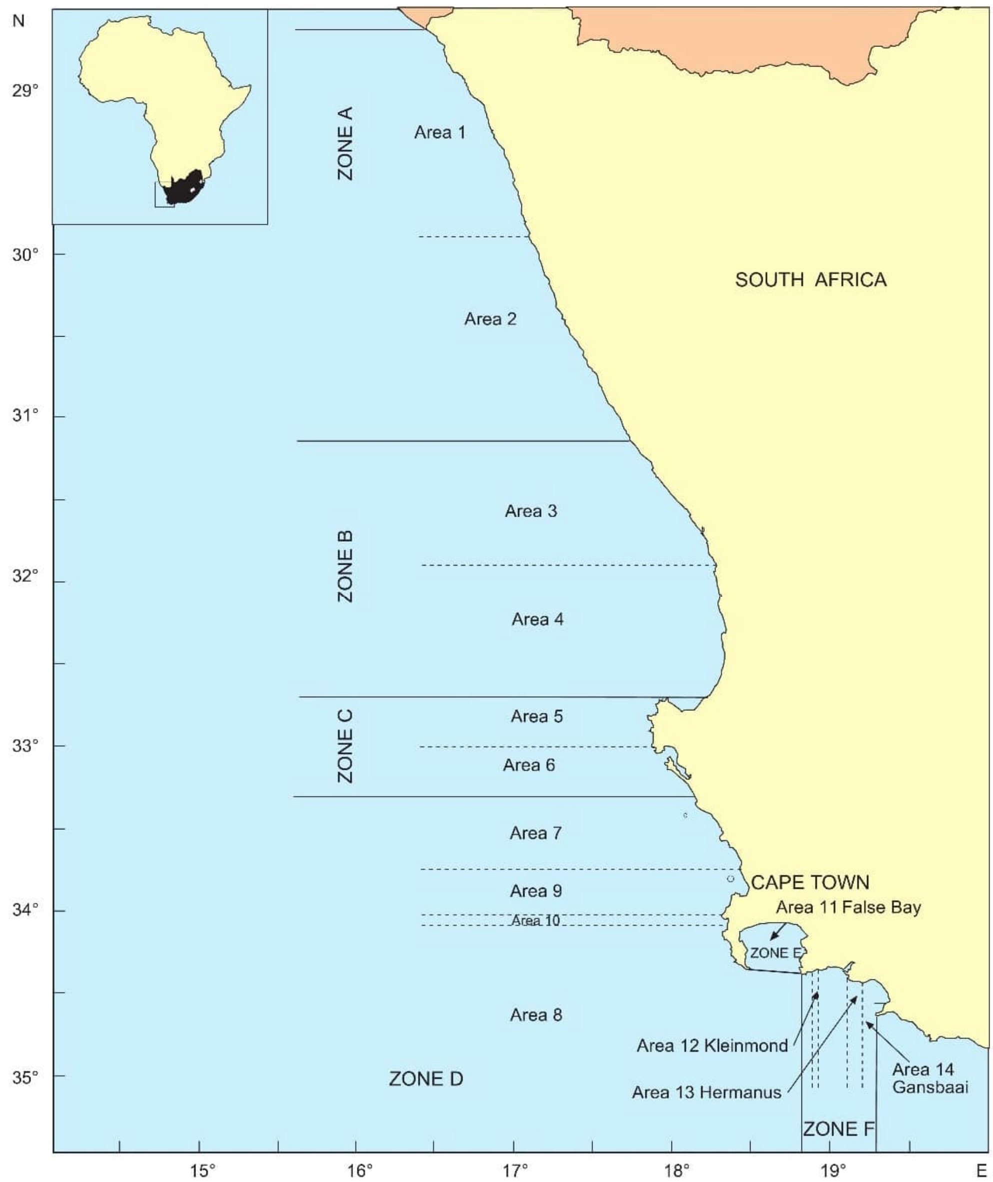


Figure 3.44: West Coast rock lobster fishing zones and areas. The five super-areas are: areas1–2, corresponding to zone A; areas 3–4, to zone B; areas 5–6, to zone C; area 7, being the northernmost area within zone D; and area 8+, comprising area 8 of zone D as well as zones E and F.

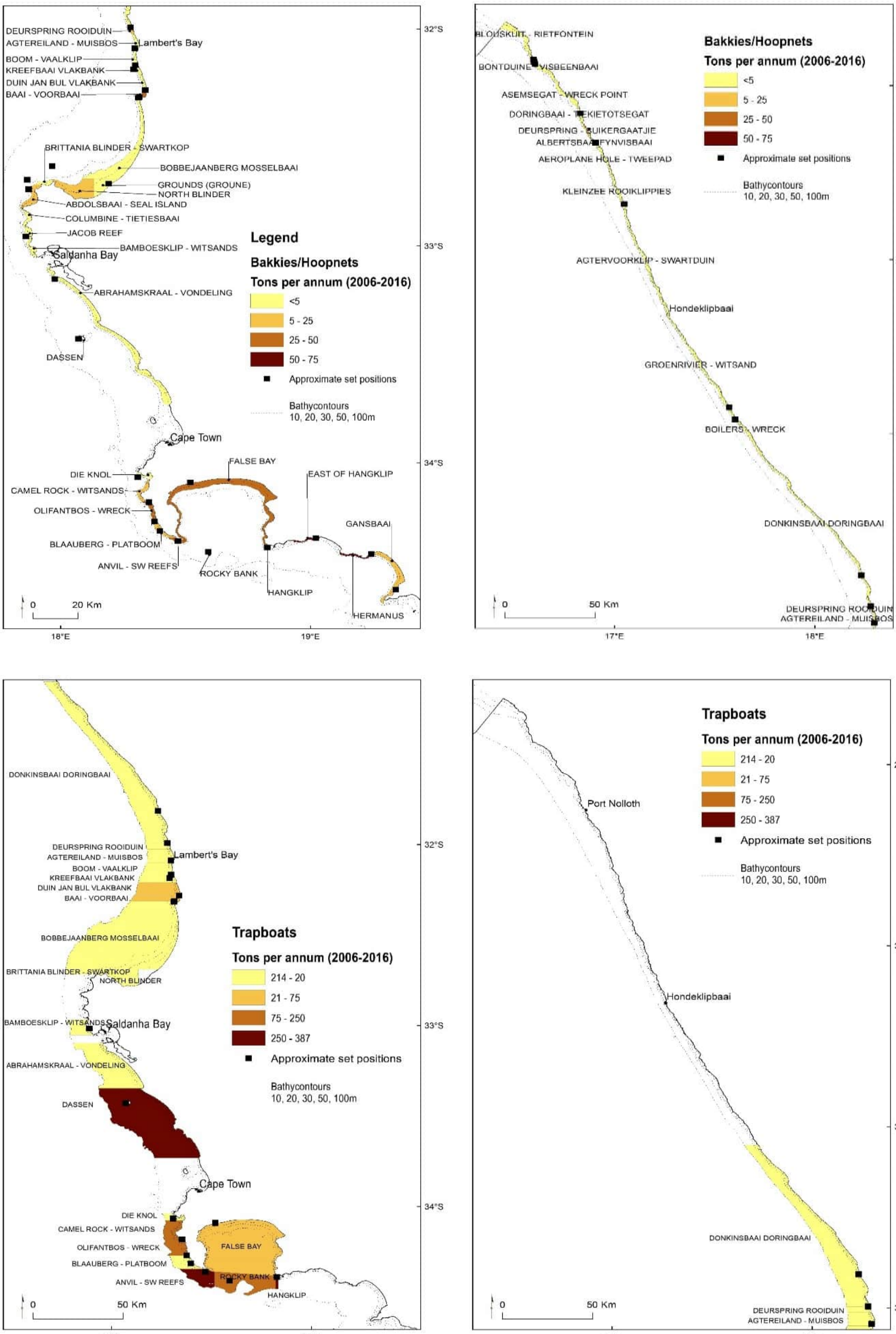


Figure 3.45: **An overview of the spatial distribution of fishing effort expended by the west coast rock lobster nearshore (above) and offshore (below) sub-sectors within demarcated lobster management zones.**

The licence area is situated offshore of rock lobster management zones C, D, and F; and offshore of the depth range at which rock lobster is targeted. Over the period 2006 to 2020, there was no fishing activity reported by the offshore or nearshore sectors within the licence block or Area of Interest for proposed drilling area (refer to Figure 3.47).

The closest fishing activity to the Area of Interest for proposed drilling is approximately 50 km off Cape Point.

There is no overlap of fishing grounds with the estimated zone of noise disturbance (5 km) which is situated approximately 45 km offshore of the closest expected fishing activity.

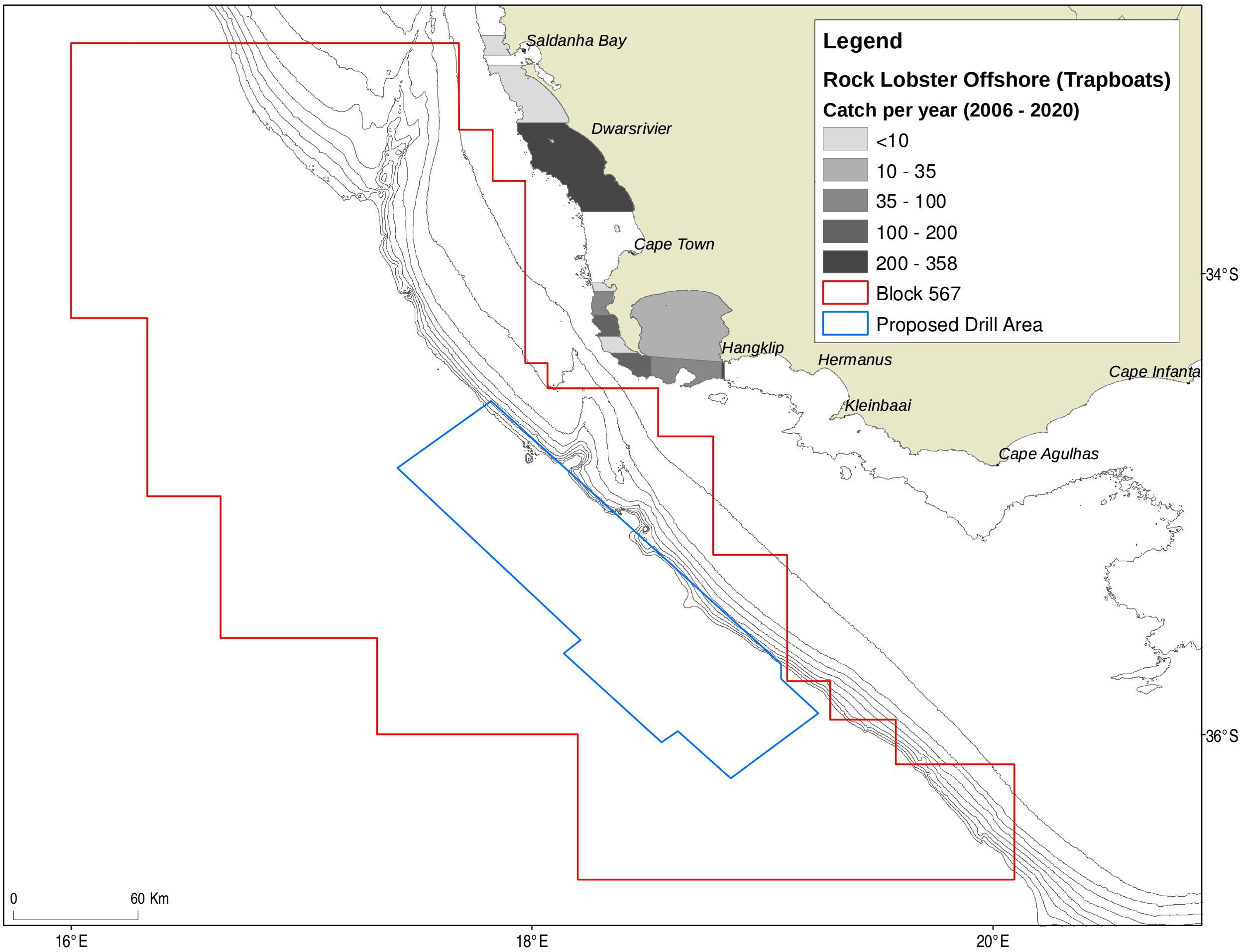


Figure 3.46: Spatial distribution of lobster catch by management sub-area over the period 2006 to 2020 (offshore/trapboat sub-sector). The licence block and proposed drilling areas are shown. Depth contours range from 100 m to 1000 m.

3.4.10 SOUTH COAST ROCK LOBSTER

South Coast rock lobsters (*Palinurus gilchristi*) are endemic to the southern coast of South Africa, where they occur on the continental shelf at a depth range of 50 m to 200 m. The fishery operates between East London and Cape Point and up to 250 km offshore along the outer edge of the Agulhas Bank. The stock is fished in commercially viable quantities in two areas off the South Coast, the first is on the Agulhas Bank approximately 200 km offshore, and the second is within 50 km of the shoreline between Mossel Bay and East London. It is the second-largest rock lobster fishery in South Africa and is capital-intensive, requiring specialised equipment and large, ocean-going vessels. Products (frozen tails, whole or live lobster) are exported to the USA, Europe and the Far East.

The South Coast rock lobster fishery is a deep-water longline trap fishery. Barrel-shaped plastic traps are set for periods ranging from 24 hours to several days. Each vessel typically hauls and resets approximately 2,000 traps per day in sets of 100 to 200 traps per line. They set between ten and 16 lines per day, each of which may be up to 2 km in length. Each line is weighted to lie along the seafloor and is connected at each end to a marker buoy at the sea surface. Vessels are large, ranging from 30 m to 60 m in length. Those that have on-board freezing capacity remain at sea for up to 40 days per trip, while those retaining live catch remain at sea between seven and 10 days before discharging at port. The fishery operates year-round with comparatively low activity during October. Longline trap-fishing is labour intensive and as such each boat requires approximately 30 officers and crew. The total sea-going complement of the fleet is about 300 individuals. In addition to sea-going personnel, the sector employs approximately 100 land-based factory (processing) and administrative personnel. Refer to Figure 3.48 for an example of a vessel operating in the south coast rock lobster sector.

Figure 3.47: Photograph of FV Southern Patriot, registered vessel fishing in the south coast rock lobster trap fishery (source: marinetraffic.com).

Fishing rights were allocated for a period of 15 years in 2005 to a total of 13 right holders to utilise 9 vessels. In 2020 a further 15 year right allocation process was completed and a total of 9 rights were granted to 7 historic right holders and 2 new entrant applicants. Current rights are valid until 30 September 2037.

Historical records of TAC, TAE, catch and standardisd Catch per Unit Effort (CPUE) are included in Table 3.13. The current TAC and TAE (2022) is 359 t and 2525 sea days, respectively. Value of catch in 2021 was assessed at R395 million.

Table 3.13: South Coast rock lobster historical records of TAC, TAE, catch and standardisd CPUE (kg trap^{-1}) (DEFF, 2020).

Season	TAC (tonnes tail mass)	TAE (allocated seadays)	Standardised CPUE (kg trap^{-1})		
			Area 1E	Area 1W	Area 2 & 3
2006/7	382	2089	1.34	0.78	0.83
2007/8	382	2089	1.09	1.09	1.11
2008/9	363	2675	1.42	1.24	1.15
2009/10	345	2882	1.17	1.18	0.85
2010/11	328	2550	1.37	1.22	0.94
2011/12	323	2443	0.96	1.09	0.95
2012/13	326	2250	0.86	0.90	0.97
2013/14	342	2536	1.41	1.30	1.41
2014/15	359	2805	1.36	1.43	1.28
2015/16	341	2858	1.97	1.50	1.04
2016/17	332	2029	1.63	1.24	0.96
2017/18	321	2148	1.61	1.38	1.41
2018/19	321				
2019/20	321				
2020/21	337				
2021/22	354				

Figure 3.49 shows the spatial distribution of fishing effort (2006/7-2019/20) in relation to the licence block and proposed drilling area. Lobster fishing grounds situated on the Agulhas Bank lie adjacent to the eastern extent of the block; however there is no direct overlap of fishing grounds with either the licence block or the proposed drilling area. The closest grounds from the proposed drilling area are situated 64 km from commercial fishing Block 397.

There is no overlap of fishing grounds with the estimated zone of noise disturbance which is situated approximately 60 km offshore of the closest expected fishing activity.

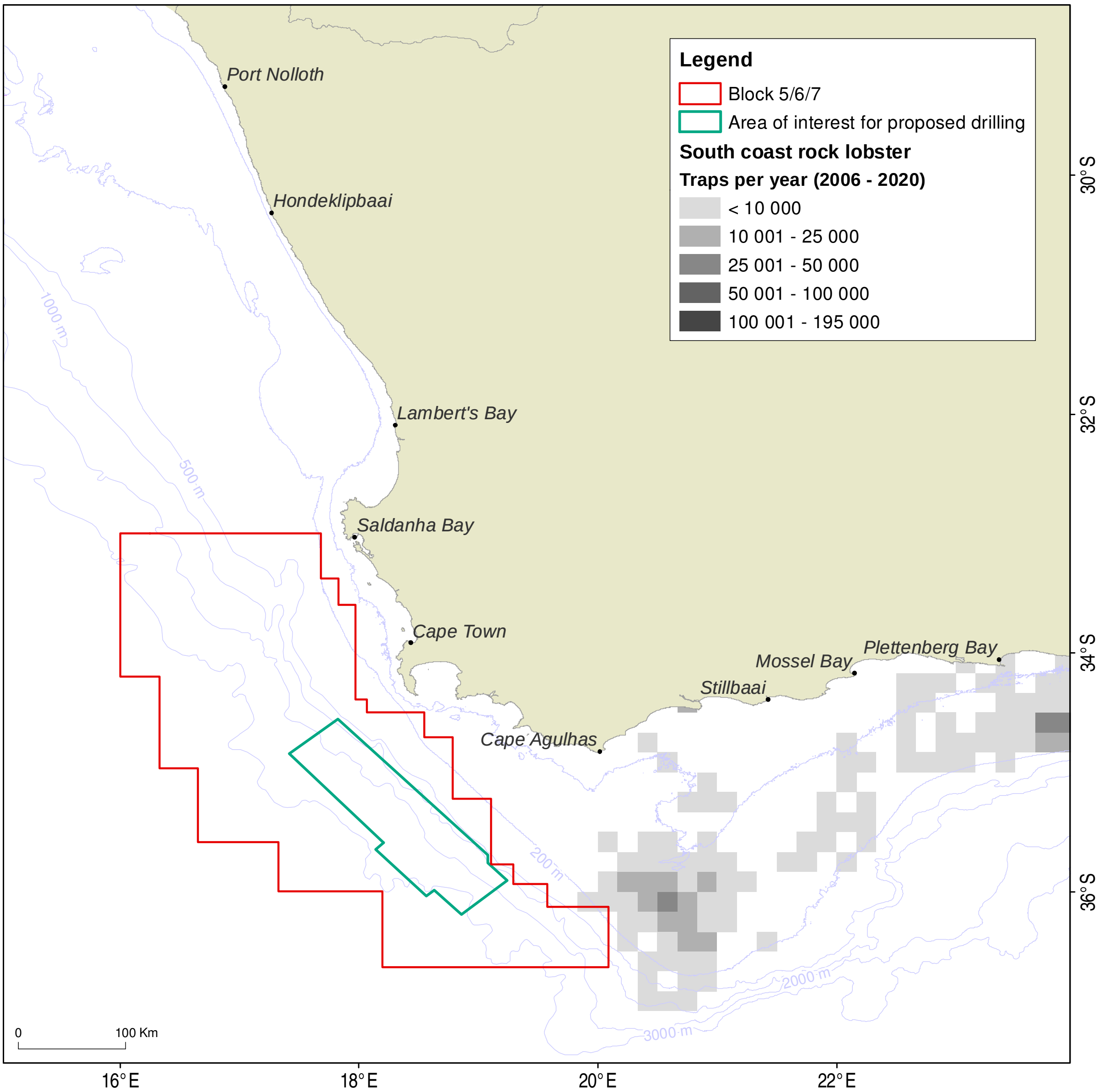


Figure 3.48: Spatial distribution of effort expended by the south coast rock lobster trap fishery in relation to the licence block and the area of interest for proposed drilling.

3.4.11 SQUID JIG

Chokka squid (*Loligo vulgaris reynaudii*) is distributed from the border of Namibia to the Wild Coast. It occurs extensively on the Agulhas Bank out to the shelf edge, increasing in abundance towards the eastern boundary of the South Coast, especially between Plettenberg Bay and Algoa Bay (Augustyn 1990; Sauer *et al*. 1992; Augustyn *et al*. 1994). Chokka squid is the target of a dedicated commercial jig fishery that operates between the Cape of Good Hope and Port Alfred. Along the South Coast adult squid is targeted in spawning aggregations on shallow-water fishing grounds extending from Plettenberg Bay to Port Alfred between 20 m and 130 m depths (Augustyn 1990; Downey 2014). The most important spawning grounds are between Plettenberg Bay and Algoa Bay (Augustyn 1990), these having been linked to specific spawning habitat requirements (Roberts & Sauer 1994; Roberts 2005). Spawning aggregations are a seasonal occurrence reaching a peak between September and December (Augustyn et al. 1992).

The method of fishing involves hand-held jigs and bright lights which are used to attract squid at night. A squid jig is defined as a lure like object with a row or number of rows of barbless "hooks" at one end and an "eye" at the opposite end. Jigging operations involve the use of one or more jigs attached to a handline at the "eye" of the jig and moved up and down in a series of short movements in the water (Squid Permit Condition, DFFE). The catch is frozen at sea or at land-based facilities at harbours between Plettenberg Bay and Port Alfred. Vessels predominantly operate out of Cape St Francis and Gqeberha harbours.

The squid fishery is fairly stable and provides employment for approximately 3 000 people locally. Typically annual catches range from 4 000 t to 12 000 t (see Figure 3.50). Landings in 2018 amounted to 13 237 t. The industry exports all of the catch to European countries at a value of approximately R80 per kg. Depending on the season, the industry is valued anywhere between R320 Million and R1.1 billion and is South Africa's third largest fishery in monetary terms. Squid is also used as bait by linefishers. The fishery is currently in the process of rights allocation, and a proportion of the effort allocation has been set aside for small-scale fisheries (refer to section 3.5).

The squid fishery is managed in terms of the Total Allowable Effort (TAE) allowed within the fishery. The TAE (2020/2021) is based on the number of crew permitted to harvest squid across the fishery (2,443) and the maximum number of person days fishing during the season (295,000). Total squid catches from commercial jig, as well as squid total allowable effort (TAE) over the period 2003 to 2019 is listed in Table 3.14. Of the overall TAE, 75% (221,250 person days) is apportioned to commercial fishing, and 25% (73,750 person days) is apportioned to small-scale fishing. Skippers record how many of their crew fish, and for how many hours each day. There are two closed seasons totaling slightly more than four months: a permanent closed period of five weeks between October and November to allow for summer spawning, and an additional three months in winter to prevent the man-days from exceeding the maximum. During the enforced annual five-week closure between October and November, the DEFF undertakes a survey on spawning aggregations in the bay areas. The annual closed period extends from 19 October to 23 November. An additional industry-imposed three-month closed season was introduced in 2014. The timing of closure is typically during March, April, and May, or April, May, and June, and the decision is made during the industry's annual general meeting held in October each year. The period of closure coincides with a drop in adult spawning activity and a reduction in catches. In 2018, the additional closed season extended from April to June (DEFF, 2019). The fishery is seasonal, with most effort conducted between November and March (see Figure 3.51). Catch depths rarely exceed 60 m (99% of the catch is taken in water depths less 60 m; see Figure 3.52).

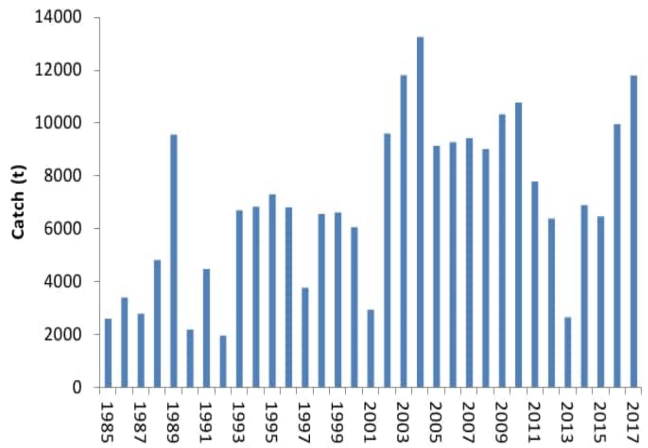


Figure 3.49: Annual chokka squid catches by the jig fishery over the period 1985 – 2017 (DEFF, 2019).

Table 3.14: Total squid catches from commercial jig, as well as squid total allowable effort (TAE) (2003 – 2019; DEFF, 2020).

Year	Squid jig catches (t)	TAE (allocated seadays)
2003	11 820	2 423 unrestricted crew* 41 restricted crew*
2004	13 261	2 423 unrestricted crew* 41 restricted crew*
2005	9 147	2 423 unrestricted crew* 22 restricted crew*
2006	9 291	2 423 unrestricted crew* 138 vessels
2007	9 438	2 422 unrestricted crew* 136 vessels
2008	9 021	2 422 unrestricted crew* 136 vessels
2009	10 341	2 422 unrestricted crew* 136 vessels
2010	10 777	2 422 unrestricted crew* 136 vessels
2011	7 796	2 422 unrestricted crew* 136 vessels
2012	6 392	2 422 unrestricted crew* 136 vessels
2013	2 664	2 422 unrestricted crew* 136 vessels
2014	6 907	TAE or 250 000 person days
2015	6 479	TAE or 250 000 person days
2016	9 952	TAE or 250 000 person days
2017	11 919	TAE or 270 000 person days
2018	13 444	TAE or 270 000 person days
2019	6 689	TAE or 295 000 person days

*Unrestricted permits applied to Right Holders who were not restricted to fishing in any particular area, whereas restricted permits applied to Right Holders who were only allowed to fish off the former Ciskei (in the Eastern Cape Province). Restricted permits were eventually phased out of the fishery from 2006.

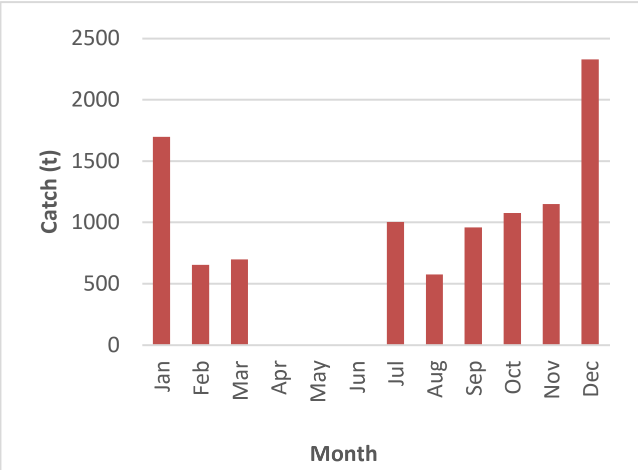


Figure 3.50: Monthly catches of chokka squid reported by the jig fishery (2017 – 2019).

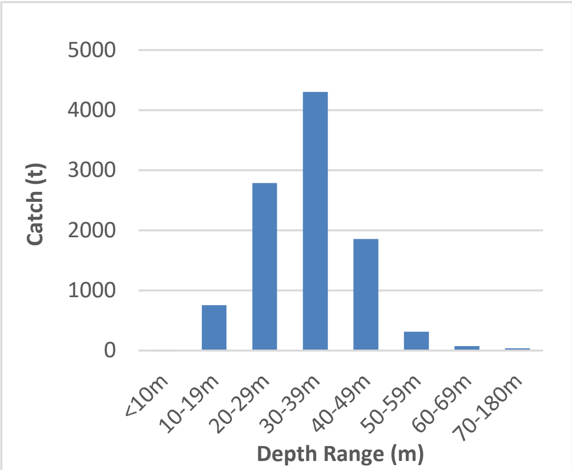


Figure 3.51: Distribution of chokka squid catch by water depth (2017 – 2019).

Figures 3.53 shows the spatial distribution of squid jig fishing areas in relation to the licence block and proposed drilling area. The licence block does not coincide with favoured fishing grounds on the South and South-East coast; however, prior to 2016, sporadic fishing activity was reported off the South-West coast within the licence block.

Over the period 2012 to 2015, 12 tonnes per annum were reported within the licence block. This amounts to 0.17% of the overall landings by the sector during this period. Since 2016, there has been no catch reported within the licence block or the Area of Interest for proposed drilling.

There is no overlap of fishing grounds with the estimated zone of noise disturbance (5 km) which is situated approximately 100 km from the closest expected fishing activity.

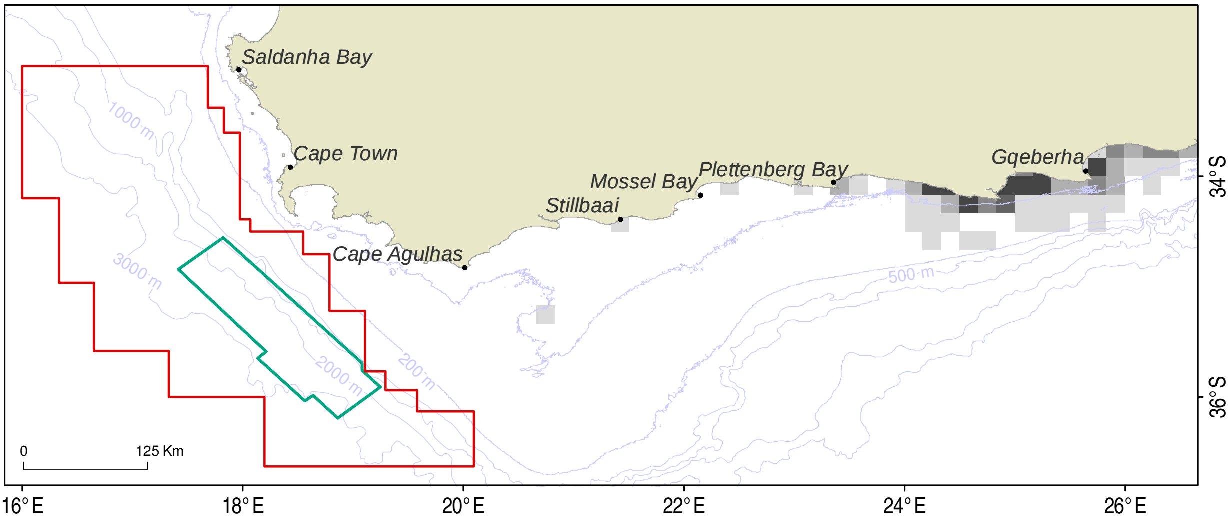


Figure 3.52: Spatial distribution of catch taken by the squid jig fishery (2016 – 2020) in relation to the licence block and the area of interest for proposed drilling.

3.4.12 WHITE MUSSELS

White mussels of the species *Donax serra* are found in the intertidal zone of sandy beaches ranging from northern Namibia to the Eastern Cape of South Africa. Their abundance is highest along the West Coast because of the higher plankton production in that area, compared with the rest of the South African coast, which is associated with upwelling of the Benguela Current.

The fishery for white mussels started in the late 1960s as part of the general commercial bait fishery and was suspended in 1988 when the bait Rights were revoked. Subsequent to stock assessments conducted in 1988/1989, harvesting of white mussels was retained as a commercial fishing sector and limited to seven areas along the West Coast (Figure 3.54), the closest of which (between Melkbos and Bokpunt) is located between 107 km and 118 km to the north-east of the Area if Interest for proposed drilling.

Surveys conducted in the 1990s showed that commercial catches amounted to less than 1% of the standing biomass in the relevant areas and the stock is therefore considered to be under-exploited.

Prior to 2007, each Right Holder was limited to a monthly maximum catch of 2 000 mussels. However, data from the fishery were unreliable, due to under-reporting and difficulties with catch monitoring, and hence catch limits were not considered to be an adequate regulatory tool to manage this fishery. As of October 2006, the monthly catch limit was lifted. Since 2007 the commercial sector has been managed by means of a total allowable effort (TAE) allocation of seven Right Holders (a Right Holder may have up to seven “pickers”), each harvesting within only one of the seven fishing areas along the West Coast. In 2013, the fishing Rights allocation process (FRAP 2013) for this fishery started and new Rights were granted in addition to those of some of the previous Right Holders. After an appeal process, 26 commercial Rights were confirmed in 2015, until December 2020. In August 2019, it was announced that the FRAP 2020 process would be extended to December 2021 and is currently ongoing. Each Right Holder was allocated a specific number of pickers. The Interim Relief sector was started in 2007 to authorize exemption to harvest certain species[9] until the small-scale policy has been finalized. During the 2013/2014 season, 1 995 Interim Relief permits were issued for the Western and Northern Cape combined. This sector is subject to a limit of 50 mussels per person per day. The recreational sector is also limited by a daily bag limit of 50 mussels per person per day. For all sectors, a minimum legal size of 35 mm applies.

In the decades preceding the 1990s, commercial catches declined continuously. The lifting of the commercial upper catch limit in 2006 led to a steep increase in the number of white mussels collected by this sector over the last few years (Figure 3.55). In addition, the development of a bait market in Namibia in recent years has created a greater demand for the resource. Recently, CPUE has remained relatively stable overall at between 300 and 500 mussels per hour harvested (Figure 3.56).

It should be noted that not all the areas allocated are being harvested, and that the largest component of the overall catch of white mussels is that of the recreational sector, but these catches are not monitored. There are also information gaps regarding the level of exploitation by Interim Relief harvesters and the levels of illegal take. On account of irregularities, and despite the improvement post-2006, the catch-and-effort data are still considered to be unreliable. Refer to Table 3.15 for recent (2018) monthly harvest of white mussels by area.

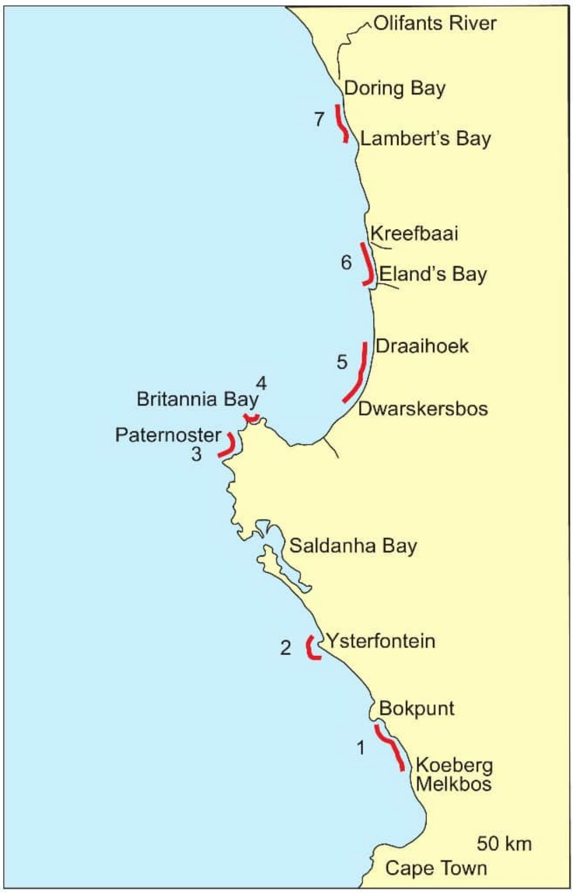


Figure 3.53: Areas allocated for commercial harvesting of white mussel, *D. serra*, along the West Coast of South Africa (DEFF, 2020).

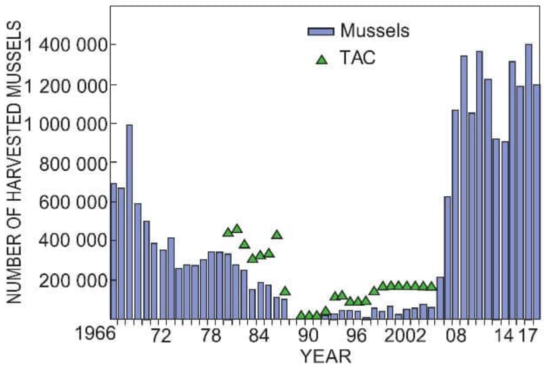


Figure 3.54: TAC and yield (total number) of white mussels harvested commercially per annum, 1966 – 2018.

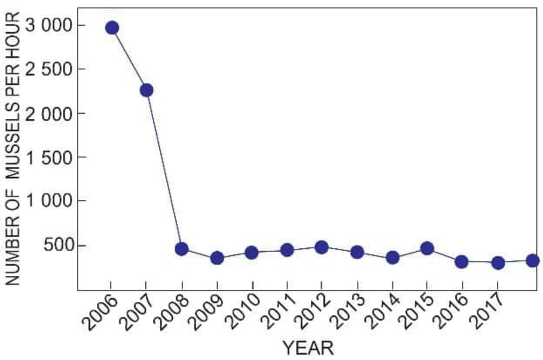


Figure 3.55: CPUE data for mussels harvested commercially from 2006 to 2018.

[9] Applicable to west coast rock lobster (nearshore), line fish, white mussels and red bait.

Table 3.15: Monthly harvest of white mussels by area during 2018 (DEFF, 2020).

AREA	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
Elands Bay	44500	35000	25000	15500	0	0	0	12750	19750	20000	17000	21000	210500
Britannia Bay	-	-	-	-	-	-	-	-	-	-	-	-	-
Paternoster	142955	184805	67540	35500	35250	0	24255	18792	37251	11680	61190	105620	724838
Yzerfontein	44179	26506	32452	2540	5600	6691	14022	12556	26213	33878	25147	26988	256772
Bokpunt	-	-	-	-	-	-	-	-	-	-	-	-	-
Dwarskersbos	1950	2440	-	0	0	0	0	500	0	1050	0	3199	9139
Lamberts Bay	-	-	-	-	-	-	-	-	-	-	-	-	-
											TOTAL		1201249

3.4.13 OYSTERS

The Cape rock oyster (*Striostrea margaritacea*) occurs on rocky reefs from Cape Agulhas to Mozambique and is targeted by the fishery along with smaller amounts of *Crassostrea gigas.* The harvesting of oysters is managed by DEFF within four broad areas namely, Southern Cape, Gqeberha, KwaZulu-Natal (KZN) North and KZN South. The number of oysters harvested from the Southern Cape and KZN areas is shown for the period 1972 to 2017 in Figure 3.57 and recent landings (2013 – 2018) are listed in Table 3.16. The coastal locations of boundaries between management zones for the Southern Cape area are shown in Figure 3.58.

Shore-based collectors pry oysters off rocks and sell the oysters locally. Harvesting takes place during spring low tides from the intertidal zone and shallow subtidal rocky reefs and areas of operation can be considered to extend from the shoreline to the 10 m depth contour. DEFF proposes that oysters will be reclassified as a small-scale fishing species and that, from 2021, will be managed under the small-scale fisheries sector (DEFF 2020).

Total catch in the Southern Cape region was at least 373 306 oysters in 2018. In 2019, there were 73 individuals listed with commercial rights to harvest oysters and these rights were due to expire on 31 December 2020. From 01 January 2021 the sector was re-classified under the small-scale fisheries sector. Most oyster pickers sell to middlemen who in turn sell to local restaurants. However, some of the catch is sold directly to the public on the beach. The fishery is managed using total applied effort (TAE) based on the catch returns received. Due to the uncertain status of the resource, and evidence of over-exploitation in the Southern Cape, this region has been prioritised for research efforts aimed at establishing indices of abundance, estimating density and population size structure, and determining a more accurate TAE. The number of pickers is limited based on the TAE and a daily bag limit of 190 oysters applies in KZN. A rotational harvesting system is implemented in KZN, whereby the north and south coast are each divided into four zones. Harvesting is limited to only one zone on the north coast and one zone on the south coast for a period of one year, affording each zone a fallow period of three years. The change over to a new zone occurs on the 1st of November of every year, which is the start of the peak oyster breeding season in KZN and thus, promotes the recovery of the exploited oyster beds (Schleyer 1988). Oysters are broadcast spawners and those along the KZN coast spawn throughout the year, with peaks during spring and summer.

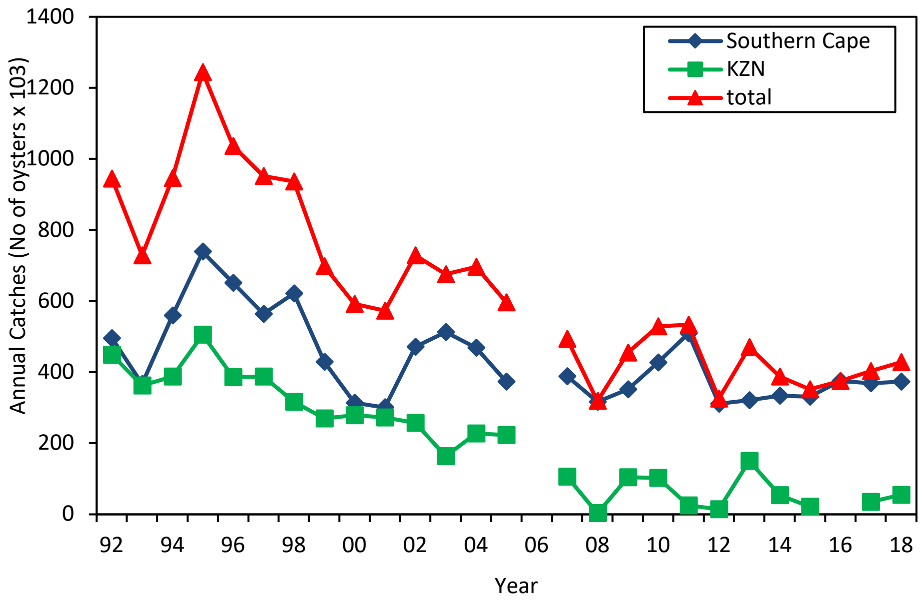


Figure 3.56: Total number of oysters (*Striostrea margaritacea; Crassostrea gigas*) harvested from the Southern Cape and KwaZulu-Natal coasts from 1992 to 2018 (DEFF, 2020).

Table 3.16: Annual oyster landings (2013 – 2018)

Year	Southern Cape and Gqeberha		KwaZulu-Natal	
	TAE	Catch	TAE	Catch
2013	105	320 312	40	149 863
2014	105	327 120	40	52 620
2015	105	330 392	40	20 833
2016	105	374 698	40	-
2017	105	368 270	40	34 171
2018	105	373 306	40	54 131

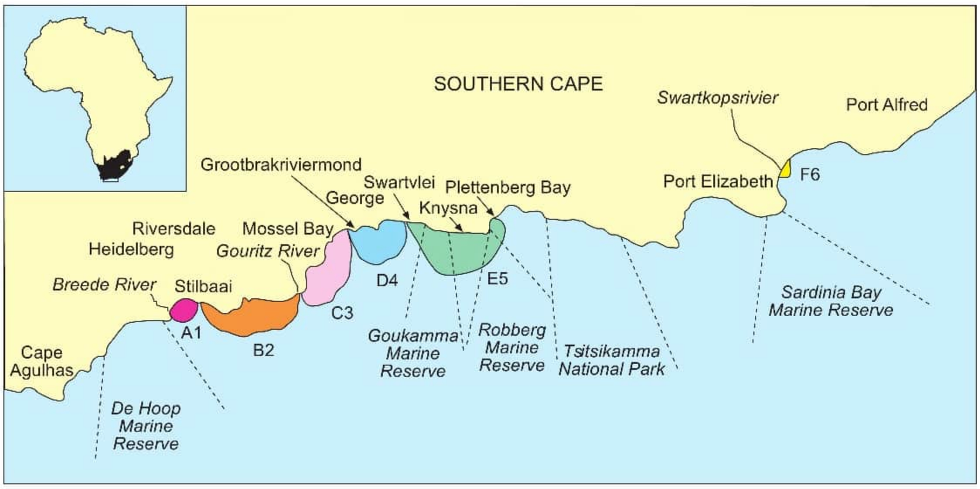


Figure 3.57: Oyster fishery in Gqeberha and the Southern Cape. Colour areas denote dedicated oyster collection zones (DEFF, 2020)

3.4.14 ABALONE

Abalone (*Haliotis midae*) are widely distributed around the South African coastline, from St Helena Bay on the West Coast to just north of Port St Johns on the East Coast. Once a lucrative commercial fishery, earning up to approximately R100 million annually at the turn of the century, rampant illegal harvesting[10] and continued declines in the abundance[11] of the resource resulted in the prohibition of recreational harvesting since 2003/4 and a total closure of the commercial fishery during the 2008/9 season. In 2010 the commercial fishery was reopened with an annual quota of 150 tons; however, this was reduced in 2013/14 to 96 tons and further reduced in 2019/2020 to 50.5 tons (refer to Table 3.17 and Figure 3.59). Estimated weight and number of illegally-harvested abalone for the years 2000–2020 is shown in Figure 3.60.

Currently the fishery is commercial, however, DFFE proposes that 50% of the TAC be apportioned to small-scale fisheries, from 2021 (DEFF Government Gazette No. 1129, 23 October 2020).

Landings of abalone (kg), effort (hours) and catch per unit effort (CPUE) are managed by harvesting area (zones A to G – refer to Figure 3.61). Refer to Table 3.18 for TACs and landings by management zone for 2016/17. Wild abalone may only be harvested by quota holders and is harvested by divers during specified harvesting seasons. The collection range is assumed to be from the coastline to 20 m depth contour, thus well inshore of the licence block and Area of Interest for proposed drilling.

In order to sustain and protect wild populations of abalone, they are bred in abalone farms along the South African coast. Land-based flow-through systems (also referred to as raceways) using pumped seawater are the most common abalone farming systems used in South Africa (refer to section 3.4.19). However, ocean-based abalone farming is also done in four designated areas in the Northern Cape. This is called 'ranching' (refer to section 3.4.15). Today there are 18 abalone farms along the South African coast, from Saldanha in the West Coast and along the South Coast up to the East Coast.

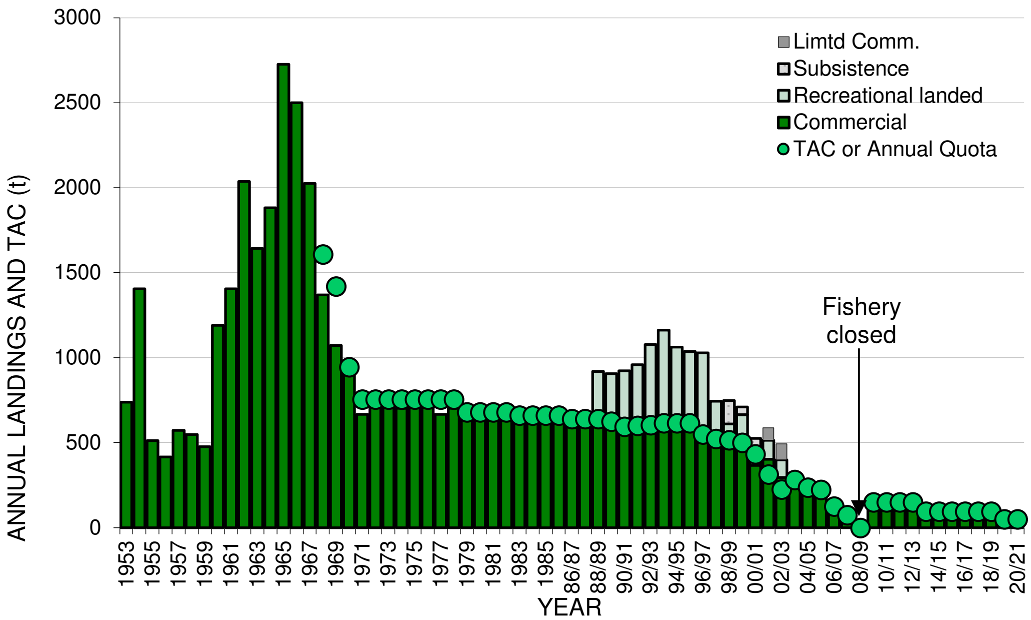


Figure 3.58: TAC and recorded (legal) annual landings for the abalone fishery from 1953 to 2020/21. Landings for the recreational sector are only available since 1988/89. Note that the substantial illegal catches are not shown.

[10] The bulk of illegally harvested abalone is transported to Asia, through channels in Hong Kong.
[11] The resource has been affected by an ecosystem shift that was brought about by the migration of West Coast rock lobster into two of the main, most productive abalone fishing areas.

Table 3.17: Total Allowable Catches (TACs) and catches for the abalone fishery.

Season	TAC (t)	Total commercial catch (t)	Total recreational catch (t)
1993/94	615	613	549
1994/95	615	616	446
1995/96	615	614	423
1996/97	550	537	429
1997/98	523	523	221
1998/99	515	482	127
1999/00	500	490	174
2000/01	433	368	95
2001/02	314	403	110
2002/03	226	296	102
2003/04	282	258	0
2004/05	237	204	0
2005/06	223	212	0
2006/07	125	110	0
2007/08	75	74	0
2008/09	0	0	0
2009/10	150	150	0
2010/11	150	152	0
2011/12	150	145	0
2012/13	150	* 0	0
2013/14	96	95	0
2014/15	96	95	0
2015/16	96	98	0
2016/17	96	89	0
2017/18	96	87	0
2018/19	96	53	0

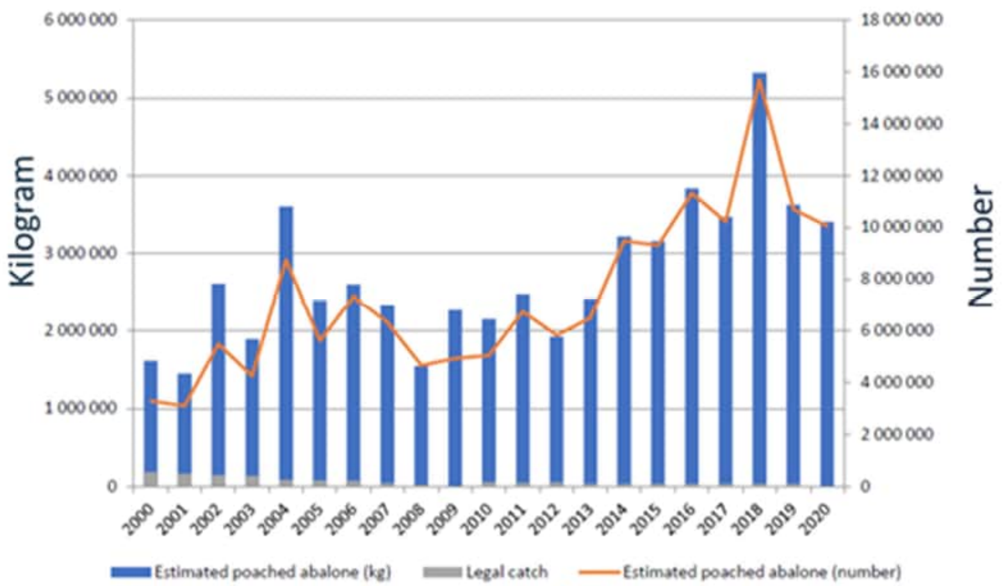


Figure 3.59: Estimated weight and number of illegally-harvested abalone based on international trade data, and recorded legal abalone catch (weight) for the years 2000–2020.

Figure 3.60: Abalone fishing Zones A to G, including sub-zones, and distribution of abalone (insert). The experimental fisheries (2010/11-2013/14) on the western and eastern sides of False Bay and in the Eastern Cape are also shown. These areas within False Bay, included in the commercial fishery recommendations for 2017/18, are referred to as Sub-zone E3 and Sub-zone D3 (DEFF, 2020)

Table 3.18: Abalone TACs and catch by zone (2016/17)

TAC (t)	Zone	Abalone (No.)	Weight (t)
25	A	33 268	26.5
25	B	35 363	28.4
0	C	0	0
0	D	0	0
12	E	12 220	11.4
16	F	12 935	10.9
18	G	15 900	12.5
96	TOTAL	109686	89.6

3.4.15 ABALONE RANCHING

The Abalone *Haliotus midae*, is endemic to South Africa and referred to locally as “perlemoen”. The natural population extends along 1500 km of coastline east from St Helena Bay in the Western Cape to Port St Johns on the east coast (Branch *et al*. 2010; Troell et al 2006). *H. midae* inhabits intertidal and subtidal rocky reefs, with the highest densities found in kelp forests (Branch et al., 2010). Kelp forests are a key habitat for abalone, as they provide a source of food and ideal ecosystem for abalone’s life cycle (Branch *et al*., 2010). Light is a limiting factor for kelp beds, which are therefore limited to depths of 10m on the Namaqualand coast (Anchor Environmental, 2012). Habitat preferences change as abalone develop. Larvae settle on encrusted coralline substrate and feed on benthic diatoms and bacteria (Shepherd and Turner, 1985). Juveniles of 3-10 mm are almost entirely dependent on sea urchins for their survival, beneath which they conceal themselves from predators such as the West Coast rock lobster (Sweijd, 2008; Tarr et al., 1996). Juveniles may remain under sea urchins until they reach 21-35 mm in size, after which they move to rocky crevices in the reef. Adult abalone remain concealed in crevices, emerging nocturnally to feed on kelp fronds and red algae (Branch *et al*., 2010). In the wild, abalone may take 30 years to reach full size of 200 mm, but farmed abalone attain 100 mm in only 5 years, which is the maximum harvest size (Sales & Britz, 2001).

South Africa is the largest producer of abalone outside of Asia (Troell *et al*., 2006). For example, in 2001, 12 abalone farms existed, generating US$12 million at volumes of 500-800 tonnes per annum (Sales & Britz, 2001). By 2006, this number had almost doubled, with 22 permits granted and 5 more being scheduled for development (Troell et al., 2006). Until recently, abalone cultivation has been primarily onshore, but abalone ranching provides more cost effective opportunities for production (Anchor Environmental, 2012). Abalone ranching is “where hatchery-produced seed are stocked into kelp beds outside the natural distribution” (Troell *et al*., 2006). Translocation of abalone occurs along roughly 50 km of the Namaqualand coast in the Northern Cape due to the seeding of areas using cultured spat specifically for seeding of abalone in designated ranching areas (Anchor Environmental, 2012). The potential to increase this seeded area to 175 km has been made possible through the issuing of “Abalone Ranching Rights” (Government Gazette, 20 August 2010 No. 729) in four concession zones for abalone ranching between Alexander Bay and Hondeklipbaai (Diamond Coast Abalone 2016).

Abalone ranching was pioneered by Port Nolloth Sea Farms who were experimentally seeding kelp beds in Port Nolloth by 2000. Abalone ranching expanded in the area in 2013 when DAFF issued rights for each of four Concession Area Zones. Abalone ranching includes the spawning, larval development, seeding and harvest. An onshore hatchery supports the ranching in the adjacent sea (Anchor Environmental, 2012). Two hatcheries exist in Port Nolloth producing up to 250 000 spat. To date, there has been no seeding in Zones 1 or 2. Seeding has taken place in Zones 3 and 4.

The licence block is situated 280 km south of ranching zone 4 (refer to Figure 3.62). The maximum depth of seeding is considered to be approximately 10 m within each of the zones.

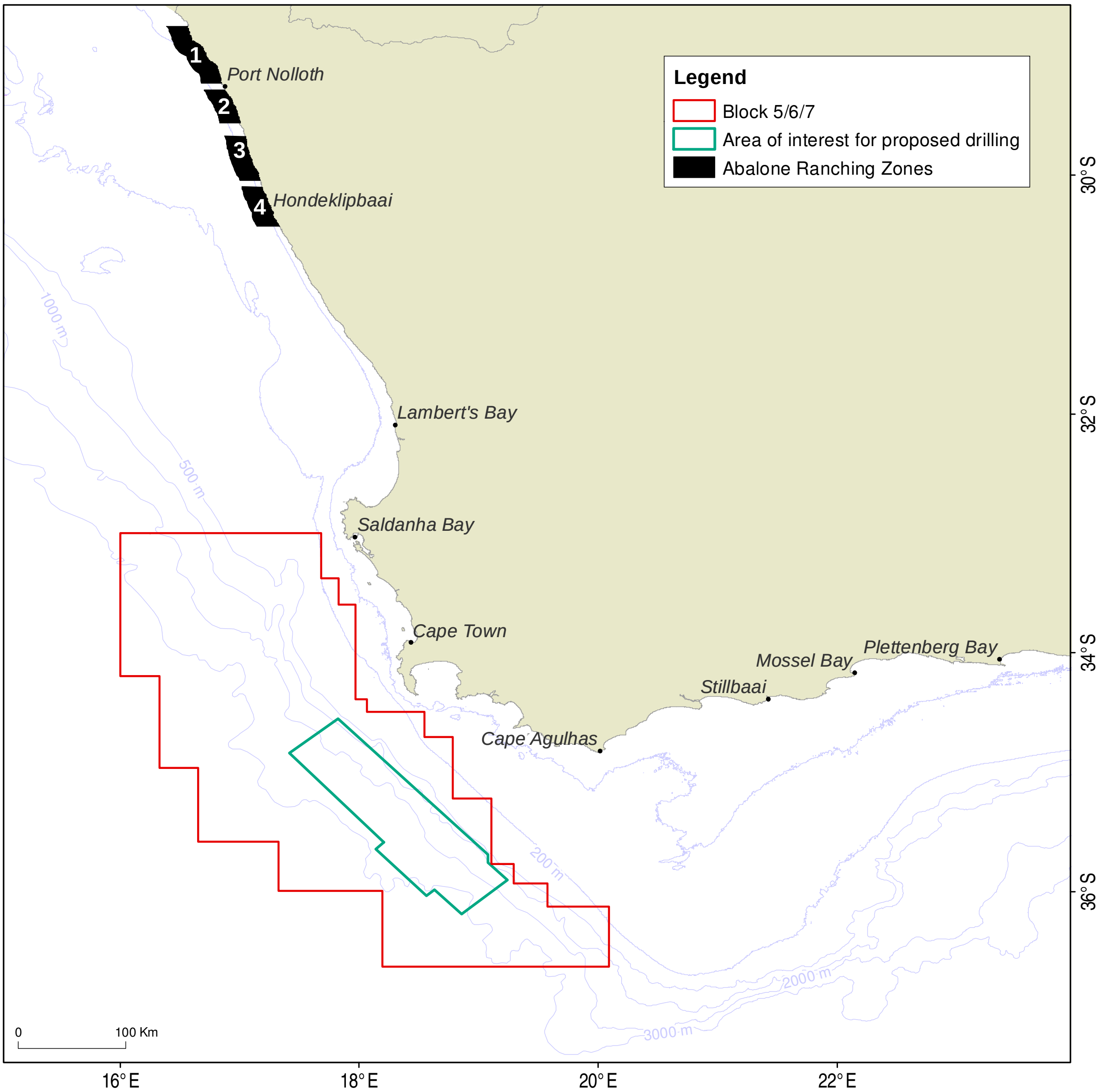


Figure 3.61: An overview of the spatial distribution of abalone ranching concession areas 1 – 4 in relation to the licence block and the area of interest for proposed drilling.

3.4.17 BEACH-SEINE AND GILLNET FISHERIES ("NETFISH" SECTOR)

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 3.19 for the number of rights issued and Figure 3.63 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 (DAFF, 2021). 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 3.19: 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

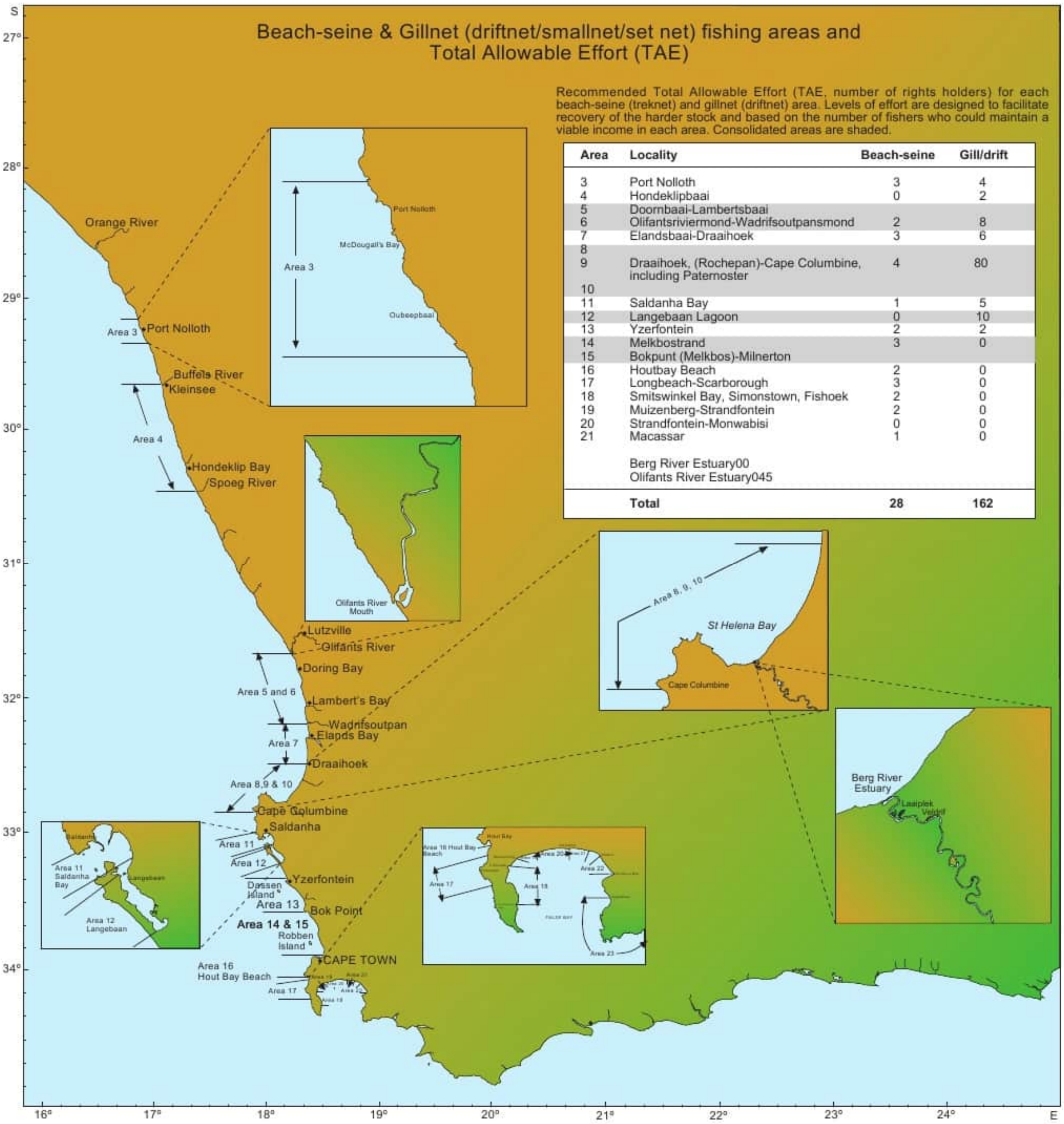


Figure 3.62: Beach-seine and gillnet fishing management areas and TAE (DAFF, 2014)

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 the licence block or the Area of Interest for proposed drilling. Figure 3.64 shows the expected range of gillnet fishing activity off the west coast of South Africa. There is no overlap of fishing grounds with the estimated zone of noise disturbance (5 km) which is situated at least 54 km offshore of the closest expected fishing activity.

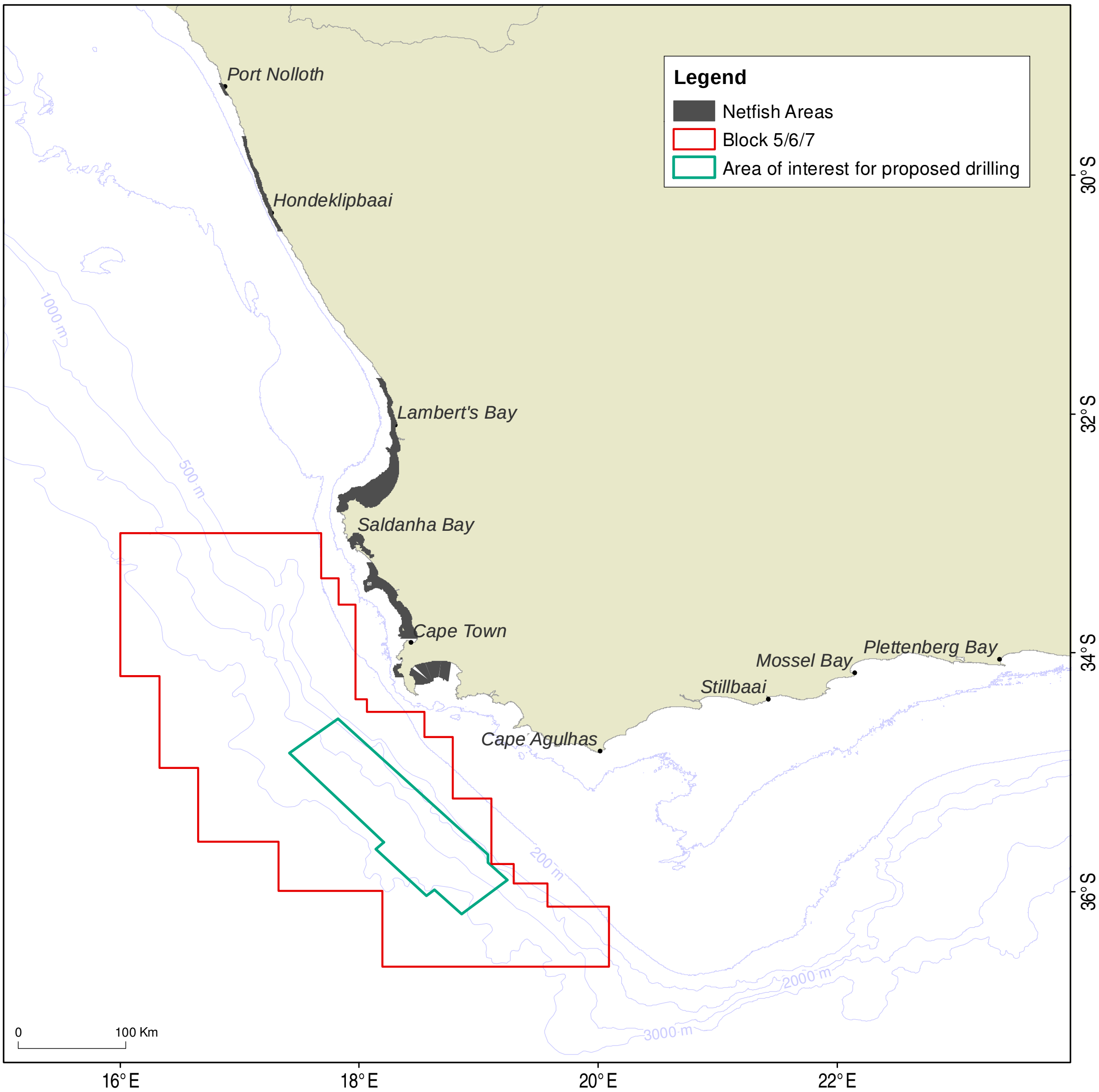


Figure 3.63: Netfish (gillnet and beach-seine) management areas (DAFF, 2016/17)

3.4.18 SEAWEED

The South African seaweed industry is based on the commercial collection of kelps (*Ecklonia maxima* and *Laminaria pallida*) and red seaweed (*Gelidium* spp.) as well as small quantities of several other species. In the Northern and Western Cape, the industry is currently based on the collection of beach-cast kelps and harvesting of fresh kelps. Beach-cast red seaweeds were collected in Saldanha Bay and

St Helena Bay, but there has been no commercial activity there since 2007. *Gelidium* species are harvested in the Eastern Cape (DAFF, 2014a).

The seaweed sector employs approximately 1 700 people, 92% of whom are historically disadvantaged persons. Much of the harvest is sun-dried, milled and exported for the extraction of alginate. Fresh kelp is also harvested in large quantities in the Western Cape as feed for farmed abalone. This resource, with a market value of about R6 million is critically important to local abalone farmers. Fresh kelp is also harvested for high-value plant-growth stimulants that are marketed locally and internationally.

Harvesting rights are issued by management area. Whilst the Minister annually sets both a TAC and TAE for the sector, the principle management tool is effort control and the number of right holders in each seaweed harvesting area is restricted. Fourteen commercial seaweed harvesting rights are currently allocated and each concession area is limited to one right-holder for each functional group of seaweed (e.g. kelps, *Gelidium* spp. and Gracilarioids). In certain areas there are also limitations placed on the amounts that may be harvested. The South African coastline is divided between the Orange River and Port St Johns into 23 seaweed Rights areas (Figure 3.65). Annual yields of commercial seaweeds in South Africa from 2001 to 2018 are listed in Table 3.20. Table 3.21 lists the yield of kelp by area for the 2018 season).

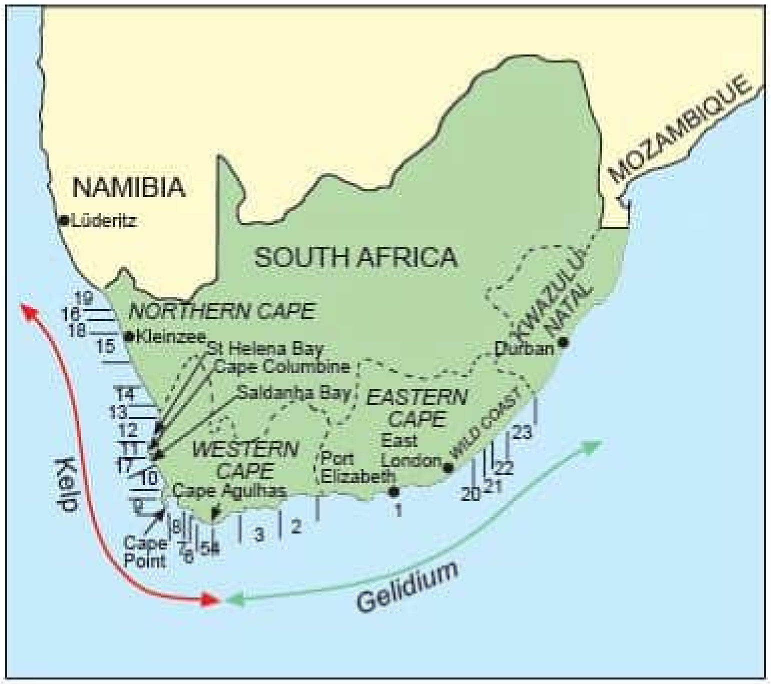


Figure 3.64: Map of seaweed rights areas in South Africa (DEFF, 2020).

Permit conditions stipulate that beach cast kelp may be collected by hand within these management areas and that kelp may be harvested using a diver deployed from a boat or the shore. Over the period 2000 to 2017, an average of 4560 tonnes per annum of dry harvested kelp (beach cast) and 367 tonnes per annum of wet harvested kelp were reported within collection areas 5 to 11. An additional 1397 tonnes per annum of kelp was harvested for KELPAK (fertilizer). Amounts harvested within these collection areas amounts to approximately 98.5% of the total kelp harvests, nationally.

Table 3.20: Annual yields of commercial seaweeds in South Africa (2001 – 2018). "Kelp beach cast' refers to material that is collected in a semi-dry state, whereas 'kelp fresh beach cast' refers to clean, wet kelp fronds that, together with 'kelp fronds harvest', are supplied as abalone feed (DEFF, 2020).

Year	*Gelidium* (kg dry weight)	Gracilarioids (kg dry weight)	Kelp beach cast (kg dry weight)	Kelp fronds harvest (kg fresh weight)	Kelp fresh beach cast (kg fresh weight)	Kelpak (kg fresh weight)
2001	144 997	247 900	845 233	5 924 489	0	641 375
2002	137 766	65 461	745 773	5 334 474	0	701 270
2003	113 869	92 215	1 102 384	4 050 654	1 866 344	957 063
2004	119 143	157 161	1 874 654	3 119 579	1 235 153	1 168 703
2005	84 885	19 382	590 691	3 508 269	126 894	1 089 565
2006	104 456	50 370	440 632	3 602 410	242 798	918 365
2007	95 606	600	580 806	4 795 381	510 326	1 224 310
2008	120 247	0	550 496	5 060 148	369 131	809 862
2009	115 502	0	606 709	4 762 626	346 685	1 232 760
2010	103 903	0	696 811	5 336 503	205 707	1 264 739
2011	102 240	0	435 768	6 023 935	249 651	1 617 915
2012	108 060	0	1 063 233	6 092 258	1 396 227	1 788 881
2013	106 182	0	564 919	5 584 856	253 033	2 127 659
2014	75 900	0	775 625	4 555 704	244 262	1 610 023
2015	95 200	0	389 202	3 974 100	249 014	1 930 654
2016	102 500	0	411 820	4 044 759	100 018	2 166 293
2017	102 802	0	482 082	3 254 561	63 276	3 001 611
2018	89 253	0	540 498	4 803 358	552 691	1 886 691

Table 3.21: Maximum sustainable yield of harvested kelp for all areas for the 2018 season (1 March 2018 – 28 February 2019). Source DEFF, 2020.

Area Number	Whole kelp (t fresh weight)	Kelp fronds (t fresh weight)
5	0	2 625
6	174	4 679
7	1 421	710
8	2 048	1 024
9	2 060	2 080
10	188	94
11	3 085	1 543
12	50	25
13	113	57
14	620	310
15	2 200	1 100
16	620	310
18	2 928	1 464
19	765	383
Total	18 371	16 404

The Area of Interest for proposed drilling lies offshore of Kelp collection areas 5 – 11 (Figure 3.66). Permit conditions stipulate that within this area kelp may be harvested using a diver deployed from a boat or the shore but is not expected to coincide with the depth range at which divers could harvest kelp. No kelp plants with a stipe less than 50 cm long may be cut or harmed. Beach cast plants may be collected by hand. The harvesting areas are therefore not expected to coincide with the licence area, which lies beyond the depth range at which divers could harvest kelp.

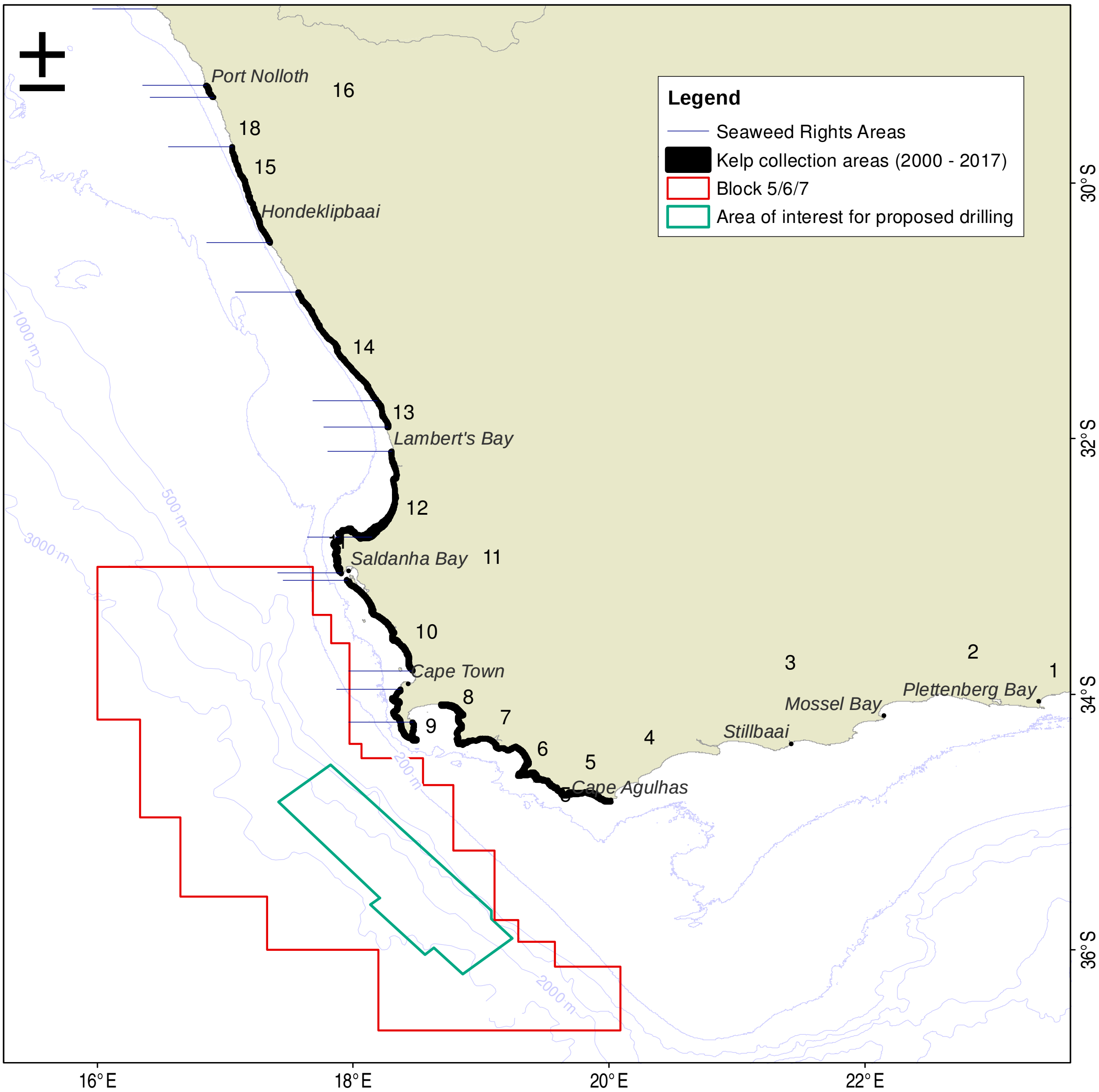


Figure 3.65: Location of seaweed rights areas (numbered) and kelp collection areas in relation to the licence block and area of interest for proposed drilling.

3.4.19 MARICULTURE

In support of the Government's Operation Phakisa to implement the National Development Goals and boost economic growth, a Strategic Environmental Assessment (SEA) was undertaken in 2019 (CSIR, 2019) for the purpose of identifying and assessing aquaculture development zones (ADZs) to streamline and accelerate authorisation of aquaculture projects. Eight ADZs were proposed around South Africa's coastline of which four are located in the Wesrten Cape Province: Strandfontein-Lamberts Bay, Velddrif-Saldanha, Hermanus-Arniston, and George-Gouritz zones (Figure 3.67). The Velddrif-Saldanha and Hermanus-Arniston zones are the closest ADZs to Block 5/6/7.

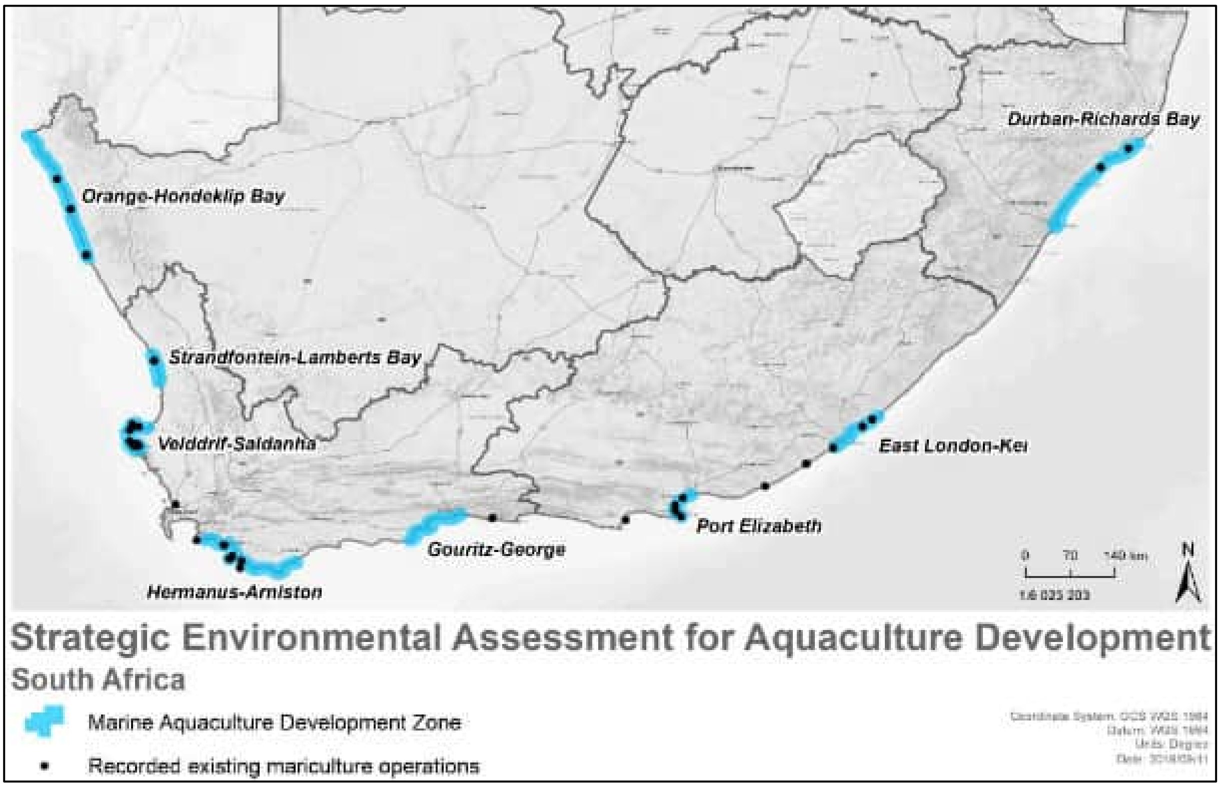


Figure 3.66: Proposed Marine Aquaculture Development Zones and existing mariculture operations.

Currently, 39 marine aquaculture farms operate in South Africa, most of them are experimental or of a small-scale commercial nature. There are 30 marine aquaculture farms operating in the Western Cape Province. Western Cape mariculture is composed of four sub-sectors namely abalone (13) finfish (2), oysters (4) and mussels (11), several farms produce multiple products (DFFE, 2019) – refer to Figure 3.69.

In 2018, the Western Cape Province recorded a production of 3701.5 tons and was the main contributor of the total marine aquaculture production in South Africa. In the Western Cape the mussel sub-sector was the highest contributor recording a production of 2182.1 tons, followed by the abalone sub-sector recording a total production of 1208.2 tons, the oyster sub-sector recorded a total production of 282.7 tons and finfish sub-sector recorded the lowest production of 28.5 tons (DFFE, 2019). It is expected that the scale of production at individual farms will increase over time along with the number of farms and the variety of products within the ADZ's, particularly of finfish (DFFE, 2019).

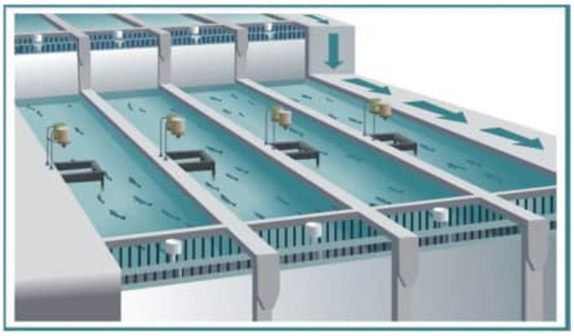
The mussel sub-sector is the highest biomass contributor to aquaculture in South Africa. The sub-sector is entirely represented by the Western Cape Province with eight longline culture operations and three raft culture operations. The species cultured in South Africa are the exotic Mediterranean mussel (*Mytilus galloprovincialis*) and the indigenous black mussel (*Choromytilus meridionalis*) (DFFE, 2019).

In the Western Cape Province thirteen abalone farms were operational with one farm operating as an abalone hatchery (some also produce seaweed as a by-product). Of the thirteen abalone farms, twelve farms are operating as flow-through operations and one farm is operating as a cage culture operation. The abalone species currently being cultivated in South Africa is the indigenous *Haliotis midae* (DFFE, 2019).

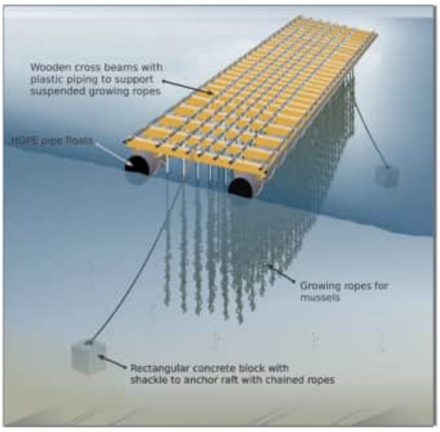
There were four Oyster farms recorded in the Western Cape, which are represented by three longline systems and one raft system. The species cultivated in South Africa is the exotic Pacific oyster (*Crassostrea gigas*) (DFFE, 2019).

Finfish farming of exotic salmonids in the Western Cape Province is represented by two farms; a cage culture system situated in Saldanha Bay and a semi re-circulating aquaculture system (RAS) (DFFE, 2019). Finfish currently farmed include dusky kob and yellowtail and the exotic salmonids (Atlantic salmon, Coho salmon and king salmon).

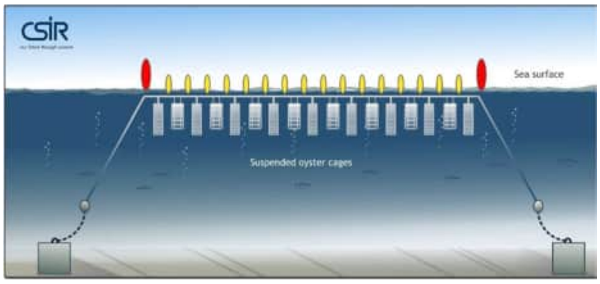
Cage culture involves the placing of cages in oceans to contain and protect the fish until they can be harvested. Finfish cage culture types include nearshore gravity net cages or pens, and open water floating, submersible and/or semi-submersible cages.



Flow-through systems are single-pass production systems where a continuous supply of water from the ocean, a storage reservoir or other water source is channelled via an inlet through tanks, ponds or channels before returning to the environment via an outlet. This system also allows for high density aquaculture production.



Raft culture is a form of suspended culture in which the “on-growing” structures (i.e. ropes) are suspended and submerged beneath a floating raft. Rafts are mostly used for marine shellfish culture, especially mussels.



Longline culture is a form of open-water suspended culture in which species are grown on ropes or in containers such as baskets, stacked trays or lantern nets, which are suspended from anchored and buoyed surface or sub-surface ropes. Longlines are commonly used for the culture of bivalve molluscs including mussels, oysters, clams and scallops, as well as marine macro algae.

Figure 3.67: Schematic diagrams of the types of aquaculture systems a) cage, b) flow-through, c) raft and d) longline.

Aquaculture operations nearest to the Area of Interest for proposed drilling include abalone farms in the Hermanus-Arniston ADZ and abalone, finfish, mussel and oyster farms in the Velddrif-Saldanha ADZ. These are all over 60 km away at their closest point. The estimated zone of noise disturbance (5 km) is situated at least 50 km offshore of the closest expected farming activity.

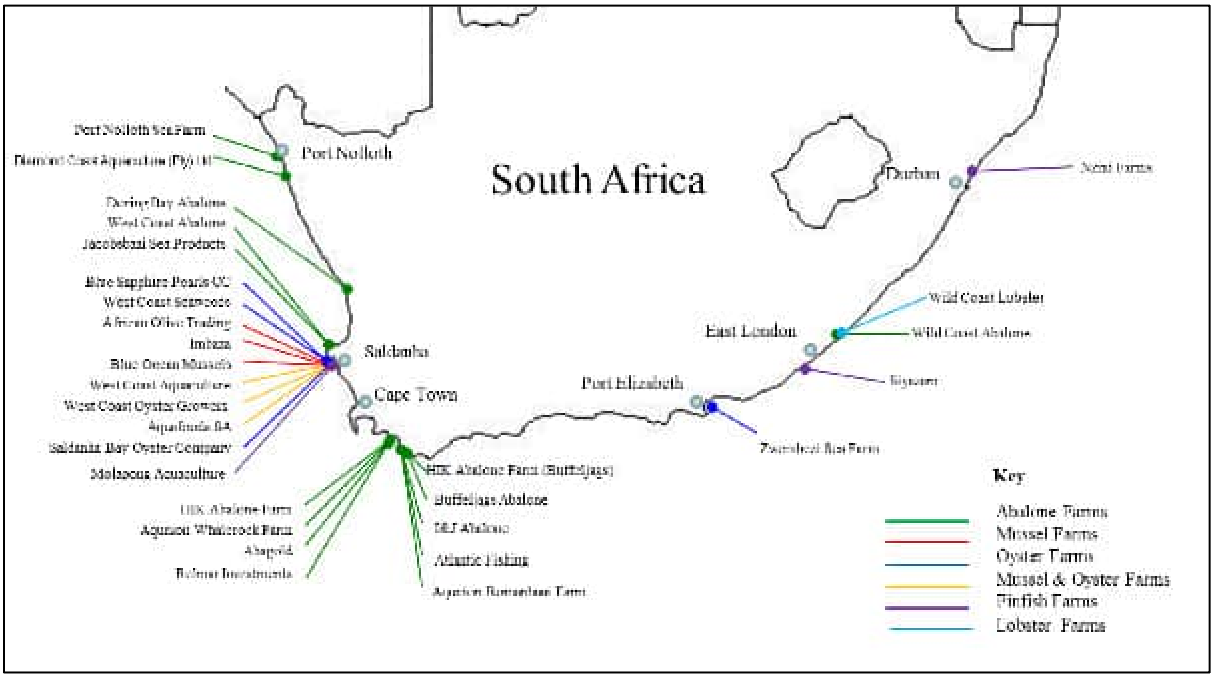


Figure 3.68: Distribution of aquaculture farms along the South African coast.

3.5 SMALL-SCALE FISHERY SECTOR

The concept of Small-Scale Fisheries (SSF) is a relatively new addition to the fisheries complexity in South Africa. The concept has its origin in a global initiative supported by the Food and Agricultural Organisation of the United Nations (FAO). In South Africa, there is a long history of coastal communities utilizing marine resources for various purposes. Many of these communities have been marginalized through apartheid practices and previous fisheries management systems. In 2007 government was compelled through an equality court order to redress the inequalities suffered by these traditional fishers. The development of a SSF sector aims in part to compensate previously disadvantaged fishing communities that have been displaced either politically, economically or by the development of large-scale commercial fisheries. This led to the development of the Small-Scale Fisheries Policy (SSFP), the aim of which is to redress and provide recognition of the rights of small-scale fishers (DAFF, 2015). The SSFP was gazetted in May 2019 under the Marine Living Resources Act, 1998 (Act No. 18 of 1998). It is only now (2021/2022) in an advanced process of implementation. It is a challenging process that has been exacerbated by the conflict and overlap with another fisheries-related process of fishing rights allocations (known as Fishery Rights Allocation Process or “FRAP”). As of August 2022, neither process has been concluded and the issues at stake are highly politicised. The SSF overlaps other historical fisheries in South Africa, leading to legal challenges where the SSF rights allocations are in conflict with other established commercial fishing sectors, most notably the commercial squid fishing sector. SSF is defined as a fishery although specific operations and dynamics are not yet fully defined as they are subject to an ongoing process by DFFE. 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 small-scale 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[12]. 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[13].

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 (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[14].

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[15]. These community co-operatives will be given 15-year small-scale fishing Rights. The criteria to be applied in determining whether a person is a small-scale fisher are that the person must (a) be a South African citizen who associates with or resides in the relevant small-scale fishing community; (b) be at least 18 years of age; (c) historically have been involved in traditional fishing

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[12] 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).

[13] 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.

[14] 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.

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

operations, which include catching, processing or marketing of fish for a cumulative period of at least 10 years; and (d) derive the major part of his or her livelihood from traditional fishing operations and be able to show historical dependence on fish, either directly or in a household context, to meet food and basic livelihoods needs..

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 (refer to Appendix 2 for a comprehensive list). The location of these coastal communities and the number of fishers per community are shown in Figure 3.67. These fishers are generally localised and do not range far beyond the areas in which they live.

- 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. Figure 3.71 shows the location of registered communities, by district municipality.

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[16]. 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 by existing commercial sectors viz; traditional linefish, west coast rock lobster, squid, hake handline[17], 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[18], whereas white mussels will become the exclusive domain of SSF. Species nominated for commercial use will be

[16] 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.

[17] 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".

[18] DFFE proposes that 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).

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. An example of such boats is shown in Figure 3.70.

Figure 3.69: Fishing boats outside the Hondeklipbaai small-scale community co-operative (photo credit Carika van Zyl).

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 South-West Coast of South Africa (refer to Section 3.4.8 for traditional linefish).

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[19]. 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) [20][21] snoek stay inshore on their southward migration (see Figure 3.8) (i.e. April through to June) and then move offshore into deeper waters to

[19] 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.

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

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

spawn[22] in July and August (and are not available to linefishers during these times as the fish are beyond the depth range of surface linefishers).

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 (refer to Section 3.4.9). The harvesting of wild abalone along the South-West Coast is expected to range to a maximum water depth of 20 m (refer to Section 3.3.14). Catches of chokka squid (*Loligo vulgaris reynaudii*) off the South Coast rarely exceed a water depth of 60 m (refer to Section 3.3.11). The collection of oysters (*Striostrea margaritacea*) along the South Coast is confined to intertidal and shallow sub-tidal areas (refer to Section 3.3.13).

The small-scale fisheries off the Northern, Western and Southern Cape coastlines are unlikely to range beyond 20 km from the coastline, thus inshore of the Area of Interest for proposed drilling at its closest point, and at least 15 km inshore of the area of noise disturbance. The small-scale fishery rights cover the nearshore area (defined in section 19 of the MLRA as being within close proximity of shoreline). As, such, SSF are currently not permitted to target albacore tuna as it is not listed in the basket of species for SSF exploitation.

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[23] 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 9m) are likely limited to "C" class being mainly vessels of <9 m[24] permitted to only operate < 15 nm offshore.

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[22] 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).

[23] 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.

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

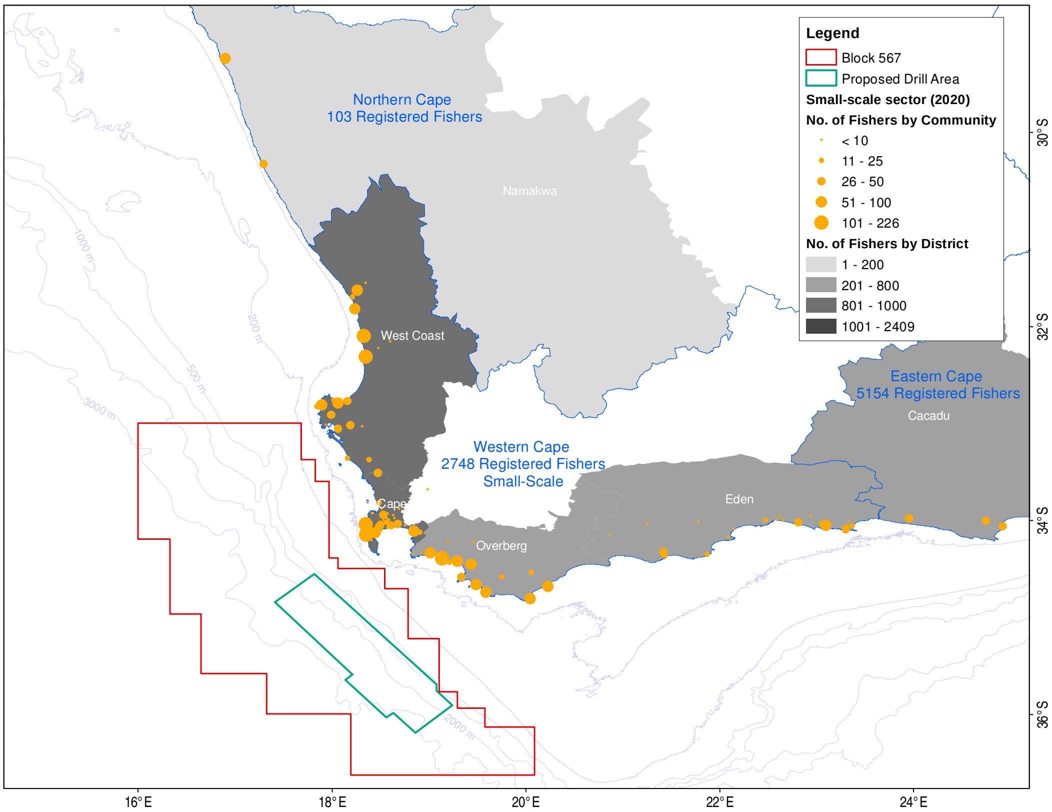


Figure 3.70: Block 5/6/7 and area of interest for proposed drilling in relation to the spatial distribution of small-scale fishing communities and number of participants per community along the west and south coast of South Africa.

3.6 RECREATIONAL FISHING

Recreational fishing is defined as a non-commercial fishery regulated by individual permits obtained by the public. The fishery has by far the largest number of participants (>450 000) of all fishery sectors in South Africa and therefore has great economic value (DFFE, 2020). Estimated 500 000 participants in 1996 (McGrath et al 1997) but more recently Leibold and van Zyl (2008) estimated 900 000 participants in 2007. Less than 6% of anglers are affiliated to angling clubs and organizations (Mann et al. 2013). Moreover, the tourism infrastructure, boats, vehicles, tackle, and bait make the recreational fishery a valuable one, estimated to be more than R9 billion per annum of economic impact. Recreational fishing includes subsets of numerous commercial fisheries such as linefish, west and east coast lobster, spearfishing, squid, crabs and many other species. A recreational fishing permit entitles the holder to catch fish for own use only and not for the purpose of selling or trading fish. The recreational fishery is managed by several output restrictions, such as size and bag limits, closed areas and seasons.

Recreational fishing is extensive around the coast of South Africa and compiles of shore based and boat-based fishing activities. Offshore recreational fishing is dependent on vessel size. Offshore small recreational or pleasure craft are limited by their certification – which varies from Category E (limited to a distance of 1 nautical mile from shore and 15 nautical miles from an approved launch site) to Category C (15 nautical miles offshore), Category B (limited to day or night passages, but within 40 nautical miles of the coastline) to Category A (allowing for extended or ocean passage). Most recreational craft are Category C certified, targeting nearshore marine species, and therefore would not technically be authorised to travel the 32 nautical miles (60 km) to the area of interest for proposed exploration drilling.

Category A and B certified recreational vessels as well as fishing charter operation vessels targeting offshore pelagic species (tuna, dorado, marlin, etc.) with rod-and-reel are known to fish in the area of Block 5/6/7 focusing their effort on the North-eastern boundary between Cape Canyon offshore of Saldanha Bay and Hope Canyon due South of Cape Point., but are unlikely to fish in the area of interest for proposed drilling as they seldom fish offshore of the 1000 m depth contour. These vessels fish seasonally in the above-mentioned areas with the majority of their effort taking place between October and May.

Landings and operational effort from this open-access recreational fishery are not reported nor recorded throughout the region.

3.7 ILLEGAL, UNREPORTED AND UNREGULATED FISHING

In 1977 South Africa first declared its Exclusive Economic Zone (EEZ) out for 200 nautical miles to seaward from the coastal baselines of both South Africa and its possessions in the Southern Ocean, the Marion and Prince Edward Islands. Following the coming into force of the 1982 UNCLOS Convention on 16 November 1994, South Africa passed the Maritime Zones Act 15 of 1994 affirming its rights and obligations to Fisheries, Oil and Gas Exploration and Exploitation as well as Marine Scientific Research within its EEZ.

IUU fishing may include activities conducted by national or foreign vessels in waters under the jurisdiction of a state – without that state's permission or in contravention of that state's laws and regulations. IUU fishing does not only entail the illegal catching of fish, but also relates to the storing, shipping and selling of fish caught illegally. IUU fishing is an international problem faced by many countries. South Africa is vulnerable to illegal fishing since it has a coastline of over 3 000 km and an exclusive economic zone of 1 068 659 km^2. In light of the above South Africa is one of the few countries in the region with the resources to patrol its waters in the effort to stop IUU fishing. The South African Authority strictly regulates fishing activity within its own EEZ and the area is regularly patrolled by a fleet of Offshore Environmental Protection Vessels operated by the department of Forestry, Fisheries and the Environment (DFFE). The South African Navy also patrol offshore regions, whilst the South African Police patrols areas within their jurisdiction (within 24 nm). Legislation also requires all foreign fishing vessels entering the EEZ to apply for an EEZ permit and that all fishing gear be stowed and that the vessel switch on their AIS. This is monitored by the DFFE VMS operations room.

Whilst South Africa experiences difficulties with land-based coastal marine poaching activity, such as abalone and rock-lobster poaching, offshore areas are not considered viable for large scale illegal activity, especially in the area of interest for drilling. Licence Block 567 is located near multiple well established and strictly regulated fisheries, including hake trawl, tuna longline and tuna pole and line fleets that will report any suspicious activity to the authorities.

Considering that the Licence Block is situated predominantly offshore of the continental shelf in water depths exceeding 1000 m, the risk of Illegal, Unreported and Unregulated (IUU) fishing would, most likely, be conducted by offshore Large Scale Tuna Longline Vessels (LSTLVs). If these vessels illegally enter the EEZ, any fishing vessel that is not reporting on its AIS would be regarded with suspicion. Fishing industry operating in the area would report any illegal fishing activity if it were sighted.

3.8 SUMMARY TABLE OF SEASONALITY OF CATCHES

The seasonality of each of the main commercial fishing sectors that operate off the south-west coast (west of 20°E) of South Africa is indicated in Table 3.22 – also presented is the relative intensity of fishing effort on a month-by-month basis.

Table 3.22: Summary table showing seasonal variation in fishing effort expended by fisheries sectors operating in the South African EEZ West of 27° E.

Sector	Targeted species	Probability of Presence in the Area of Interest	Percentage of Activity Within Area of Interest		Regional Fishing Intensity by Month (H = high; M = Low to Moderate; N = None)											
			Effort (%)	Catch (%)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Demersal Trawl	Deepwater hake, shallow-water hake	Possible	0.16	0.27	H	H	H	H	H	H	H	H	H	H	H	H
Midwater Trawl	Cape horse mackerel	Improbable	0	0	H	H	H	H	H	H	H	H	H	H	H	H
Demersal Hake Longline	Hake, kingklip	Possible	0.1	0.12	M	H	H	H	H	H	H	H	H	H	H	H
Demersal shark longline	Shark species	Improbable	0	0	M	M	M	M	M	M	M	M	M	M	M	M
Small Pelagic Purse-Seine	Sardine, anchovy, round herring	Improbable	0	0	M	H	H	H	H	H	H	H	H	H	H	M
Large Pelagic Longline	Tuna species, swordfish and shark species	Probable	7.25	5.79	M	M	M	M	H	H	H	H	H	H	H	M
Tuna Pole-Line	Albacore, snoek	Probable	12.54	13.74	H	H	H	H	H	M	M	M	M	M	H	H
Traditional Linefish	Snoek, hottentot, geelbek, kob, yellowtail	Improbable	0	0	H	M	M	M	M	M	M	M	M	M	M	H
West Coast Rock Lobster	West Coast Rock Lobster	Improbable	0	0	M	M	M	M	M	M	M	M	N	M	M	M
South Coast Rock Lobster	South Coast Rock Lobster	Improbable	0	0	H	H	H	H	H	M	M	M	M	H	H	H
Squid Jig	Squid/chokka	Improbable	0	0	H	H	M	N	N	N	M	M	M	N	N	H
Small-scale	Hake, monkfish, kingklip, snoek, oysters, squid	Improbable	0	0	M	M	M	M	M	M	M	M	M	M	M	M
Netfish	Mullet, St Joseph shark, (bycatch species such as galjoen, yellowtail, white steenbras	Improbable	0	0	M	M	M	H	H	H	M	M	M	M	M	M
Mariculture	Oysters, mussels, abalone, finfish	Improbable	0	0	M	M	M	M	M	M	M	M	M	M	M	M
Demersal Research Survey	Demersal species	Possible	0	0	M	M	N	N	M	M	N	N	M	M	N	N
Pelagic Research Survey	Small pelagic species	Possible	0	0	N	N	M	M	M	M	N	N	N	M	M	N

4 IMPACT ASSESSMENT

4.1 DRILLING AND PLACEMENT OF INFRASTRUCTURE ON THE SEAFLOOR

Source of Impact

The project activities likely to result in exclusion of fishing operations are listed below:

Planned Activities (Normal Operation)	
Activity Phase	Activity
Operation	Operation of drilling unit at the drill site
Demobilisation	Abandonment of wellhead on seabed and placement of an over trawlable cap over wellhead

TEEPSA is proposing to possibly drill up to five exploration wells in the proposed area of interest for drilling within Block 5/6/7. Drilling is expected to take up to three to four months to complete the physical drilling and testing of each well. It is anticipated that future drilling operations would be undertaken throughout the year and not be limited to a specific seasonal window period. A drilling unit is considered to be an “offshore installation” and during drilling, there would be a minimum safety zone of 500 m around drilling unit (0.79 km^2). All unauthorised vessels would be excluded from entering this safety zone.

Once drilling and logging are completed, the exploration well(s) will be sealed with cement plugs, tested for integrity and abandoned according to international best practices. The intention is to abandon the wellheads on the seafloor in waters deeper than 750 m if deemed safe to do so based on a risk assessment. Where it is deemed to be safe, the wellhead will be left and fitted with an over-trawlable abandonment cap. The dimensions of the cap are estimated to measure approximately 5.2 m x 5.2 m, with a height of 4.4 m. In accordance with the Marine Traffic Act, 1981 seafloor infrastructure or any appliance used for the exploration or exploitation of the seabed is protected by a 500 m safety zone therefore no anchoring or trawling would be permitted within a radius of 500 m of the wellhead[25].

4.1.1 EXCLUSION FROM FISHING GROUND DUE TO TEMPORARY SAFETY ZONE AROUND DRILLING UNIT

Potential Impact Description

All unauthorised vessels would be excluded from entering the safety zones. The safety zones will result in an exclusion area of approximately 0.79 km^2 (assuming an exclusion radius of 500 m) around the drilling unit. The implementation of the safe operational zone around the drilling unit will exclude fishing around the drilling unit for the duration of the drilling operation. The temporary exclusion of fisheries from the safety zone could result in the displacement of fishing effort into alternative areas or, if no alternative areas are available, the loss of catch (direct negative impact).

[25] The location of abandoned and suspended wellheads is listed by SANHO in the annual summary of South African Notices to Mariners.

Project Controls

Compliance with COLREGS (the Convention dealing with safety at sea, particularly to reduce the risk of collisions at sea) and SOLAS (the Convention ensuring that vessels comply with minimum safety standards).

Sensitivity of Receptors

An overview of the South African fishing industry and a description of each commercial sector is presented in Section 3. The affected fisheries sectors (receptors) have been identified based on the extent of overlap of fishing grounds with the area of interest for well-drilling. The **demersal trawl, demersal longline, large pelagic longline and tuna pole-line sectors operate within the area of interest for well drilling.**

Sensitivity herein considers the extent of the fishing ground and the ability of a particular sector to operate as expected considering a project-induced change to their normal fishing operations. The vulnerability of a particular fishing sector to the impact of the safety zone would differ according to the degree of disruption to that particular type of fishing operation. The current assessment considers this to be related to the type of gear used by the particular sector and the probability that the fishing can be relocated away from the affected area into alternative fishing areas without disruption.

For example, a vessel operating in the large pelagic longline sector will set a mainline, which may be up to 100 km in length. Once deployed, the line will be left to drift in surface water currents for several hours before retrieval. Gear may cover a large area during this time and may entangle around the drilling unit. For this reason and catch and effort in the area of interest, the sensitivity of the large pelagic longline sector is considered to be **HIGH**[26]. The demersal trawl and demersal longline sectors are potentially more adaptable to exclusion than the large pelagic longline sector and have been rated as **LOW**[27] sensitivity considering the overlap with the fishing grounds. The sensitivity of the tuna pole-line sector, which is a mobile operation, has also been rated as **LOW**.

Impact Magnitude (or Consequence)

For all sectors the impact is considered to be short-term (up to **3-4 months for drilling**) with the extent being limited to the 500 m radius around the drilling unit (**site**). The **intensity** of each sector, based on the catch and effort within the safety zone (summarised below), is **low**.

- Demersal trawl sector: The maximum catch and effort within the 500 m drilling unit safety zone that may be affected amounted to 0.02% and 0.03% of the overall effort and catch figures.
- Demersal longline sector: The maximum catch and effort within the 500 m drilling unit safety zone that may be affected amounted to 0.02% of both the overall catch and effort figures.
- Large pelagic longline sector: The maximum catch and effort within the area of exclusion[28] amounted to 3.9% of both the overall catch and 3.91% of the overall effort figures.

[26] Receptors are not resilient to Project impacts and will not be able to adapt to such changes without substantive adverse consequences on their quality of life.

[27] Receptors are not fully resilient to Project impacts but are generally able to adapt to such changes albeit with some diminished quality of life.

[28] Since surface longlines are buoyed and unattended, they drift in surface currents and cover a large area before they are retrieved. In assessing the impact of exclusion on the sector, the affected area has been raised from 500 m to 30 km as operators would be obliged to take a precautionary approach in order to avoid gear entanglement with the (stationary) drilling unit.

- Tuna pole sector: The maximum catch and effort within the 500 m drilling unit safety zone that may be affected amounted to 0.1% of both the overall catch and effort figures.

Thus, the **magnitude** (or consequence) for these four sectors is considered to be **very low**. The proposed area of interest for drilling does not overlap with the fishing grounds of the midwater trawl, demersal longline, small pelagic purse-seine, large pelagic purse-seine, tuna pole-line, linefish, west coast rock lobster, south coast rock lobster, squid jig or small-scale fisheries. Thus there will be no impact on these sectors due to the presence of the drilling unit.

Impact Significance

Based on the sensitivity of the receptors and the magnitude predicted above, the potential impact on the large pelagic longline sector is assessed to be of **LOW significance**, while the impact on the demersal trawl, demersal longline, and tuna pole-line sectors is **NEGLIGIBLE**.

Mitigation

The potential for mitigation includes effective communications with fishing sectors which could allow vessel operators the opportunity to plan fishing operations in areas unaffected by the presence of the drilling unit. Thus, it may be possible for operators to relocate fishing effort into alternative areas if adequate information is provided ahead of the project. Recommended mitigation measures are listed in Table 4.1.

Table 4.1: Recommended Measures to Mitigate the Impact of Temporary Exclusion.

No.	Mitigation measure	Classification
1	At least three weeks prior to the commencement of the drilling operations, distribute a Notice to Mariners to key stakeholders prior to the well-drilling operations. The Notice to Mariners should give notice of (1) the co-ordinates of the drilling area, (2) an indication of the proposed operational timeframes, (3) the dimensions of the safety zone around the drilling unit (500 m), and (4) 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. Stakeholders include the relevant fishing industry associations: FishSA, SA Tuna Association; SA Tuna Longline Association, Fresh Tuna Exporters Association, South African Deepsea Trawling Industry Association (SADSTIA) and South African Hake Longline Association (SAHLLA). Other key stakeholders: SANHO, South African Maritime Safety Association (SAMSA), and DFFE Vessel Monitoring, Control and Surveillance (VMS) Unit in Cape Town. These stakeholders should again be notified at the completion of drilling when the drilling unit and support vessels are off location.	Avoid/reduce at source
2	Request, in writing, the SANHO to broadcast a navigational warning via Navigational Telex (Navtext) and Cape Town radio (Channel 16 VHF; Call sign: ZSC) for the duration of the well drilling operation.	Avoid
3	Manage the lighting on the drilling unit and support vessels to ensure that it is sufficiently illuminated to be visible to fishing vessels and compatible with safe operations.	Abate on site
4	Notify any fishing vessels at a radar range of 24 nm from the drilling unit via radio regarding the safety requirements around the drilling unit.	Abate on site
5	Implement a grievance mechanism that allows stakeholders to register specific grievances related to operations, by ensuring they are informed about the process and that resources are mobilised to manage the resolution of all grievances, in accordance with the Grievance Management procedure.	Abate on site

Residual Impact

The potential impacts cannot be eliminated due to the nature of the activity and associated safe operational zone. With implementation of the mitigation measures, which will ensure good communication and coordination with the various fishing sectors allowing them to focus fishing in other areas, the intensity will reduce by one level for all sectors. The residual impact significance will remain **LOW** for the large pelagic longline sector and **NEGLIGIBLE** for the demersal trawl, demersal longline, and tuna pole-line sectors (refer to Table 4.2):

Table 4.2 Impact of Temporary Exclusion around the Drilling Unit.

1	Temporary Exclusion around the Drilling Unit	
Project Phase	**Operational Phase**	
Type of Impact	**Direct**	
Nature of Impact	**Negative**	
	Pre-Mitigation Impact	**Residual Impact**
Sensitivity of Receptor	**HIGH** Large pelagic longline **LOW** Demersal trawl, demersal longline and tuna pole-line	**HIGH** Large pelagic longline **LOW** Demersal trawl, demersal longline and tuna pole-line
Magnitude (or Consequence)	**VERY LOW**	**VERY LOW**
Intensity	**LOW**	**VERY LOW**
Extent	**Site**	**Site**
Duration	**Short Term**	**Short Term**
Significance	**LOW** Large pelagic longline **NEGLIGIBLE** Demersal trawl, demersal longline and tuna pole-line	**LOW** Large pelagic longline **NEGLIGIBLE** Demersal trawl, demersal longline and tuna pole-line
Probability	**Probable** Large pelagic longline **Possible** Demersal trawl, demersal longline and tuna pole-line	**Probable** Large pelagic longline **Possible** Demersal trawl, demersal longline and tuna pole-line
Confidence	**High**	**High**
Reversibility	**Fully Reversible**	**Fully Reversible**
Loss of Resources	**Low**	**Low**
Mitigation Potential	**Low**	**Low**
Cumulative potential	**Possible**	**Possible**

4.1.2 EXCLUSION FROM FISHING GROUND DUE TO ABANDONMENT OF WELL

Potential Impact Description

The abandonment of the wellhead on the seafloor will pose an obstruction to any fishing activity directed towards the seabed (specifically demersal trawl). Thus, reducing fishing grounds for the demersal trawl fishery, resulting in a potential loss of catch and possible damage to fishing gear (direct negative impact).

The demersal long-line sector, which also sets its gear on the seafloor, will not be impacted after well abandonment as this sector will be permitted to set lines over an abandoned wellhead. This sector is not considered further here.

Project Controls

Abandoned wellheads would be fitted with an over-trawlable abandonment cap to minimise the risk of damage to demersal trawl gear.

Sensitivity of Receptors

Sensitivity herein considers the extent of the demersal trawl grounds and the ability of the sector to operate as expected considering a project-induced change to normal fishing operations. Considering wellhead abandonment, even though wellheads will be fitted with a so-called over-trawlable abandonment cap, the demersal trawl sector will still choose to lift nets to avoid the abandoned wellheads in order to avoid damage to their trawl gear, which will result in reduced access to available fishing ground (whilst the net is lifted from the seabed, they are unable to harvest the targeted fish stock). The sensitivity of the demersal trawl sector to wellhead abandonment is considered to be **MEDIUM**.

Impact Magnitude (or Consequence)

Figure 4.1 shows the demersal trawling effort in relation to Block 5/6/7 and Area of Interest for proposed exploration drilling area. The Area of Interest for proposed exploration drilling is situated offshore of the main trawl grounds in the area; however there the area does coincide with the outer depth range of fishing effort (up to 800 m water depth). The Area of Interest for proposed exploration drilling covers 364 km^2 of trawling ground, which amounts to 0.64% of the total extent of the offshore demersal trawling footprint within the South African EEZ. Over the period 2017 to 2019, an average of 60 trawls per year were reported within the proposed drilling area yielding 317 tonnes of hake. This is equivalent to 0.16% and 0.27% of the overall effort and catch, respectively, reported nationally by the sector.

The abandonment of a wellhead within the trawl ringfenced area would exclude fishing from an area of 0.79 km^2 per wellhead (500 m radius), which is equivalent to 0.001% of the offshore trawl footprint. Placed across the area of highest fishing activity within the Area of Interest for proposed drilling, an average of 9 drags per year could be expected across the affected area (equivalent to 0.03% of the overall national effort figures reported by the sector).

The impact on the demersal trawl sector will be limited to the immediate area of the wellheads (**site**) and is of **medium intensity** (fishing strategies would have to be altered within the area). Since the abandoned wellheads will present a permanent obstruction to the demersal trawl sector, the impact will persist beyond the temporary drilling operation (**permanent**). Thus, the magnitude (or consequence) is considered to be **medium**.

Impact Significance

Due to the medium sensitivity of the receptor and the medium magnitude of the impact, the presence of the abandoned wellhead(s) is deemed to be of **MEDIUM** significance. The alternative of removing the wellhead(s) (although not the preferred option) would allow normal fishing operations to resume in the drill area after decommissioning (**NO IMPACT**).

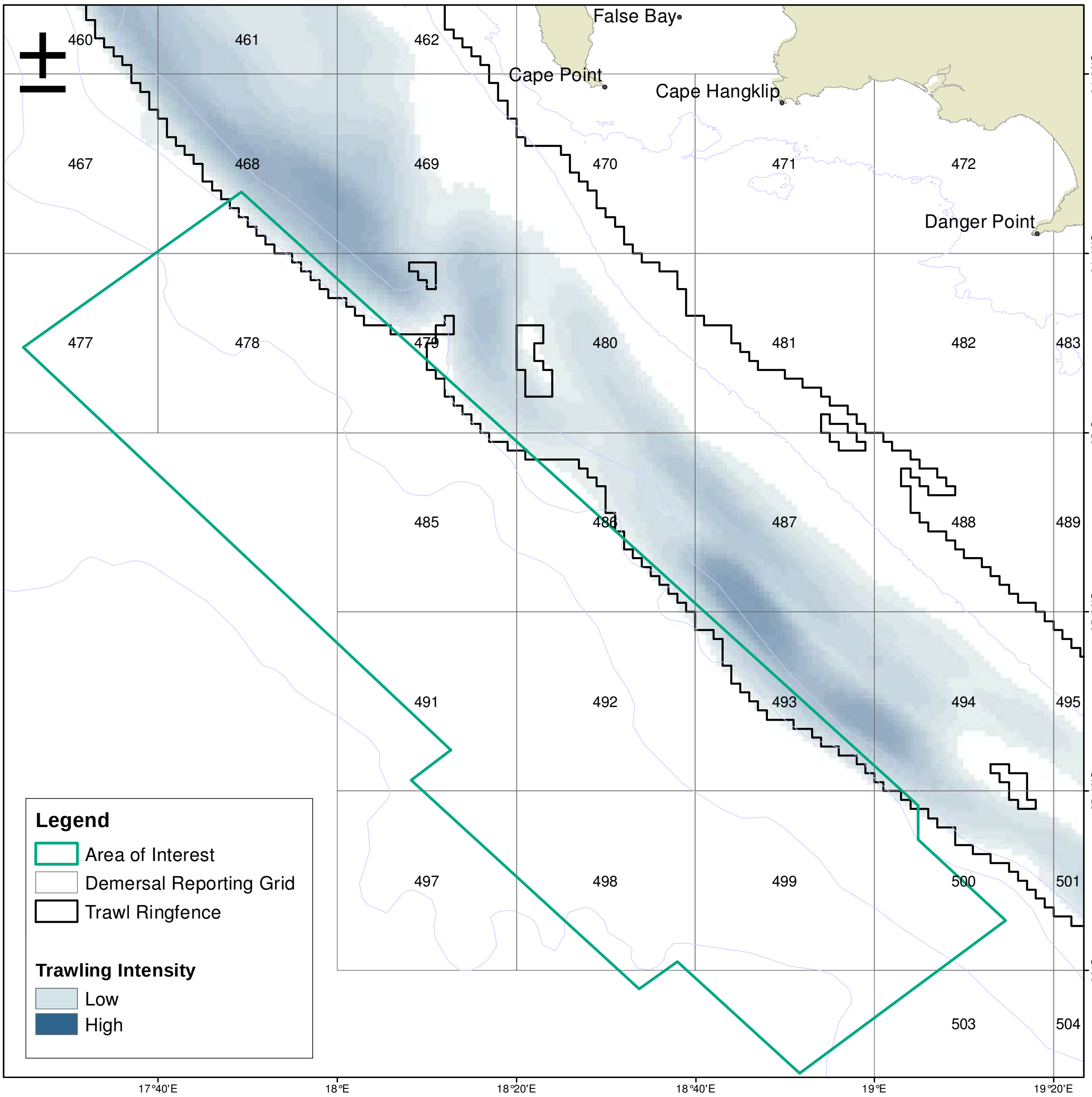


Figure 4.1: **Spatial distribution of demersal trawling intensity in relation the proposed drilling area and commercial grid blocks (labelled). Depth contours indicated (100 m to 1000 m.**

Mitigation

The potential for mitigation includes the planning of well drilling outside the area currently "ringfenced" for demersal trawl activity or to remove wellhead structures if coincident with the trawl "ringfenced" area. This would eliminate the impact on the sector. If an abandoned wellhead coincides with the trawl "ringfence" area, removal of the wellhead would eliminate the impact on the sector, as the area would remain free of snagging hazards and therefore trawlable. Recommended mitigation measures are listed in Table 4.3.

Table 4.3: Recommended Measures to Mitigate the Impact of Permanent Exclusion.

Mitigation measure		
1	Abandoned wellhead and buoy anchor locations must be surveyed and accurately charted with the South African Navy Hydrographer (SANHO).	Abate
2	Avoid drilling within the boundaries of the demersal trawl "ringfenced" area or remove wellhead structures if coincident with the trawl "ringfenced" area.	Avoid / restore

Residual Impact

This potential impact can be eliminated (no residual impact) if drilling avoids the demersal trawl "ringfenced" area or if the wellheads are remove from the "ring-fenced" area (refer to Table 4.4).

Table 4.4 Impact of Exclusion from Fishing Ground during Demobilisation (Abandonment of Wellhead(s) on Seafloor)

2	Exclusion of Fisheries from Fishing Grounds Due to Wellhead Abandonment		
Project Phase	Demobilisation Phase		
Type of Impact	Direct		
Nature of Impact	Negative		
	Pre-Mitigation Impact	Residual Impact	
		Avoid Trawl Ground	Removal of Wellhead
Sensitivity of Receptor	MEDIUM Demersal trawl	NO IMPACT	NO IMPACT
Magnitude (or Consequence)	MEDIUM		
Intensity	Medium		
Extent	Site		
Duration	Permanent		
Significance	**MEDIUM**		
Probability	Probable		
Confidence	High		
Reversibility	Reversible		
Loss of Resources	Low		
Mitigation Potential	High		
Cumulative potential	Possible		

4.2 DISCHARGE OF DRILL CUTTINGS

Source of Impact

The project activities that will result in accumulation of cuttings, drilling fluid and cement on the seabed are summarised below:

Planned Activities (Normal Operation)	
Activity Phase	Activity
Operation	Discharge of drill cuttings and WBM at the well bore during the initial riserless drilling stages
	Discharge of drill cuttings and NADF below sea surface during the risered drilling phase
	Discharge of residual cement during casing installation at the end of the riserless drilling
	Discharge of excess fluids and residual cement during plugging of the wells

Drill cuttings, which range in size from clay to coarse gravel and reflect the types of sedimentary rocks penetrated by the drill bit, are the primary discharge during well drilling. Drill cuttings and muds would be disposed at sea in line with accepted drilling practices.

These activities and their associated aspects are described further below.

- The cuttings from the initial (riserless) top-hole sections of the well (drilled with WBMs) are discharged onto the seafloor where they would accumulate in a conical cuttings pile around the wellhead. In the order of 1 235 tons of cuttings would be generated at the wellbore. In addition to the cuttings, approximately 5 140 tons of WBM (excluding the seawater portion) will be discharged onto the seafloor over a period of 7 days (60 hrs plus lag time between operations).
- After the surface casing string is set in a well, specially designed cement slurries are pumped into the annular space between the outside of the casing and the borehole wall. To ensure effective cementing, an excess of cement is usually used. This excess (100 m^3 in the worst case) emerges out of the top of the well onto the cuttings pile, where (depending on its mix) it either does not set and dissolves slowly into the surrounding seawater.
- During the risered drilling stage, the primary discharge from the drilling unit would be the drill cuttings. The chemistry and mineralogy of the rock particles reflects the types of sedimentary rocks penetrated by the bit. Cuttings from lower hole sections (drilled with NADFs) are lifted up in the marine riser to the drilling unit, which creates a closed loop system between the rig and well. Cuttings are separated from the drilling fluid by the on-board solid control systems. The solids waste stream is discharged overboard through the cutting chute, which would be located 10 m below the sea surface. Treated cuttings (<6% oil on cuttings) released from the drilling unit would be dispersed more widely around the drill site by prevailing currents. In the order of 793 tons of cuttings and 113 tons of NADFs will be discharged from the drill unit. Cuttings and mud released during the risered stage would be discharged over a period of ~16 days (166 hrs in three batches plus lagtime between operations).
- Further muds are released from the drilling unit during the displacement phase, at the end of the 26' section. The mud used during these processes is a High Viscous Gel sweeps / KCl Polymer PAD mud, of which releases totalling 100 tons would occur over a period of 6 days.
- Before demobilisation, the well(s) would be plugged, tested for integrity and abandoned, irrespective of whether hydrocarbons have been discovered in the reserve sections. Cement plugs would be set inside the well bore and across any reserve sections. Excess cement (100 m^3 in the worst case) used during plugging is similarly discarded on the seabed.

Potential Impact Description

The discharge of drill cuttings, drilling fluids and residual cement onto the seabed from the top-hole section of the well will result in the physico-chemical disturbance of the seabed sediments and accumulation on the seabed, as well as result in an increase of sediment in the water column. The effects of sediment deposition at the seabed extend to potential smothering of and toxic effects on benthic communities and associated trophic level cascade effects which could affect normal feeding patterns of certain fish species. This could have an impact on commercial fisheries that operate in the area through the reduction in catch rates and/or an increase in fishing effort (indirect negative impact).

Project Controls

The operator will also ensure that the proposed drilling campaign is undertaken in a manner consistent with good international industry practice and BAT. The following controls will be implemented:

- Based on pre-drilling ROV survey(s), the well(s) will specifically be sited to avoid sensitive hardgrounds, as the preference will be to have a level surface area to facilitate spudding and installation of the wellhead.
- Should WBMs not be able to provide the necessary characteristics for drilling during the risered stage, a low toxicity Group III NADF will be used in this instance, an “offshore treatment and disposal” strategy will be implemented (i.e. cuttings will be treated offshore to reduce oil content to <6% Oil On Cutting (OOC) and discharged overboard).
- Discharge of risered cuttings *via* a caisson at greater than 10 m below surface to reduce dispersion of the cuttings in surface currents.

Sensitivity of Receptors

The drilling activities would be undertaken in the offshore marine environment more than 60 km offshore. The majority of the area of interest for drilling is situated in an ecosystem type rated by SANBI as of “Least Concern” (see Pulfrich, 2022). Identified Critical Biodiversity Areas (CBSs) do, however, occur within the area of interest for drilling, covering 5.4% (558 km^2) of the area of interest outside of the ammunition dump. The biodiversity features specifically protected by these CBAs include spawning areas for certain fish and areas of high anchovy egg density. Seasonally high abundances of ichthyoplankton (hake eggs and larvae), particularly in late winter and early spring, may occur in the inshore portions of the Area of Interest. The overall sensitivity of fisheries recruitment receptors is considered **LOW**.

The fishing sectors that could be affected by the discharge of drill cuttings are those that operate within or adjacent to the area of interest, namely demersal trawl, demersal longline, large pelagic long-line and tuna pole. The sensitivity of these sectors to cuttings discharge is considered to be **LOW**, as fishing gear would not be impacted and activity could continue in adjacent areas.

The sediment plume is unlikely to overlap with the fishing grounds of the midwater trawl, small pelagic purse-seine, West Coast rock lobster, South Coast rock lobster, traditional linefish, squid jig and small-scale fisheries. Thus, there is unlikely to be an impact on these sectors due to cuttings discharge.

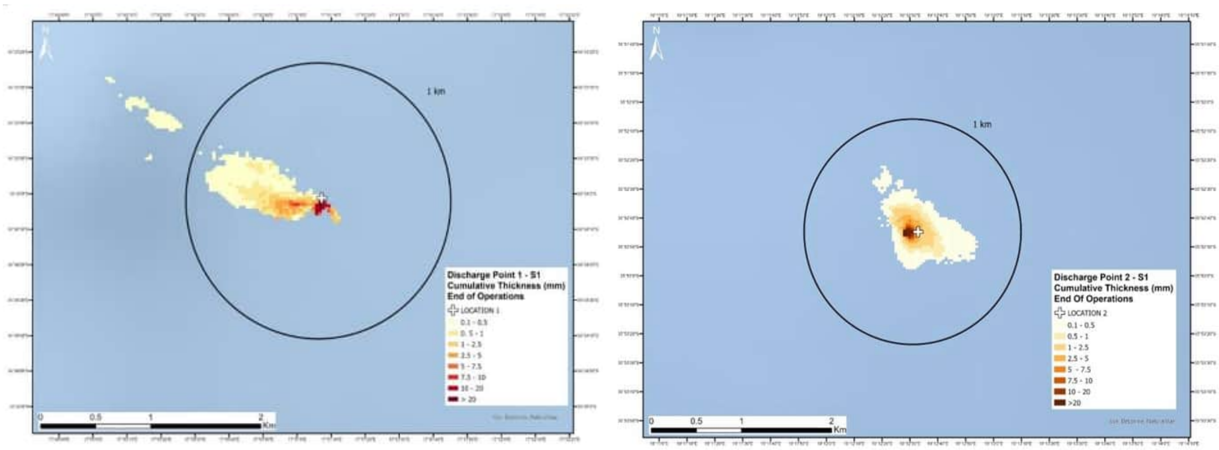
Impact Magnitude (or Consequence)

In order to assess these impacts the expected fall and spatial extent of the deposition of discharged cuttings was investigated in the Drilling Discharges Modelling Studies (Livas 2022a). The modelling considered two locations within the area of interest for well-drilling and across four alternative seasons. The discharge locations were selected to cover the area of interest as the closest to sensitive areas, closest to the coastline and at locations reflecting different metocean conditions with the intention that the selected locations represented the worst-case scenarios (i.e. presented the worst risk to the environment). Discharge Point 1 (34°34´1.2"S; 17°51´7.2"E) was situated 72 km from the coastline at a water depth of 719 m and Discharge Point 2 (35°52´44.4"S; 19°13´30"E) was situated 155 km from the coastline at a water depth of 1 357 m.

Sediment Deposition

- For the current project the cuttings mound at the wellbore at Discharge Point 1 at the end of drilling operations (i.e. at the end of both the riserless and risered drilling stages) will amount to a maximum depositional thickness of 1 119 mm (1.119 m) extending up to 135 m south of the discharge point (Season 1), progressively thinning out in a WNW direction to <0.5 mm after 650 m, but extending to a maximum distance of 1.8 km from the discharge in a WNW direction (Figure 4.2**Error! Reference source not found.**, left). A maximum deposit thickness of 1 410 mm is reached during Season 2, but extending only 55 m around the wellbore. For Seasons 3 and 4, the maximum thickness deposits are lower and generally less extensive than for the Seasons 1 and 2 (Season 3: max. thickness 661 mm extending to max of 56 m; Season 4: max. thickness 435 mm extending to max of 41 m).
- For Discharge Point 2, the cuttings mound at the wellbore at the end of drilling operations will amount to a maximum depositional thickness of 588 mm extending westwards up to 144 m from the discharge point (Season 1), progressively thinning out to <0.5 mm after 205 m, but extending to a maximum distance of 580 m from the discharge point (Figure 4.2, right). For Season 2 the maximum thickness deposits are lower but more extensive than for the Season 1 (491 mm extending to max of 179 m). For Seasons 3 and 4, the maximum thickness deposits are slightly lower and less extensive than for the Season 1 (Season 3: max. thickness 581 mm extending to max of 132 m; Season 4: max. thickness 571 mm extending to max of 130 m).
- Most of the deposit (60%) is attributable to the riserless discharges at the seabed from drilling of the top hole sections (42″ and 26″), remaining close to the discharge points due to the low current speeds at the seabed.
- At both locations, the cuttings deposit thickness >1 mm does not show recovery with time, showing negligible decrease in thickness 10 years after the operations. This can primarily be attributed to weak bottom currents at the well locations. The risks[29] associated with the riserless drilling stage are primarily physical, induced by the thickness deposit (55%) at Discharge 1 (Season 1 & 3) and 29% at Discharge 2 (Season 4).

[29] The environmental risk assessment used in the drillings discharge modelling uses the conventional PEC (Predicted Environmental Concentration) / PNEC (Predicted No Effect Concentration) ratio approach. This ratio gives an indication of the likelihood of adverse environmental effects occurring as a result of exposure to the contaminants and is based on the comparison of the ecosystem exposure to a compound (or deposition thickness) with the ecosystem sensitivity for this compound (or deposition thickness). A significant risk corresponds to a calculated concentration (or thickness) in the environment (exceeding the predicted no effect concentration to a level likely to potentially impact 5% of species in a typical ecosystem.



Max cumulative thickness value: 1 119 mm
Max. Distance: 1 800 m

Max cumulative thickness value: 588 mm
Max. Distance: 580 m

Figure 4.2: Cuttings thickness deposit on the seabed at the end of drilling operations at (left) Discharge Point 1 (Worse case: Season 1) and (right) Discharge 2 (Worse case: Season 1) (Source Livas 2022a).

Grain Size Variation

- As would be expected, the riserless discharges resulted in the greatest variation in grain size in surficial sediments to those originally present, with the maximum variation recorded at the end of operations in Discharge Point 1 being 17 000% (compared to a natural grain size of 0.01 mm) for the 42″ section (Worst case: Discharge 1, Season 1, 42” section), but confined to a maximum distance from the wellbore of no more than 35 m. The variation due to drilling of the risered sections is also significant, with a maximum value of 2 400% (for the 17.5″ section) within 50 m from the Discharge Point 1 (Season 1), but with larger plumes occurring in the WNW and extending up to 2.2 km from the discharge point for the 12.25″ section.
- For Discharge Point 2 the maximum grain size variation recorded was 10 200% for the 26″ section (Worst case: Season 2), but confined to a centralised area around the wellbore of no more than 125 m. The variation due to drilling of the risered sections is also significant, with a maximum value of 1 400% (for the 17.5″ section) extending up to 50 m to the SE from the discharge point, but with larger plumes occurring in the ESE and N directions and extending up to 1.58 km from the discharge point for the 12.25″ and 8.5″ sections.
- Change in grain size around the wellbore was the greatest contributor to ecological risk, accounting for a maximum of 50% at Discharge Point 1 (Season 2) and 73% at Discharge Point 2 (Season 3).

Environmental Risk to Sediments

- The risk related to the sections drilled with the riser is much higher than the potential risk induced by the riserless sections (which has a negligible impact and is physical rather than chemical). The sediment environmental risk of the sections drilled with a riser is more chemical than physical, due to EZ MUL NT (mostly fatty acid component of the product), responsible for 56% of the total risk, and INVERMUL NT (mostly the fatty acid component too), responsible of 41% of the total risk.
- The risered sections of the well represent a significant risk above the threshold at which 5% of the species in the ecosystem are likely to be affected. This risk is primarily associated with the

chemicals from the drilling muds remaining in the sediments. There is no trace of risk due to the riserless section discharges. The drill cuttings discharge model calculated a maximum risk (i.e. compilation of all maximum risks achieved at any time during the whole modelling period) of 99.9 % (99.9% of species at risk) during the discharge of the 17 ½″ section, 150 m W of Discharge Point 1 and 90 m W of Discharge Point 2 at the end of operations. This risk remains at 99.4% and 97% for the same point 10 years after the operations for Discharge Point 1 and 2, respectively, emphasising the slow recovery of seabed impacts at such depths under low current conditions. However, this risk remains highly localised.

- The maximum distance from the discharge point at which a significant cumulative risk was calculated at the end of the drilling operations for season 1 is up to 5 km NW and 1.7 km NW of Discharge Point 1 (Figure 4.3) and 1.7 km NW of Discharge Point 2 (Figure 4.4), respectively. At Discharge 2, however, this extends to a maximum of 4.6 km during Season 3. As would be expected, the risk is not centralised around each discharge point, and is orientated towards the NW (Discharge Point 1) and E and NW (Discharge Point 2) in the direction of the prevailing current, illustrating the strong influence of surface currents on drill cuttings dispersion and redeposition on the seabed. Ten years after operations the footprints for Season 1 reduce to 2.1 km NW (Discharge Point 1) and 1.5 km NW (Discharge Point 2).

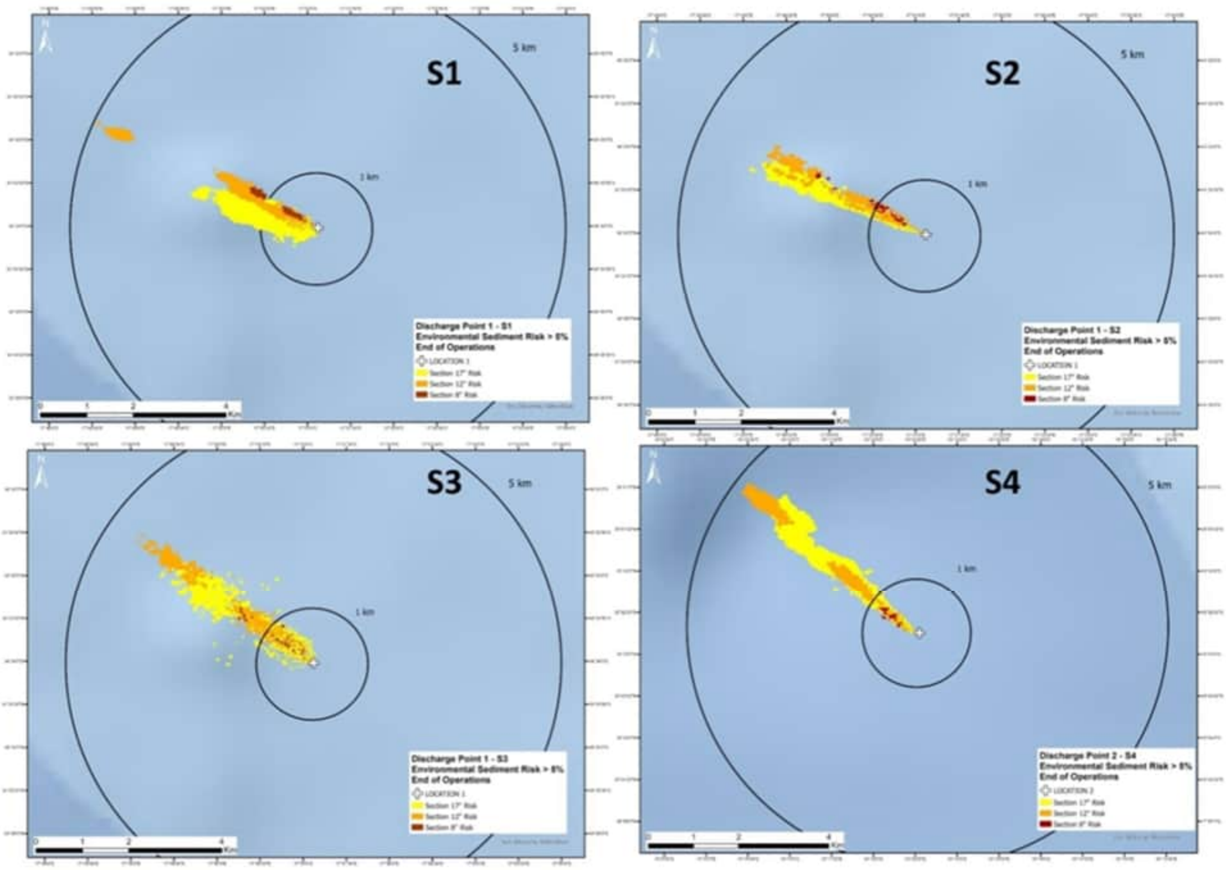


Figure 4.3: Maximum potential risk in the sediment at the end of the drilling operations for all four seasons at Discharge Point 1 (Source Livas 2022a).

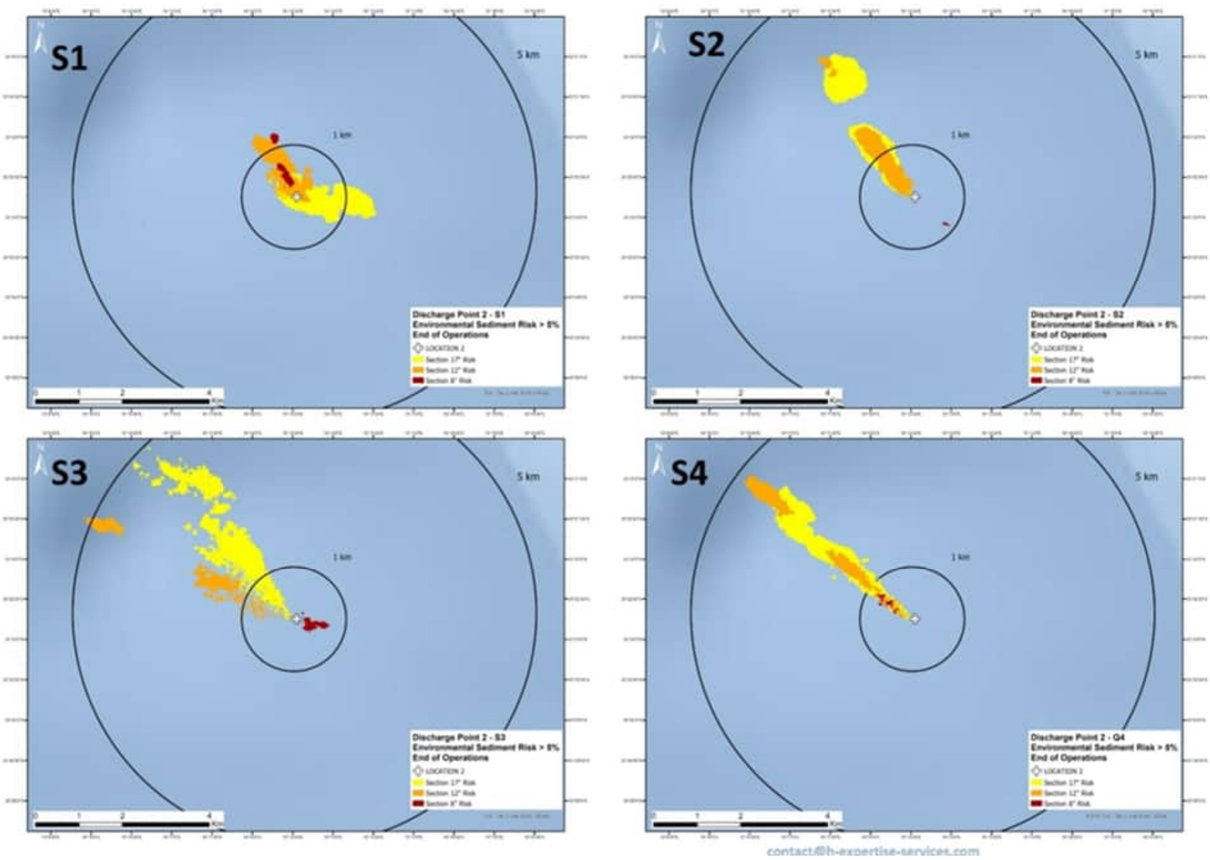


Figure 4.4: Maximum potential risk in the sediment at the end of the drilling operations for all four seasons at Discharge Point 2 (Source Livas 2022a).

Environmental Risk to the Water Colum

The environmental risk calculated in the water column could be high, but close to the discharge points. The risk is short term because the plume is rapidly dispersed and diluted by the currents, not exceeding 24 hours of duration in the water column around 15 km away NW from the discharge points 1 and 2. For both discharge points, the volume of water at risk is mainly due to the riserless sections. However, for discharge point 2, the maximum distance at risk from the discharge point was observed during the discharge of the risered section (25.6 km NW during the Winter season) whereas it was observed during the discharge of the riserless section for discharge point 1 (52 km NW towards a EBSA during the Winter season). This is due to the greater depth of Discharge Point 2, presenting weaker bottom currents than for Discharge Point 1. This depth difference also explains why the environmental risk value is higher at the sea bottom for Discharge Point 2 compared to point 1, presenting weaker currents limiting dispersion and dilution of the chemicals. The main contributors to the environmental risk in the water column are Barite (riserless sections), Caustic Soda and Potassium Chloride (risered section) for all the seasons for both discharge points.

The results of the modelling show that timing the drilling operations to take place during Summer (December to February) presents the lowest Environmental Impact to the water column for Discharge Point 1 (the highest risk is considered to be during Winter (June to August). At Discharge Point 2, Summer presents the highest instantaneous risk but the lowest time-averaged risk; whereas drilling during Autumn (March to May) presents the lowest instantaneous risk, but the second highest time-averaged risk.

For the two discharge points, the total duration of the risk in the water column would last between 14 to 17 days. During this time the plume would be become dispersed and diluted by surface currents in the area.

The environmental risk in the water column is mainly due to the riserless sections discharges, given that the physical risk is due to the release of Barite from the riserless sections mainly, and the chemical risk is due to the release of Caustic Soda and Potassium Chloride from the riserless sections only. The risk is **short term** because the plume would rapidly disperse and dilute due to water currents (within 14 – 17 days). The plume would extend from the well site in a NW direction to a maximum distance of 52 km (Discharge Point 1) and 26 km (Discharge Point 2) - **localised** impact.

The fishing sectors that could be affected by the discharge of drill cuttings are those that operate within the area of interest for drilling, to a distance between 25.6 km in a NW direction (for the risered section) to up to 52 km in a NW direction (for the riserless drilling to a maximum of 20 m above and 10 m below the modelled discharge point). Fisheries at risk include those that operate within or adjacent to the drill area in a NW direction, namely demersal trawl, demersal longline, large pelagic longline and tuna pole-line. It is unlikely that the distribution and abundance of commercial fish species will be significantly impacted by the deposition of well drill cuttings during this project except in the immediate area. The increase in water turbidity (resulting from the suspension of fine particulate matter) could lead to avoidance behaviour by fish. Although the potential smothering effect on benthic communities (as per the Marine Ecology Assessment) is considered to be of LOW - MEDIUM intensity (unconsolidated sediments) and HIGH intensity (hardgrounds), toxic effects of drilling muds on benthic communities are considered to be of LOW intensity for WBMs (riserless stage) and MEDIUM intensity for NADFs (risered stage). The intensity of the impact on fishing in and adjacent to the area of interest is considered **LOW**. The maximum cumulative risk on the seabed and throughout the entire water column would, however, remain localised (i.e. 5 km from the drilling unit per well for smothering risk to 52 km for potential toxic effects in the direction of the prevailing current, NW). Releases of chemical constituents are pulsed, with those above the Predicted No Effect Environmental Concentration (PNEC) persisting for only a few hours during the risered drilling stages and therefore not influencing benthic communities. Rapid dilution (few hours) of these constituents ensures that impacts would persist only over the short term are not extending beyond the 28 days required for the drilling of the base case (Livas 2022a).

The effects of sediment deposition at the seabed extend to potential smothering of benthic communities and associated trophic level cascade effects which could affect normal feeding patterns of certain fish species. Benthic and demersal species that spawn, lay eggs or have juvenile life stages dependent on the seafloor habitat (e.g. hake) may be negatively affected by the smothering effects of drill cuttings. However, the major fish spawning areas occur further inshore on the shelf. Although the depositional footprints are unlikely to coincide with the spawning areas for hake, seasonally high abundances of ichthyoplankton (hake eggs and larvae), particularly in late winter and early spring, may occur in the inshore portions of the Area of Interest. Any potential effects of turbid water plumes generated during cutting disposal on phytoplankton and ichthyoplankton production, fish migration routes and spawning areas, or on benthic and demersal species in the area would thus be negligible.

The magnitude of the impacts of the discharge of drilling fluids on commercial fishing is thus considered **very low** for up to 5 wells regardless of season.

Impact assessment

The biochemical impacts to marine fauna were assessed by Pulfrich (2022) as being of negligible significance on marine organisms in unconsolidated sediments and of low significance on marine organisms on hard grounds – the difference relating to the high sensitivity of the latter in comparison to the low sensitivity of the former.

Behavioural responses could include avoidance of the plume, or attraction to the plume as an area of refuge from predation. The likely response in this case is unknown; however, based on the relatively low area and volume of the cuttings discharge and plume, respectively, the potential impact is considered to be of **negligible significance** (refer to Table 4.5).

Mitigation

The following measures will be implemented to reduce the toxicity and bioaccumulation effects on marine fauna:

Table 4.5: Recommended Measures to Mitigate the Impact of Discharged Drill Cuttings.

No.	Mitigation measure	Classification
1	Ensure there is meticulous design of pre-drilling site surveys to provide sufficient information on seabed habitats, and to map potentially vulnerable habitats thereby preventing potential conflict with the well site. Undertake pre-drilling site surveys (with ROV) to ensure there is sufficient information on seabed habitats, including the mapping potentially vulnerable habitats within 1 000 m of a proposed well site.	Avoid / reduce at source
2	Ensure that, based on the pre-drilling site survey and expert review of ROV footage, drilling locations are not located within a 1 000 m radius of any sensitive or potentially vulnerable habitats (e.g. hard grounds), species (e.g. cold corals, sponges) or sensitive structural features (e.g. rocky outcrops),.	Avoid / reduce at source
3	Careful selection of drilling fluid additives taking into account their concentration, toxicity, bioavailability and bioaccumulation potential; Ensure only low-toxicity, low bioaccumulation potential and partially biodegradable additives are used. Maintain a full register of Material Safety Data Sheets (MSDSs) for all chemical used, as well as a precise log file of their use and discharge.	Avoid / reduce at source
4	If NADFs are used for drilling the risered sections, ensure regular maintenance of the onboard solids control package and avoid inappropriate discharge of NADF cuttings.	Abate on site
5	Monitoring requirements: • Test drilling fluids for toxicity, barite contamination and zero oil content (inWBM) and less than 6% (for NADF) to ensure the specified discharge standards are maintained. • Monitor (using ROV) cement returns and if significant discharges are observed on the seafloor terminate cement pumping, as far as possible. • Monitor (using ROV) hole wash out to reduce discharge of fluids as far as possible.	Reduce at source / abate on site

Residual Impact

With the implementation of the mitigation measures, the residual impact on commercial fishing remains of NEGLIGIBLE significance (refer to Table 4.6).

Table 4.6 Impact of the Discharge of Drill Cuttings on Fisheries

3	Discharge of Drill Cuttings	
Project Phase:	**Operational**	
Type of Impact	**Indirect**	
Nature of Impact	**Negative**	
	Pre-Mitigation Impact	**Residual Impact**
Sensitivity of Receptor	**LOW** Demersal trawl, demersal longline. large pelagic longline, tuna pole-line	**LOW** Demersal trawl, demersal longline, large pelagic longline, tuna pole-line
Magnitude (or Consequence)	**VERY LOW**	**VERY LOW**
Intensity	**Low**	**Low**
Extent	**Local**	**Local**
Duration	**Short-term**	**Short-term**
Significance	**NEGLIGIBLE**	**NEGLIGIBLE**
Probability	**Possible**	**Possible**
Confidence	**Medium**	**Medium**
Reversibility	**Fully reversible**	**Fully reversible**
Loss of Resources	**Low**	**Low**
Mitigation Potential	**-**	**Very Low**
Cumulative potential	**Unlikely**	**Unlikely**

4.3 GENERATION OF UNDERWATER NOISE

Source of Impact

The main sources of underwater noise related to project activities are listed below.

Planned Activities (Normal Operation)	
Activity Phase	Activities
Mobilisation	Transit of drilling unit and support vessels to drill site
Operation	Operation of drilling unit and support vessels at the drill site
	Transit of support/supply vessels between the drilling unit and port
	Vertical Seismic Profiling (VSP)
Decommission	Transit of drilling unit and support vessels to drill site

Well Drilling and Support Vessels

The presence and operation of the drilling unit and support vessels during transit to the drill site, during drilling activities on site, and during demobilisation will introduce a range of underwater noises into the surrounding water column that may potentially contribute to and/or exceed ambient noise levels in the area. For non-impulsive noise, the overall noise level from combined noise emissions from the drilling unit and two support vessels (worst-case) is approximately 198.1 dB re 1 µPa @ 1m (or dB re 1 $\mu Pa^2 \cdot S$ @ 1m) (SLR Consulting Australia 2022).

Vertical Seismic Profiling – VSP

Vertical Seismic Profiling (VSP) would be undertaken in order to generate a high-resolution image of the geology in the well's immediate vicinity. VSP is a standard method used during well logging and can generate noise that could exceed ambient noise levels. VSP uses a small airgun array (1 200 cubic inch volume), which is deployed from the drilling unit at a depth of between 7 m and 10 m below sea level. The airguns are discharged at a pressure of 2 000 per square inch (psi). Hydrophones are lowered into the well at broad intervals (up to hundreds of metres apart) to receive signals from the stationary seismic source. VSP source generates a peak sound pressure level (Pk SPL) of 242.2 dB re 1µPa at 1 m, a peak to peak sound pressure level (Pk-Pk SPL) of 248.0 dB re 1 µPa @ 1m, a root-mean-square sound pressure level (RMS SPL) of 238.3 dB re 1 µPa @ 1m, and a sound exposure level (SEL) 223.8 dB re µPa2·s @ 1m. The airguns would be discharged approximately five times at 20 second intervals. This process is repeated, as required, for different sections of the well for a total of approximately 250 shots. A VSP is expected to take up to nine hours per well to complete, depending on the well's depth and number of stations being profiled.

Potential Impact Description

Elevated noise levels could impact marine fauna by:

- Causing direct physical injury to hearing or other organs, including permanent (PTS) or temporary threshold shifts (TTS) in hearing;
- Masking or interfering with other biologically important sounds (e.g. communication, echolocation, signals and sounds produced by predators or prey); and
- Causing disturbance to the receptor resulting in behavioural changes or displacement from important feeding or breeding areas.

The noise generated by vessels and well-drilling operations in general, as well as VSP, falls within the hearing range of most fish and would be audible for considerable ranges before attenuating to below threshold levels. The received level of noise (and risk of physiological injury or behavioural changes) would depend on the animal's proximity to the sound source. Nonetheless, the underwater noise generated during the project could affect a demersal species residing on the seabed in the vicinity of the wellhead, to those occurring throughout the water column and in the pelagic habitat near the surface. These could have a secondary impact on the fishing industry, namely reduced catch and/or increased fishing effort (indirect negative impact).

Research into the threshold levels for underwater noise impacts on fish have focused on the potential for physiological effects (injury or mortality) rather than on quantifying noise levels with behavioural effects. A review of the literature and guidance on appropriate thresholds for assessment of underwater noise impacts are provided in the 2014 Acoustical Society of America (ASA) Technical Report *Sound Exposure Guidelines for Fishes and Sea Turtles* (ASA, 2014)[30].

The ASA Technical Report includes thresholds for mortality (or potentially mortal injury) as well as degrees of impairment such as temporary or permanent threshold shifts (TTS or PTS, indicators of hearing damage). Separate thresholds are defined for peak noise and cumulative impacts (due to

[30] See also: Hawkins, A.D., Pembroke, A.E. and A.N. Popper. 2014. Information gaps in understanding the effects of noise on fishes and invertebrates. Rev Fish Biol Fisheries (2015) 25:39-64

continuous or repeated noise events) and for different noise sources (e.g. explosives, pile driving, and continuous vessel noise, drilling or dredging). In relation to fish behavioural impacts, the ASA Technical Report includes a largely qualitative discussion, focussing on long term changes in behaviour and distribution rather than startle responses or minor movements. For this exploratory drilling project, the types of noise sources are drilling noise and vessel noise. The ASA qualitative approach to this type of noise includes definitions of effects at three distances from the source defined in relative terms: Near (N): this distance typically refers to fish within tens of meters from the noise source; Intermediate (I): distances within hundreds of meters from the noise source; and Far (F): fish within thousands of meters (kilometres) from the noise source. The ASA does provide numeric noise thresholds for physiological effects for some fish (those where the swim bladder is involved in hearing). However, for most effects and categories of fish the risk of effect is described qualitatively as low, moderate or high risk. Most tuna do not have a swim bladder. For continuous noise of this type at distances far from the source, there is a low risk of adverse behavioural responses for any fish types. A moderate risk of masking effects is identified in the "far" range of distances for fish without a swim bladder, i.e. of the order of kilometres from the noise source. For the purpose of this impact assessment, the objective is to determine a range of distances at which noise from project activities has the potential to exceed ambient or background sound levels. Adverse masking noise and other behavioural effects are not expected in locations where noise from the project is below the background level.

Marine fauna use sound in various contexts, including social interactions and foraging, predator avoidance, navigation and habitat selection. The effects of sounds on marine fauna differ according to the intensity of the sound source, whether it is continuous or pulsed, (e.g. shipping vs pile-driving) and the sensitivity of a particular fish species to particle motion and sound pressure. The effects on fish of elevated sound may include mortality and potential mortal injury, impairment in the form of recoverable injury, temporary threshold shifts and masking. Behavioural changes may include stress, startle responses and avoidance (Popper *et al*., 2014). Experiments have been carried out to define those levels of sound that cause mortality, injury or hearing damage; however, it is more difficult to determine the levels of sound that cause behavioural effects, which are likely to take place over wider areas.

There is a lack of definitive evidence regarding the effects of drilling operations on marine fishes; however, there is no direct evidence of mortality or mortal injury to fish as a result of ship noise. The most likely outcome of the exposure of fish to continuous noise are behavioural responses, masking (impairment in hearing sensitivity in the presence of noise), temporary threshold shifts (a short- or long-term change in hearing sensitivity) and recoverable injury (minor internal injury unlikely to result in mortality). The U.S. NMFS does not give numerical guidelines for behavioural responses of fish to sounds generated by shipping, but lists the relative risk of behavioural effects arising as a result of shipping and continuous sounds from moderate to high in the nearfield, moderate in the intermediate field and low in the far field.

A review by Popper et al. (2014) indicates temporary threshold shifts in fish with swim bladders at a continuous sound exposure level of 158 db re 1 µPa (rms) and recoverable injury at a level of 170 db re 1 µPa (rms). These are within the range of sound levels produced by the proposed drilling operations. According to Popper et al. (2014), for non-impulsive noise sources in general, relatively high to moderate behavioural risks are expected at near to intermediate distances (tens to hundreds of meters) from the source location. Relatively low behavioural risks are expected for fish species at far field distances (thousands of meters) from the source location. Refer to Table 4.7 for a summary of threshold levels of the different types of effects on fish as a result of noise exposure.

Behavioural responses to impulsive sounds are varied and include leaving the area of the noise source (Dalen and Rakness 1985; Dalen and Knutsen 1987; Løkkeborg 1991; Skalski *et al.* 1992; Løkkeborg and Soldal 1993; Engås *et al.* 1996; Wardle *et al.* 2001; Engås and Løkkeborg 2002; Hassel *et al.* 2004), changes in depth distribution and feeding behaviour (Chapman and Hawkins 1969; Dalen 1973;

Pearson *et al.* 1992; Slotte *et al.* 2004), spatial changes in schooling behaviour (Slotte *et al.* 2004), and startle response to short range start up or high level sounds (Pearson *et al.* 1992; Wardle *et al.* 2001).

As a general guideline, the sound ranges of 161 to 166 dB re 1 µPa RMS may be used as a suitable indicator sound pressure level at which behavioural modifications of fish start to take place. Behavioural effects are generally short-term, however, with duration of the effect being less than or equal to the duration of exposure, although these vary between species and individuals, and are dependent on the properties of the received sound.

Table 4.7 Noise exposure criteria and acoustic thresholds for fish (Popper *et al.,* 2014).

Type of animal	Mortality and potential mortal injury	Impairment			Behaviour
		Recovery injury	TTS	Masking	
Fish: no swim bladder (particle motion detection)	>219 dB SEL_{24hr}, or >213 dB Pk SPL	>216 dB SEL_{24hr} or >213 dB Pk SPL	>>186 dB SEL_{24hr}	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low
Fish: swim bladder is not involved in hearing (particle motion detection)	210 dB SEL_{24hr} or >207 dB Pk SPL	203 dB SEL_{24hr} or >207 dB Pk SPL	>>186 dB SEL_{24hr}	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low
Fish: swim bladder involved in hearing (primarily pressure detection)	207 dB SEL_{24hr} or >207 dB Pk SPL	203 dB SEL_{24hr} or >207 dB Pk SPL	186 dB SEL_{24hr}	(N) Low (I) Low (F) Moderate	(N) High (I) High (F) Moderate
Fish eggs and fish larvae	>210 dB SEL_{24hr} or >207 dB Pk SPL	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low

Notes: peak sound pressure levels (Pk SPL) dB re 1 µPa; Cumulative sound exposure level (SEL_{24hr}) dB re 1 µPa^2·s. Relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near (N), intermediate (I), and far (F).

Project Controls

The drilling contractor will ensure that the proposed project is undertaken in a manner consistent with good international industry practice and BAT.

Sensitivity of Receptors

Sensitivity herein considers the extent of fishing ground, ability of the fishing industry to operate as expected considering a project-induced change to their normal fishing operations (linked in part to fishing gear type and vessel manageability), as well as the vulnerability of the targeted fish species.

The greatest risk of physiological injury from VSP sound sources is for species with swim-bladders (e.g. hake and other demersal species targeted by demersal longline and demersal trawl fisheries, small pelagic species targeted by the midwater and purse-seine fisheries). In many of the large pelagic species, however, the swim-bladders are either underdeveloped or absent, and the risk of physiological injury through damage of this organ is therefore lower (Pisces, 2022). Fish without swim bladders and crustaceans are less susceptible to noise-induced reaction on behaviour than fish with swim bladders. However, two of the four tuna species targeted in South African fisheries, *Thunnus albacares* (yellowfin) and *T. obesus* (bigeye), do have swim bladders (Collette & Nauen, 1983) and so may be physically vulnerable. Consequently, the sensitivity of the tuna pole sector is considered to be HIGH, whereas the sensitivity of the demersal trawl, demersal longline and large pelagic longline sectors is considered to be MEDIUM. The other sectors fall outside the estimated zone of noise disturbance of up to 5 km.

4.3.1 VESSEL AND DRILLING

Impact Magnitude (or Consequence)

Exposure to high sound levels can result in physiological injury to marine fauna through a number of avenues, including shifts of hearing thresholds (as either permanent (PTS) or temporary threshold shifts (TTS), tissue damage, acoustically induced decompression sickness (particularly in beaked whales), and non-auditory physiological effects. Both PTS and TTS represent actual changes in the ability of an animal to hear, usually at a particular frequency, whereby it is less sensitive at one or more frequencies as a result of exposure to sound. In assessing injury from noise, a dual criterion is adopted based on the peak sound pressure level (SPL) and sound exposure level (SEL) (a measure of injury that incorporates the sound pressure level and duration), with the one that is exceeded first used as the operative injury criterion. PTS-onset and TTS-onset thresholds differ between impulsive and non-impulsive noise. Peak sound pressure levels for impulsive noise resulting in mortality or potential mortal injury for fish eggs and larvae, and fish range from 207 - 213 dB re 1 µPa, with TSS in fish occurring at cumulative sound exposure levels of above 186 dB re 1 µPa^2·s.

Temporary threshold shifts may occur at close range for fish species lacking swim bladders or where the swim bladders are not involved in hearing, with TTS expected in fish with swim bladders involved in hearing at cumulative rms sound pressure levels of 158 dB re 1 µPa over 12 hours at a maximum threshold distance of 170 m from the source (SLR Consulting Australia 2022). The non-impulsive drilling operation noise therefore has low physiological impacts (both mortality and recovery injury) on fish and sea turtle species. The risk of TSS close to continuous shipping sounds is generally low, although masking and behavioural changes would be likely.

As Block 5/6/7 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 licence block and area of interest for drilling (OceanMind Limited 2020). For the duration of the exploration drilling, a safety zone would be established around the drill unit, potentially requiring adjustment of vessel traffic routes and associated changes in the concentration of vessel and ambient noise at the drill site. 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 (SLR Consulting Australia 2022). The sound level generated by drilling operations (drill rig and support vessels) fall within the 180-200 dB re 1 µPa range at the drilling unit, with main frequencies less than 0.2 kHz. The noise generated by the supply vessel and drill rig, thus falls within the hearing range of most fish and would be audible for considerable ranges before attenuating to below threshold levels.

The Sound Transmission Loss Modelling (STLM) study (SLR Consulting Australia 2022) identified the zones of impact of vessel / drilling operations and VSP on fish based on relevant noise impact assessment criteria. The noise effect categories included mortality and potential mortal injury, recoverable injury and temporary threshold shift (TTS) due to non-impulsive noise and impulsive noise (either immediate impact from single airgun pulses, cumulative effects of exposure to multiple airgun pulses (up to 250 VSP shot points) and cumulative effects of exposure to drilling noise over a period of 12 hours) (refer to Table 4.8). For the current proposed well-drilling project in Block 5/6/7 it was estimated that non-impulsive noise from drilling activities could result in potential TTS to a distance of 170 m from the drill site and injury (recoverable) within 40 m from the drill site. However, pelagic fish species are highly mobile and able to move away from the sound source before trauma could occur (refer to Table 3.7). Besides physiological effects, the underwater noise from well drilling operations may induce localised behavioural changes or masking of biologically relevant sounds in some marine fauna, but there is no evidence of significant behavioural changes that may impact on the wider ecosystem (Perry, 2006). As noted above, based on the noise exposure criteria provided by Popper et al. (2014), for non-impulsive noise sources in general, relatively high to moderate behavioural risks are expected at near to intermediate distances (tens to hundreds of meters) from the source location. Relatively low behavioural risks are expected for fish species at far field distances (thousands of meters) from the source location.

The fisheries affected by this impact could include demersal trawl, demersal longline, large pelagic longline and tuna pole. Based on the overlap of fishing grounds with the affected area (to a distance of a few kilometres around the drilling unit or vessel), the impact has been rated as being **local** in extent.

The impact of drilling and vessel noise is considered to be of **medium intensity**, based on the catch and effort within the estimated 78.5 km^2 behavioural disturbance zone (based on a conservative radius of 5 km from the drilling location[31]) and considering that the proposed new drilling rea is located in a main marine traffic route and thus is in an area already experiencing increased marine traffic and vessel noise.

- Demersal trawl sector: The maximum catch and effort may be affected amounted to 0.17% and 0.12 % of the overall catch and effort figures.
- Demersal longline sector: The maximum catch and effort that may be affected amounted to 0.20% and 0.15% of the overall catch and effort figures.
- Large pelagic longline sector: The maximum catch and effort that may be affected amounted to 0.18% and 0.18% of the overall catch and effort figures.
- Tuna pole sector: The maximum catch and effort that may be affected amounted to 1.24% and 0.7% of the overall catch and effort figures.

For all sectors the impact is considered to be short-term (up to **3-4 months** for drilling) with the duration of behavioural effects being less than or equal to the duration of exposure, although these vary between species.

The **magnitude** of the impact of sound on catch rates during these activities is assessed to be **VERY LOW** for all five wells. Refer to Table 4.9 for the impact ratings on commercial fisheries during the drilling activities.

Table 4.8 Summary of the maximum zones of impact on fishes estimated for all assessed drilling activities (adapted from SLR Consulting Australia, 2022).

Drilling activities		Maximum threshold distances, metre		
		Potential mortal injury	**Recovery injury**	**TTS**
VSP – immediate impact		30	30	N/a
VSP – cumulative	250 VSP pulses	50	80	630
VSP – cumulative	50 VSP pulses	30	40	220
Drilling – cumulative		N/a	40 for 48h	170 for 12h

[31] For fish species, based on the noise exposure criteria provided by Popper et al. (2014), relatively high to moderate behavioural risks are expected at near to intermediate distances (tens to hundreds of meters) from the source location. Relatively low behavioural risks are expected for fish species at far field distances (thousands of meters) from the source location. A distance of 5 km has been used as a worst case scenario to calculate the catch and effort within the zone of noise disturbance. Under a precautionary assumption that the drilling location would be situated in the area of highest fishing activity (i.e. the worst case scenario to the sector was assessed).

Impact Significance

The overall significance of the impact is assessed to be **LOW** for the tuna pole sector and **VERY LOW** for the demersal trawl, demersal longline and large pelagic longline sectors.

Mitigation

Mitigation will ensure good communication and coordination with the various sectors allowing them to focus fishing in other areas.

Residual Impact

With the implementation of the mitigation measures, which will ensure good communication and coordination with affected sectors, allowing them to focus fishing in other areas, the intensity of the impact will reduce to low. The residual impact due to vessel and drilling noise would however remain of **LOW** significance for the tuna pole and **VERY LOW** for the demersal trawl, demersal longline and large pelagic longline sectors (refer to Table 4.9).

Table 4.9: Impact of Vessel and Drilling Noise on Catch Rates.

4	Impact of Sound on Catch Rates during Vessel and Drilling Operations	
Project Phase	**Mobilisation, Operations and Decommissioning**	
Type of Impact	**Indirect**	
Nature of Impact	**Negative**	
	Pre-Mitigation Impact	**Residual Impact**
Sensitivity of Receptor	**MEDIUM** Demersal trawl, demersal longline and large pelagic longline	**MEDIUM** Demersal trawl, demersal longline and large pelagic longline,
	HIGH Tuna pole-line	**HIGH** Tuna pole-line
Magnitude (or Consequence)	**VERY LOW**	**VERY LOW**
Intensity	**MEDIUM**	**LOW**
Extent	**Local**	**Local**
Duration	**Short-term**	**Short-term**
Significance	**LOW** tuna pole-line	**LOW** tuna pole-line
	VERY LOW Demersal trawl, demersal longline, large pelagic longline	**VERY LOW** Demersal trawl, demersal longline, large pelagic longline
Probability	**Possible**	**Possible**
Confidence	**Medium**	**Medium**
Reversibility	**Fully reversible**	**Fully reversible**
Loss of Resources	**Low**	**Low**
Mitigation Potential	**-**	**Very Low**
Cumulative potential	**Unlikely**	**Unlikely**

4.3.2 VERTICAL SEISMIC PROFILING

Impact Magnitude (or Consequence)

The cumulative sound fields based on an assumed 9-hour operation of VSP per well (of up to 250 pulses) were modelled and the zones of cumulative impact on fish were found to extend from the drilling site to distances of 630 m (TTS effects), 80 m (recoverable injury) and 50 m (mortality) (refer to Table 4.7).

As most targeted fish species likely to be encountered within the licence area are highly mobile, they would be expected to flee and move away from the sound source before trauma could occur thus the above assessment is based on the assumption of the worst-case scenario that the animal does not move away from the noise source.

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, based on the noise exposure criteria provided by Popper et al. (2014), relatively moderate to low behavioural risks are expected at near to intermediate distances (tens to hundreds of meters) from the source locations. Relatively low behavioural risks are expected for fish species at far field distances (thousands of meters) from the source location. A distance of 5 km has been used as a worst case scenario to calculate the catch and effort within the zone of noise disturbance. The catch and effort within the estimated 78.5 km^2 behavioural disturbance zone[32] are summarised below.

- Demersal trawl sector: The maximum catch and effort may be affected amounted to 0.17% and 0.12 % of the overall catch and effort figures.
- Demersal longline sector: The maximum catch and effort that may be affected amounted to 0.20% and 0.15% of the overall catch and effort figures.
- Large pelagic longline sector: The maximum catch and effort that may be affected amounted to 0.18% and 0.18% of the overall catch and effort figures.
- Tuna pole sector: The maximum catch and effort that may be affected amounted to 1.24% and 0.7% of the overall catch and effort figures.

Although the effects would largely be limited to the 500 m safety exclusion zone where fishing cannot take place in any event, due to the variability in research on changes in catch rates caused by VSP, the intensity of the impact has been rated **MEDIUM** in accordance with a precautionary approach.

Based on the overlap of fishing grounds with the affected area (to a distance of a few kilometres around the drilling unit), the impact has been rated as being **LOCAL** in extent. The fishing grounds of the demersal trawl, demersal longline, large pelagic longline and tuna pole thus fall within the threshold of sound levels that may lead to a behavioural response from fish.

Behavioural effects are generally short-term, with duration of the effect being less than or equal to the duration of exposure (up to 9 hours per well), although these vary between species. The effects on catch rates have been shown to persist for up to 10 days after the exposure. The potential impact on catch rates could therefore be considered to be of temporary or **short-term duration**.

The impact of VSP operations on zooplankton was assessed in the marine faunal assessment report (Pisces, 2022), which found that the zone of impact for zooplankton to suffer physiological injury is in relatively close proximity to the operating sound source (within 245 m of sound source). As this faunal group cannot move away from the approaching sound source, it is likely to suffer mortality and/or

[32] Under a precautionary assumption that the drilling location would be situated in the area of highest fishing activity (i.e. the worst case scenario to the sector was assessed).

physiological injury within the zone of impact. Potential impacts on ichthyoplankton and pelagic invertebrates would thus be of high intensity at close range, but highly localised and transient due to the localised and short-term nature of the VSP operations. The major spawning areas, as well as egg and larval drift pathways of commercially important species, such as hake, pilchards, horse mackerel and anchovy lie inshore of the Area of Interest for drilling. Seasonally high abundances of ichthyoplankton (hake eggs and larvae), particularly in late winter and early spring may however, occur in the inshore portions of the Area of Interest. Although declines in zooplankton abundance as a result of VSP operations are likely to be negligible, the impact is considered to be of **medium-term duration** for the demersal trawl and demersal long-line sectors.

The overall **magnitude** of the impact of sound on catch rates during these activities is assessed to be **LOW** for the demersal trawl and demersal long-line sectors and **VERY LOW** for the large pelagic longline and tuna pole sectors.

Impact Significance

The overall significance of the impact is assessed to be **LOW** for the demersal trawl, demersal longline and tuna pole and of **VERY LOW** significance for the large pelagic longline sector.

Mitigation

Mitigation will ensure good communication and coordination with the various sectors allowing them to focus fishing in other areas. Research suggests that gradual increase in signal intensity and prior exposure to airgun noise would decrease the severity of alarm responses by fish and invertebrate species. The mitigation measure proposed in the marine ecology assessment (Pulfrich 2022) is that the initiation of airgun firing be carried out as “soft-starts” thus allowing fish to avoid potential physiological injury but it is considered unlikely that this would mitigate effects on catch rates in the wider area.

Residual Impact

With the implementation of the mitigation measures, which will ensure good communication and coordination with the large pelagic longline sector allowing them to focus fishing in other areas, the intensity of the impact will reduce to low. The residual impact of sound produced during VSP operations is assessed to be of **LOW** significance for the tuna pole sector and of **VERY LOW** significance for the demersal trawl sector, demersal longline and large pelagic longline sectors (refer to Table 4.10). There is no impact expected on other fisheries sectors.

Table 4.10: Overall Impact of Underwater Noise from VSP on Catch Rates.

5	Impact of Sound on Catch Rates VSP	
Project Phase:	**Operational**	
Type of Impact	**Indirect**	
Nature of Impact	**Negative**	
	Pre-Mitigation Impact	**Residual Impact**
Sensitivity of Receptor	**MEDIUM** Demersal trawl, demersal longline, large pelagic longline	**MEDIUM** Demersal trawl, demersal longline, large pelagic longline
	HIGH tuna pole-line	**HIGH** tuna pole-line
Magnitude (or Consequence)	**VERY LOW to LOW**	**VERY LOW to LOW**
Intensity	**MEDIUM**	**LOW**
Extent	**Local**	**Local**
Duration	**Short-term** large pelagic longline and tuna pole **Medium-term** demersal trawl, demersal longline	**Short-term** large pelagic longline and tuna pole **Medium-term** demersal trawl, demersal longline
Significance	**LOW** Demersal trawl, demersal longline and tuna pole-line	**LOW** tuna pole-line
	VERY LOW Large pelagic longline	**VERY LOW** Demersal trawl, demersal longline Large pelagic longline
Probability	**Highly likely**	**Possible**
Confidence	**Medium**	**Medium**
Reversibility	**Fully reversible**	**Fully reversible**
Loss of Resources	**Low**	**Low**
Mitigation Potential	**-**	**Low**
Cumulative potential	**Unlikely**	**Unlikely**

4.4 UNPLANNED EVENTS – OIL SPILL

Source of Impact

Unplanned Activities (Emergency Event)	
Activity Phase	Activity
Mobilisation	Transit of drilling unit and support vessels to drill site
Operation	Operation of drilling unit at the drill site and transit of support /supply vessels between the drilling unit and port
	Bunkering of fuel
	Hydrocarbon spills (minor) (e.g. bunkering, loss of BOP hydraulic fluid)
	Loss of well control / Blow-out
Demobilisation	Transit of drilling unit and support vessels from drill site

Project activities that have the potential to affect the fishing industry though unplanned events include hydrocarbon spills which are described below:

- Accidental, instantaneous spills of marine diesel and/or hydraulic fluid can potentially occur during all project activity phases, both from the drilling unit or from support vessels. For example, the release of fuel at the sea surface during bunkering, or the discharge of hydraulic fluid from the BOP at the seabed as a result of hydraulic pipe leaks or ruptures. Such spills are usually of a low volume.
- Larger volume spills of marine diesel would occur in the event of a vessel collision or vessel accident. The movement of the support vessel between the survey area and the port town, and presence of drilling unit, may result in limited interaction with commercial, recreational and fishing boats and other marine recreational activities during their approach to the ports. Such interaction may cause a vessel strikes or collisions resulting in oil tank damage.
- A large-scale, uncontrolled release of oil / gas from the well into the marine environment resulting from a failure of standard pressure control double barrier system (as a minimum) during well-drilling.

Description of Impact

Diesel, hydraulic fluid and/or oil spilled in released into the marine environment would have an immediate and direct effect on water quality, with detrimental effects on marine fauna. These could range from mortality (due to toxicity or suffocation) to sub-lethal physiological damage and long-term effects including disruption of behavioural mechanisms, reduced tolerance to stress, and incorporation of carcinogens into the food chain (Thomson et al. 2000). If the spill reaches the coast, it can result in the smothering of sensitive coastal habitats.

There are several possible direct and secondary impacts of hydrocarbon spills on fisheries:

- Oil contamination of mobile finfish species, in particular of juveniles in nursery areas could result in displacement of species from normal feeding and protective areas as well as possible physical contamination and/or physiological effects such as clogging of gills, both of which would lead to fish mortality;
- Oiling of sessile or sedentary species would result in physical clogging on individuals, disturbance and or removal of habitat for these species and gill clogging for filter feeding species such as mussels, all of which is likely to result in mortality;
- Oiling of passively drifting spawn products (eggs and larvae) would result in their contamination and mortality (the extent of mortality would depend on the nature and extent of the contaminants) leading to reduced recruitment and loss of stock;
- Exclusion of fisheries from areas that may be polluted or closed to fishing due to contamination of sea water by the oil or for example the chemicals used for cleaning oil spills; and
- Gear damage due to oil contamination.

Project Controls

Compliance with COLREGS (the Convention dealing with safety at sea, particularly to reduce the risk of collisions at sea) and SOLAS (the Convention ensuring that vessels comply with minimum safety standards). A 500 m safety zones will be enforced around the drilling unit within which fishing and other vessels would be excluded.

To be prepared in the event of a spill incident, the project will implement an emergency response system to mitigate the consequences of the spill. As standard practice, the Emergency Response Plan (ERP) will include crisis contacts and protocols and an Oil Spill Contingency Plan (OSCP) will be prepared and available at all times during the drilling operation.

Regulation 37 of MARPOL Annex I will be applied, which requires that all ships of 400 gross tonnage and above carry an approved Shipboard Oil Pollution Emergency Plan (SOPEP). The purpose of a SOPEP is to assist personnel in dealing with unexpected discharge of oil onboard, to set in motion the necessary actions to stop or minimise the discharge to the sea and to mitigate its effects on the marine environment. Thus, project vessels will be equipped with appropriate spill containment and clean-up equipment, e.g. dispersants and absorbent materials. All relevant vessel crews will be trained in spill clean-up equipment use and routine spill clean-up exercises.

One of the primary safeguards against a large-scale hydrocarbon blow-out during well-drilling is the column of drilling fluid in the well, which maintains hydrostatic pressure on the wellbore. Under normal drilling conditions, this pressure should balance or exceed the natural rock formation pressure to help prevent an influx of gas or other formation fluids. As the formation pressures increase, the density of the drilling fluid is increased to help maintain a safe margin and prevent "blowouts." However, if the density of the fluid becomes too heavy, the formation can be damaged and fracture. If drilling fluid is lost in the resultant fractures, a reduction of hydrostatic pressure occurs. Maintaining the appropriate fluid density for the wellbore pressure regime is therefore critical to safety and wellbore stability. Abnormal formation pressures are detected by primary well control equipment (pit level indicators, return mud-flow indicators and return mud gas detectors) on the drill unit. The drilling fluid is also tested frequently during drilling operations and its composition can be adjusted to account for changing downhole conditions. The likelihood of a blow-out is further minimised by installation of a blow-out preventer (BOP) on the wellhead at the start of the risered drilling stage. The BOP is a secondary control system, which contain a stack of independently-operated cut-off mechanisms, to ensure redundancy in case of failure. The BOP is designed to close in the well to prevent the uncontrolled flow of hydrocarbons from the reservoir. A blow-out occurs in the highly unlikely event of these pressure control systems failing.

If the BOP does not successfully shut off the flow from the well, the drilling rig would disconnect and move away from the well site while crews mobilise a capping system. The capping system would be lowered into place from its support barge and connected to the top of the BOP to stop the flow of oil or gas.

Oil Spill Response Limited (OSRL), the global oil spill response co-operative funded by more than 160 oil and energy companies, has a base in Saldanha Bay and another base in Aberdeen, which houses cutting edge well capping equipment designed to shut-in an uncontrolled subsea well. The Saldanha based capping stack is available to oil and gas companies across the industry and provides for swift subsea incident response around the world. The equipment is maintained ready for immediate mobilisation and onward transportation by sea and/or air in the event of an incident. TEEPSA is a member of OSRL. This would significantly reduce the spill period. All of TEEPSA's wells are designed to allow for capping.

Other project controls include the preparation and implementation of a Shipboard Oil Pollution Emergency Plan (SOPEP), and Oil Spill Response Plan, an Oil Spill Contingency Plan (OSCP) and a Well Control Contingency Plan (WCCP).

Refer to ESIA Report for more detail on TEEPSA's response and prevention strategies.

Sensitivity of Receptors

Pulfrich (2022) provides a review of the effects of a large-scale oil blow-out on marine fauna for the current project. The sections of the marine fauna assessment report that are considered relevant to the fisheries assessment are summarised below.

Adult free-swimming fish in the open sea seldom suffer long-term damage from oil spills because oil concentrations in the water column decline rapidly following a spill, rarely reaching levels sufficient to cause mortality or significant harm. Adult pelagic fish are expected to actively avoid very contaminated waters, and consequently documented cases of fish-kills in offshore waters are sparse (ITOPF 2014, in Pulfrich 2022). Only in extreme cases of coastal spills when gills become coated with oil can effects be lethal, particularly for benthic or inshore species. Sub-lethal and long-term effects can include disruption of physiological and behavioural mechanisms, reduced tolerance to stress and opportunistic pathogens, and incorporation of Polycyclic Aromatic Hydrocarbons (PAHs) through ingestion of contaminated sediments or prey that has accumulated oil (Thomson et al. 2000; Beyer et al. 2016 in Pulfrich 2022). Experimental exposure of fish to oil-contaminated sediments was found to reduced fitness and thereby increase the potential for population-level impacts, but field studies of population impacts related to sediment contamination are lacking (Pearson 2014).

The embryonic and larval life stages of fish show acute toxicity to PAHs, even at low concentrations, although effects vary depending on the species and the extent of exposure. The time of year during which a large spill takes place will significantly influence the magnitude of the impact on plankton and pelagic fish eggs and larvae. Should the spill coincide with a major spawning peak in the hake, anchovy and pilchard spawning areas during spring and summer, it could result in severe mortalities and consequently a reduction in recruitment (Baker *et al.* 1990; Langangen *et al*. 2017), although Neff (1991) maintains that temporally variable and environmental conditions are likely to have a far greater impact on spawning and recruitment success than a single large spill. Sensitivity of fish eggs and larvae was thought to be primarily associated with exposure to fresh (unweathered) oils (Teal & Howarth 1984; Neff 1991), but recent studies have demonstrated that the weathered water accommodated a fraction of the spill results in increased toxicity (Esbaugh *et al*. 2016).

The spatial and temporal distribution of spawning areas as well as inshore nursery ground areas and fishing grounds are considered in relation to the spatial distribution of the various different oiling scenario probabilities presented in the oil spill modelling report. The spatial extent of surface oiling is also considered in assessing the potential scale of an impact of contamination of fishing grounds.

Figures 3.2 – 3.5 provide a general depiction of spawning areas of key targeted species areas in relation to Block 5/6/7. Further information is provided in the specialist marine ecology assessment (Pulfrich, 2022).

A variety of pelagic species, including anchovy, pilchard, and horse mackerel, are reported to spawn off the Western, Southern and Eastern Agulhas Bank. The eggs and larvae spawned in this area are thought to largely remain on the Agulhas Bank. Demersal species that spawn along the South Coast include the cape hakes and kingklip. Spawning of the shallow-water hake occurs primarily over the shelf (<200 m) whereas that by the deep-water hake occurs off the shelf. Similarly, kingklip spawn off the shelf edge to the south of St Francis and Algoa Bays. Squid spawn principally in the inshore waters (<50 m) between Knysna and Gqeberha, with larvae and juveniles spreading westwards. The inshore area of the Agulhas Bank serves as an important nursery area for numerous linefish species, a significant proportion of which 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 using the inshore Agulhas Bank as nursery grounds (Van der Elst 1976, 1981; Garratt 1988, in Pulfruch 2020). As is evident above, off the South Coast spawning areas are mostly located inshore (that is on the shelf from the coastline to approximately the 200 m depth contour). The coastal bays and estuarine environments are critical nursery areas for many of the fish stocks on which the various commercial fisheries are based. In particular, the small pelagic species of anchovy, sardine, red-eye round herring and juvenile horse mackerel and numerous linefish and demersal species are found in these protected areas in their juvenile stages. Any contamination of these areas would result in mortality of icthyoplankton and impact in the short term on recruitment of species to the demersal trawl sectors, demersal longline, small pelagic purse-seine, midwater trawl, linefish and squid jig sectors.

The eggs and larvae are also 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, therefore, some overlap of Block 5/6/7 with the northward egg and larval drift of commercially important species, and the return migration of recruits. Thus, ichthyoplankton abundance in the inshore portion of the Area of Interest is likely to be seasonally high, particularly in late winter and early spring. The embryonic and larval life stages of fish, however, show acute toxicity to PAHs, even at low concentrations, although effects vary depending on the species and the extent of exposure. In the context of the detrimental effect on icthyoplankton (spawn products) on recruitment to fisheries, all affected fishing sectors are considered to be vulnerable to unplanned and uncontrolled major events and are rated as **HIGH** sensitivity.

Mariculture activities are highly sensitive to water quality variability. The effects of oil spills would potentially have the greatest impact on sessile filter feeding (e.g. mussels and oysters) and grazing species (e.g. abalone) resulting in mortality through physical clogging and or direct absorption. For shore-based collection of abalone, white mussels and any mariculture activities, any pollution associated with oil reaching the shoreline could be devastating for the industry resulting in complete loss of stock. Oil reaching the shoreline could contaminate any water intake for fish farming at the various shore-based aquaculture facilities referenced in Section 3.4.20. Any discharge into the Saldanha Bay area may affect both natural fish populations and bivalve mariculture within the ADZ area. Impacts on juvenile and adult fish can be lethal, as gills may become coated with oil. Sub-lethal and long-term effects can include disruption of physiological mechanisms, reduced tolerance to stress, and incorporation of carcinogens into the food chain (Thomson *et al*., 2000). The result of which would cause severe decrease in overall production rates of any farm within the vicinity of the contaminated area.

Although the Area of Interest is located in the offshore marine environment (more than 60 km offshore), a large spill could directly affect sensitive coastal receptors such as inshore nursery grounds for commercial fish stocks.

Impact Magnitude

The environmental impacts associated with the various oil spill scenarios modelled by Livas (2022b) for two potential well sites in 719 m depth and 72 km from the closest shoreline (Discharge 1) and 1 357 m depth and 155 km from the closest shoreline (Discharge 2) depth are assessed below, based on the footprints for the probability of surface oiling from spill events.

There is a possibility that the hydrocarbon resource targeted by the proposed exploration wells could be condensate rather than crude oil. Condensate and crude oil have the same rock source and would have a similar composition, but would be produced in different volumes with gas taking the place of the liquid component should the resource be condensate. In the event of the well producing oil, the potential blowout rate is estimated at 25 000 bbl of oil and 700 000 Sm^3 of gas per day. In contrast, should the well produce condensate, the estimated potential blowout rate would be 1 200 bbl of condensate and

6.4 million Sm^3 of gas per day. As the release quantities for condensate would be significantly lower and the persistence of the condensate at sea is much lower than oil, the environmental impacts realised during a condensate blowout would also be much lower. Using Discharge Position 1 (719 m depth) as an example, Livas (2022b) compared the model results between a crude oil and condensate blowout to determine the worst-case scenario.

The environmental impacts are assessed below, based on the footprints for the probability of surface oiling from spill events for the worst-case scenario provided by Livas (2022b).

Various factors determine the impacts of oil released into the marine environment. The physical properties and chemical composition of the oil, local weather and sea state conditions and currents greatly influence the transport and fate of the released product. The physical properties that affect the behaviour and persistence of an oil spilled at sea are specific gravity, distillation characteristics, viscosity and pour point, all of which are dependent on the chemical composition of the oil. As soon as oil is spilled, it undergoes physical and chemical changes (collectively termed 'weathering'), which in combination with its physical transport, determine the spatial extent of oil contamination and the degree to which the environment will be exposed to the toxic constituents of the released product. It is estimated that of the oil forming surface layers during a spill, ~40% is rapidly lost to weathering (McNutt et al. 2012). Whereas spreading, evaporation, dispersion, emulsification and dissolution are most important during the early stages of a spill, the ultimate fate of oil is determined by the longer term processes of oxidation, sedimentation and biodegradation.

Stochastic Modelling Results:

It is important to note that the stochastic model outputs do not represent the extent of any one oil spill event (which would be substantially smaller) but rather provides a probability summary of the total individual simulations for a given scenario.

Water Column and surface layer Probability of Contamination

Depending on the season, stochastic simulation results of the oil spill modelling study indicated that at Release Point 1, the hydrocarbon mixture escaping from the well reaches the higher probability for contamination of the deep layers at 380 m to 420 m depth (**capping only**) before forming a subsurface plume that is transported in a north-westerly direction by the current. For this deep layer, 90% probability is reached at distances between ~9 km and ~14 km from the discharge point but spreading up to 70 km to the SE (Season 1) and in the direction of the sensitive Brown's Bank MPA and EBSA, and up to 97 km to the NW (Season 4) in the direction of the Cape Canyon. The probability of contamination of surface water (0-20 m depth) extends up to 165 km to the NW (90% probability) but spreading up to 1 420 km to the NW (Worst case: Season 1; Refer to Figure 4.5).

For Release Point 2 in deeper water, higher probability for contamination of deep layer is reached between 1 000 m and 1 020 m depth (**capping only**), with the oil in most cases being transported in a north-westerly direction by the current reaching 90% probability between ~8 km and ~16 km from the discharge point (depending on the season), but spreading up to 77 km to the SE (Season 1) and in the direction of the sensitive Brown's Bank MPA and EBSA. The probability of contamination of surface water (0-20 m depth) extends up to 91 km to the NW (90% probability) but spreading up to 1 172 km to the WNW (Worst case: Season 1; refer to Figure 4.6).

The application of Subsea Dispersant Injection (SSDI) at the release points results in an increase in the deep layer contamination area and the depth of contamination. For Release Point 1 there is a 90 % probability of contamination up to 18 km and maximum distance 61 km SE to 114 km NW at maximum depths of 400 – 420 m as the dispersant decreases the size of the droplets, reducing the speed of ascent to the surface, thereby increasing the presence of oil in the deep layers, especially close to the release point. At Release Point 2, the contamination area extends up to 18 km SE for the 90% probability for Season 1, but with a maximum distance of 62 km SE for Season 4), and maximum depths of 980 – 1 000 m).

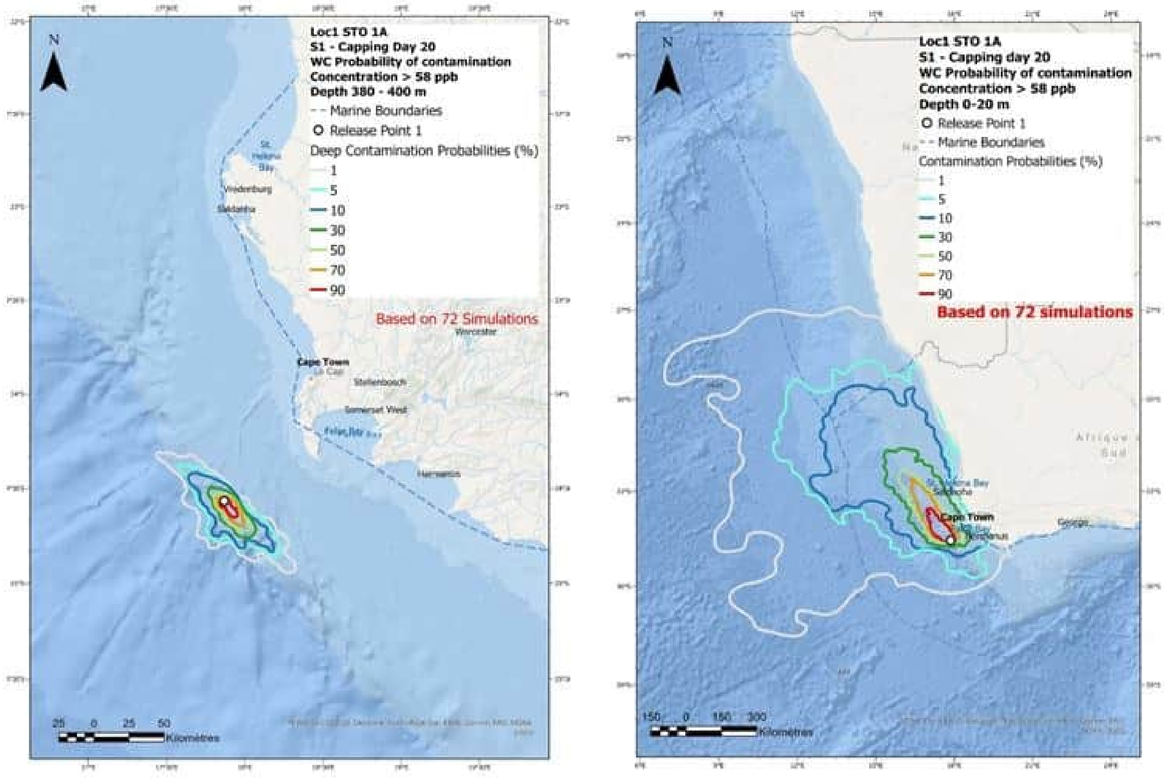


Figure 4.5: Water column probability of contamination >58 ppb for deep-water (left) and surface layers (right) for worst case Season 1 at Release Site 1 with capping only (Source: Livas 2022b).

Surface and Shoreline Oil Presence Probability

For both Release Points 1 and 2, the highest concentrations of rising oil are transported northwestwards into fish spawning areas; with a low probabilities of transport into nearshore nursery areas. Some of the finely dispersed oil droplets in the subsurface plume would remain suspended in the water column and undergo microbial degradation or may be absorbed onto suspended sediments that are then deposited on the seabed. In areas where benthic turbidity events are common and termination depths are relatively close to the seabed, a substantial fraction of the hydrocarbons may therefore be returned to the seabed via redepositing sediments.

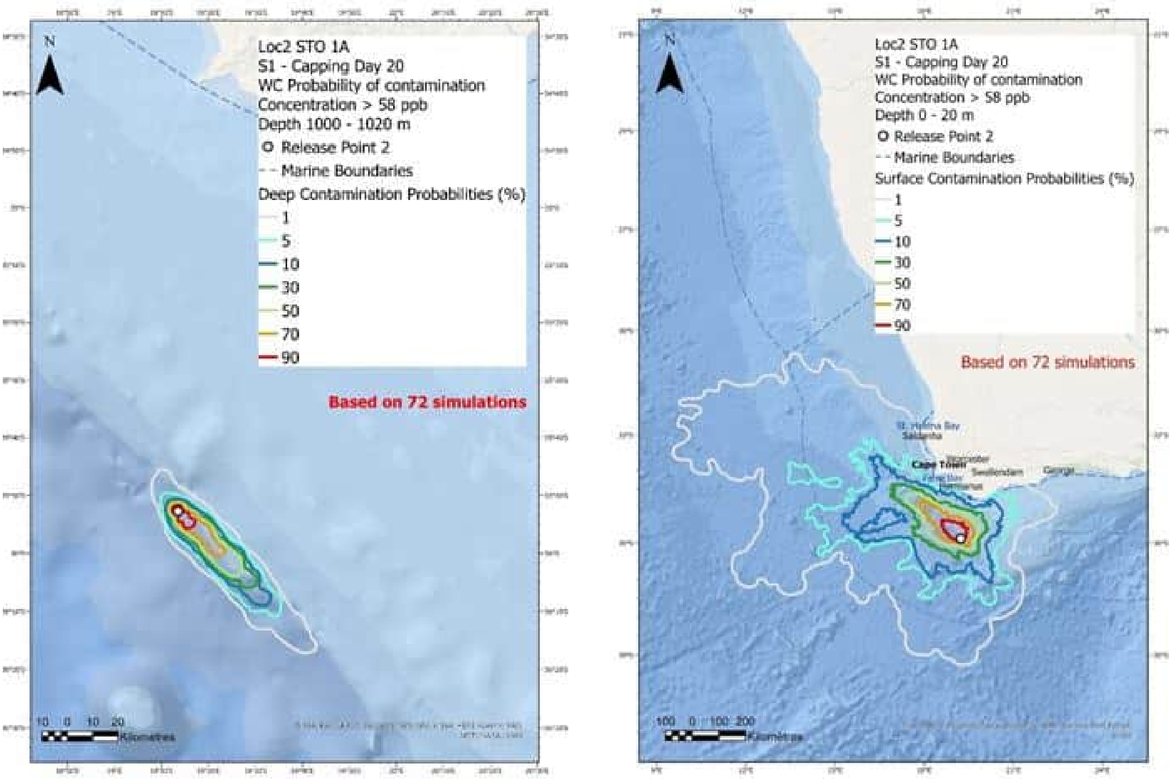


Figure 4.6: Water column probability of contamination >58 ppb for deep-water (left) and surface layers (right) for worst case Season 1 at Release Site 2 with capping only (Source: Livas 2022b).

Once the oil reaches the surface it is distributed by prevailing winds and currents surface. The behaviour and spread of the slick (>5 µm threshold), the likelihood of it reaching the shore and the minimum time for oil to reach the shore is subsequently determined by both the seasonality and the type of spill response implemented (see Livas 2022b for details). For both release points, stochastic modelling results indicate that the probability (>1 % probability) of shoreline oiling above the 10 g/m^2 threshold, extends along a maximum of some 2 640 km of coastline from Plettenberg Bay to north of the Namibian border for Release Point 1, with the maximum distance of the 1% oil surface probability contour extending 1 105 km NW of the release point (Worst case: Season 1). The probability of shoreline oiling is as high as 99% for the Cape Peninsula, 90% for False Bay and 88% probability of shoreline oiling along the West Coast north of Cape Town, with oil reaching the shore within 0.6 days (Worst case: Season 3). The model predicts that up to a maximum of 6 159 tons of oil could reach the shore.

For Release Point 2 (**for the capping response only**), the stochastic modelling results indicate that the probability (>1% probability) of shoreline oiling above the 10 g/m^2 threshold extends along a maximum of 1 635 km of shoreline from George to Port Nolloth (Season 4), with the maximum distance of the 1% oil surface probability contour extending 755 km NW of the release point (Worst case: Season 1). The probability of shoreline oiling is as high as 98% between Hermanus to Agulhas Cape, with 70% probability of oiling on the Cape Peninsula and up to 30% probability of oiling along the West Coast north of Cape Town, with oil reaching the shore within 2.2 days (Worst case: Season 3). The model predicts that up to a maximum of 1 700 tons of oil could reach the shore.

The period June to August (Season 3) was identified as the worst in respect of the maximum amount of oil reaching the shore coupled with the maximum probability of shoreline oiling for both discharge locations. This is due to the dominant surface currents being directed towards the N and NW and winds from NW to SE, driving the spill more towards the coast than for during other seasons. Season 1 (December to February) was the period when a release would have the lowest probability of impacting the shore. This is due to the prevailing currents and wind driving the spill away from the coast toward the NW. However, the stronger currents and winds result the oil being distributed further, with oil from Release Point 1 entering Namibian waters and oil from Release Point 2 spreading westwards into international waters beyond South Africa's EEZ.

With both surface response and SSDI response, the maximum distances from the release point and the maximum shoreline likely to be oiled are reduced, and the minimum arrival time of the oil to shore is extended (for Release Point 1 only). However, the maximum oil presence probability for oiling of the Cape Peninsula is still 95% for Release Point 1 (Season 3) and 33% for release Point 2 (Season 3), with highest values for shoreline oiling at Hermanus Bay to Cape Agulhas from Release Point 2 being as high as 87% (Season 3).

The probability of surface oiling beyond the EEZ for both Release Points 1 and 2 remains at 1% although the area affected is much reduced. The probability of shoreline oiling extending into Namibia remains for Release Point 1 but is reduced to <5%.

Deterministic Simulations

The deterministic predictions for the worst-case oil onshore (**with capping only**) was between 9.9 and 14.6 kg/m^2 extending along 650 to 1 230 km of coastline for Release Point 1 and between 6.5 and 10.3 kg/m^2 extending along 520 to 800 km of coastline for Release Point 2. Capping, surface response and application of SSDI response not only reduces the oil concentration onshore to between 6.2 and 14.5 kg/m^2 (for Release Point 1) and 4.2 to 9.3 kg/m^2 (for Release Point 2) but also reduces the length of coastline affected to a maximum of 1 031 km and 714 km for Release Points 1 and 2, respectively.

From the mass balance figures presented in Livas (2022b), it is evident that the majority of the oil released during a blow-out is evaporated and biodegraded, and that a substantial proportion of the spilled oil remains in the water column (submerged), with only a comparatively small proportion reaching the shoreline. The effect of the response procedures implemented in the control of the spill also become clear. As would be expected, additional surface response deployment reduces both the amount of oil at the surface and that reaching the shore. Application of SSDI response has the effect of substantially reducing oil droplets size thereby promoting entrainment and dispersion in the water column and natural biodegradation processes. Consequently, the amount of oil reaching the surface and subsequently reaching the shore is reduced. However, the entrained plume could potentially extend over substantial distances and cover large areas before the hydrocarbons settle out.

Impact Assessment

Large spills: The extent of the surface oiling could be **regional to international**. Large scale effects on fishing operations would also be likely to include area closures and exclusion of fisheries from areas that may be polluted or closed to fishing due to contamination of surface waters by oil or the chemicals used for cleaning oil spills. Based on the possible extent of surface oiling (and overlap with major fish spawning and nursery areas, and key fishing areas), the intensity of the impact on most commercial fisheries would be high. Based on the extent of surface oiling of a large scale blow-out, the operations of most commercial fisheries would be affected on a regional scale; viz, demersal trawl, midwater trawl, demersal longline, small pelagic purse-seine, large pelagic longline, tuna pole-line, traditional linefish, west coast rock lobster, south coast rock lobster and squid jig. In addition to these offshore fisheries, nearshore small-scale fishing (beach seine, gillnet, seaweed harvesting, white mussels, oysters, abalone, etc.) as well as aquaculture facilities could be affected by shoreline oil contamination. For crude oil the weathering processes over the short-term (hours to weeks) include evaporation, dispersion, dissolution, photo-oxidation, emulsification and spreading, whereas biodegradation and sedimentation dominate the weathering processes over the medium- to long-term (weeks to years). Due to the scale (**regional to international**) extent and **medium-term duration** (due to impact on recruitment) of the impact, the magnitude of the impact on these sectors is expected to be **VERY HIGH**. In all cases impacts are partially reversible.

Small spills: For small spills of diesel or hydraulic fuel during normal operations, the dominant weathering processes are evaporation and dispersion over the short-term. In the unlikely event of an operational spill, the intensity of the impact would depend on whether the spill occurred in offshore waters (i.e. during bunkering) or closer to the shore (e.g. vessel accident) where encounters with sensitive receptors will be higher. Due to the dominant winds and currents in the drill area, a diesel slick would be blown as a narrow plume in a north-westerly direction and away from the coast and spawning areas (regional in extent). The diesel would remain at the surface for up to 5 days (short-term) with a negligible probability of reaching sensitive coastal habitats. In offshore water, the magnitude of a small spill on all fisheries is expected to be of overall **VERY LOW**.

In the case of a spill *en route* to the drill area, the spill may extend into mariculture areas, in which case the intensity would be considered **HIGH**, but of local extent over the medium-term. In nearshore water, the magnitude of a small spill on all fisheries is expected to be of **MEDIUM**.

Impact Significance

Small spill: Based on the high sensitivity of receptors and the very low (offshore) and medium magnitude (nearshore), the potential impact of a small accidental spill on commercial fisheries is considered to be of **LOW TO MEDIUM** significance for an offshore and nearshore spill, respectively.

Well blow-out: Based on the high sensitivity of receptors and the very high magnitude, the potential impact on the commercial and small-scale fisheries is considered to be of **VERY HIGH** significance without mitigation.

Mitigation

Mitigation measures would require the implementation of an oil spill contingency plan including specialised well capping facilities for uncontained blow-outs. Oil spill contingency should consider the risk of this occurring and consider avoiding, as far as possible, drilling operations during the Austral winter when the likelihood of shoreline oiling following the unlikely event of a blow-out is highest, or implementation of additional onsite response and mitigation. The use of dispersants, although appropriate for offshore areas are not likely to be suitable in the vicinity of filter feeding species such as abalone and oysters.

In addition to the best industry practices and the project standards, the following measures are recommended to manage the impacts associated with blow-outs:

Table 4.11: Measures for mitigating impacts of an emergency oil spill event.

No.	Mitigation measure	Classification
1	Prepare and implement a Shipboard Oil Pollution Emergency Plan and a well specific response strategy and plans (Oil Spill Contingency Plan and Blow-Out Contingency Plan). In doing so take cognisance of the National Marine Pollution Contingency Plan, which sets out national policies, principles and arrangements for the management of emergencies including oil pollution in the marine environment. There are three principal components underpinning an Oil Spill Response Plan: • Crisis management (Emergency Command and Control Management); • Spill response, containment and clean-up; and • Well control.	Avoid
2	Avoid, as far as possible, scheduling drilling operations during the Austral winter when the likelihood of shoreline oiling following the unlikely event of a blow-out is highest. In the case of exploration wells drilled in a sequence covering this period, response needs to be enhanced.	Avoid
3	Selection of response strategies that reduce the mobilisation / response timeframes as far as is practicable. Use the best combination of local and international resources to facilitate the fastest response.	
4	Schedule joint oil spill exercises including TEEPSA and local departments / organisations to test the Tier 1, 2 & 3 responses.	
5	Ensure contract arrangements and service agreements are in place to implement the OSCP, e.g. capping stack in Saldanha Bay and other international locations, SSDI kit, surface response equipment (e.g. booms, dispersant spraying system, skimmers, etc.), dispersants, response vessels, etc.	Abate on site / Restore
6	Use low toxicity dispersants that rapidly dilute to concentrations below most acute toxicity thresholds. Dispersants should be used cautiously and only with the permission of DFFE.	Abate on and off site
7	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.	Abate on site
8	In the event of a spill, use satellite-borne Synthetic Aperture Radar (SAR)-based oil pollution monitoring to track the behaviour and size of the spill and optimise available response resources	Abate off site
9	Ensure personnel are adequately trained in both accident prevention and immediate response, and resources are available on each vessel.	Avoid / reduce at source
10	Bunkering at sea: 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.	Avoid / Reduce at source
11	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 mobilised to manage the resolution of all grievances, in accordance with the Grievance Management procedure.	Abate on site

Residual Impact

Small spill: With the implementation of the above-mentioned intrinsic mitigation measures, the residual impact would be of **LOW significance** for small spills (refer to Table 4.12) and of **HIGH significance** for large spills (refer to Table 4.13).

Well blow-out: With the implementation of the mitigation measures, although the intensity and duration would remain, the extent would decrease, thereby reducing the magnitude to high and significance to **HIGH significance.**

Table 4.12 Impact on the fishing industry of an unplanned, small operational spill from drilling and associated activities.

6	Impact on fisheries of small scale hydrocarbon spill	
Project Phase:	Operational	
Type of Impact	Indirect	
Nature of Impact	Negative	
	Pre-Mitigation Impact	Residual Impact
Sensitivity of Receptor	HIGH	HIGH
Magnitude (or Consequence)	VERY LOW (offshore) MEDIUM (nearshore)	VERY LOW
Intensity	High (nearshore) to Low (offshore)	Low (offshore and nearshore)
Extent	Local (nearshore) to Regional (offshore)	Local (nearshore) to Regional (offshore)
Duration	Medium Term (nearshore) to Short Term (offshore)	Short Term (nearshore and offshore)
Significance	LOW (offshore)	LOW (offshore)
	MEDIUM (nearshore)	LOW (nearshore)
Probability	Unlikely	Unlikely
Confidence	Medium	Medium
Reversibility	Fully Reversible	Fully Reversible
Loss of Resources	Low	Low
Mitigation Potential	-	Low
Cumulative potential	Unlikely	Unlikely

Table 4.13 Impact on the fishing industry of an unplanned, large-scale blow-out from drilling and associated activities.

7	Impact on fisheries of large-scale hydrocarbon spill	
Project Phase	Operational	
Type of Impact	Indirect	
Nature of Impact	Negative	
	Pre-Mitigation Impact	Residual Impact
Sensitivity of Receptor	HIGH	HIGH
Magnitude (or Consequence)	VERY HIGH	HIGH
Intensity	High	High
Extent	Regional	Regional
Duration	Medium Term	Medium Term

Significance	VERY HIGH	HIGH
Probability	Unlikely	Unlikely
Confidence	Medium	Medium
Reversibility	Partially Reversible	Partially Reversible
Loss of Resources	High	Medium
Mitigation Potential	-	Medium
Cumulative potential	Possible	Possible

4.5 UNPLANNED EVENTS – LOSS OF EQUIPMENT TO SEA

Source of Impact

Activities and events that could result in lost equipment:

Unplanned Activities		
Activity Phase		Activity
Drilling	Mobilisation	N/A
	Operation	Operation of drilling unit and project vessels and accidental loss of equipment to the water column or seabed during operation
	Demobilisation	N/A

These events are described further below:

- Accidental loss of unsecured equipment / waste on deck during transit; and
- Accidental loss of equipment during vessel transfer with crane (i.e. waste containers, equipment, consumable package, etc.).

A vessel accident/collision could also result in the wreck remaining on the seafloor.

Potential Impact Description

The potential impacts associated with lost equipment include (direct negative impact):

- Potential snagging of demersal gear with equipment that would sink to the seabed;
- Potential risk of entanglement of fishing gear with equipment drifting at the water surface or in the water column; and
- Potential risk of collision of vessels with free-floating equipment drifting at the water surface or in the water column (ship-strikes).

Project Controls

Contractors will ensure that the proposed exploration campaign is undertaken in a manner consistent with good international industry practice and BAT. Equipment and gear will be recovered, where possible, near the surface.

Sensitivity of Receptors

Sensitivity here refers to the ability of the sector to operate as expected considering a project-induced events. Demersal trawl gear could be at risk of damage from equipment lost at the seafloor. Floating equipment could become entangled with fishing gear designed to target the pelagic zone or surface waters (e.g. pelagic longlines, purse-seine). Thus, the sensitivity of fishing gear to lost equipment is considered to be **high**.

Impact Magnitude (or Consequence)

The loss of floating equipment could pose a collision hazard to any vessel before the object sinks under its own weight. In the unlikely event of the loss of floating equipment, the impact could be of low intensity, limited to the site over the short-term. The impact magnitude for equipment lost to the water column is, therefore, considered very low for all fisheries sectors that operate within the licence block.

The accidental loss of equipment onto the seafloor could pose a snagging hazard to demersal trawl gear if located within the demersal trawl grounds. The impact could be of **low intensity**, limited to the **site** over the **short-term** before being buried over time. The impact magnitude for equipment lost on the seabed is, therefore, also considered **very low** for the demersal trawl sector.

Impact Significance

Based on the high sensitivity of the demersal trawl sector and the very low magnitude, the potential impact on commercial fishing is of **low significance** without mitigation.

Mitigation Measures

The following is recommended:

Table 4.14: Measures for mitigating impacts of the loss of equipment to sea.

No.	Mitigation measure	Classification
1	Ensuring that loads are lifted using the correct lifting procedure and within the maximum lifting capacity of the crane system.	Avoid
2	Minimise the lifting path between vessels.	Avoid
3	Undertake frequent checks to ensure items and equipment are stored and secured safely on board each vessel.	Avoid
4	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 licence area with the dates of abandonment / loss and locations and, where applicable, the dates of retrieval.	Repair / restore
5	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.	Repair / restore
6	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 mobilised to manage the resolution of all grievances, in accordance with the Grievance Management procedure.	Abate on site

Residual Impact Assessment

The implementation of the mitigation measures will reduce the intensity of the impact to very low. The residual impact will, however, remain of very low magnitude and of **LOW** significance (Table 4.15).

Table 4.15 Impact on the Fishing Industry of Lost Equipment.

8	Impact of Lost Equipment	
Project Phase:	Operational	
Type of Impact	Indirect	
Nature of Impact	Negative	
	Pre-Mitigation Impact	Residual Impact
Sensitivity of Receptor	HIGH	HIGH
Magnitude (or Consequence)	VERY LOW	VERY LOW
Intensity	Low	Very Low
Extent	Site	Site
Duration	Short Term	Short Term
Significance	LOW	LOW
Probability	Possible	Unlikely
Confidence	Medium	Medium
Reversibility	Partially to Fully Reversible	Partially to Fully Reversible
Loss of Resources	Low	Low
Mitigation Potential	-	Low
Cumulative potential	Unlikely	Unlikely

4.6 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[33] .

Oil and gas exploration could be undertaken in various licence blocks off the West, South and East coasts of South Africa, although very little drilling has been undertaken in the last 10 years. In the order of 358 wells have been drilled in the South African offshore environment to date (based on information provided by PASA in 2021), the majority of which have been drilled off the South Coast on the Agulhas Bank. Two wells were previously drilled by Soekor within Block 5/6/7; one of which was a "dry" well, while the other well showed signs of gas.

There is no current development or production from the South African West Coast offshore. The Ibhubesi Gas Field (Block 2A) (off West Coast, approximately 220 km north of Block 5/6/7) and Kudu Gas Field (off southern Namibia) have been identified for development. On the South Coast, PetroSA operates the F-A production platform, which was brought into production in 1992. The F-A platform is

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

located 85 km south of Mossel Bay in a water depth of 100 m. Gas and associated condensate from the associated gas fields are processed through the platform. The produced gas and condensate are exported through two separate 93 km pipelines to the PetroSA GTL plant located just outside the town of Mossel Bay. It is widely reported that the gas supplying the Mossel Bay GTL plant from Block 9 was due to cease in late 2020 (Business Insider) and it seems likely to close unless a domestic gas supply is identified or a large bail out by the South Africa taxpayer is agreed to fund processing of higher cost feedstocks.

In the Benguela region, fisheries are at risk of additional disruption due to accumulated pressure should new exploration and mining activities commence (by other applicants or existing exploration right holders) during the same period within which the drilling activities in Block 5/6/7 are proposed. Table 4.16 lists the applications for petroleum exploration and mineral prospecting rights in the Southern Benguela region (South African West Coast and southern Namibia) since 2007, indicating which of these have been undertaken. Concurrent activities such as other planned speculative or proprietary seismic surveys in the southern Benguela region could add to the cumulative impact on fisheries.

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 albacore 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. There are a number of reconnaissance permit application and EIA / Basic assessments being undertaken for proposed seismic surveys off the West Coast (Ion, Shearwater and TGS), although it is unlikely that all these will be undertaken as they are targeting similar areas in the Deep Water Orange Basin. These surveys are proposed northward of Block 5/6/7 and are unlikely to have any overlapping impacts. This said, reduced fishing area for the large pelagic long-line sector in particular should these seismic and drilling activities occur at the same time, which is unlikely.

In terms of well drilling Africa Energy are preparing to drill in Block 2B in late 2022/23. This block is located approximately 400 km to the north of Block 5/6/7 and there are unlikely to be any overlapping impacts from normal operations (e.g. underwater noise, discharges, etc.).

Noise, operational lighting and discharges associated with the proposed exploration programme would also have cumulative impact on marine fauna, and possible indirect impact on fishing in the area of interest. Due to the licence area being located within the main vessel traffic routes that pass around southern Africa, ambient noise levels are naturally elevated. Fishing receptors (namely demersal trawl, demersal longline, large pelagic longline and tuna pole-line) are unlikely to be significantly additionally affected as fish behaviour will not be affected beyond an estimated 5 km from the drilling unit during drilling and VSP operations. Noise levels would return back to ambient after drilling is complete. All vessels (fishing, shipping, exploration) operating within the area will make routine discharges to the ocean, each with potential to cause a local reduction in water quality, which could impact targeted fish species. However, each point source is isolated in time and widely distributed within the very large extent of the open ocean. At levels compliant with MARPOL conventions no detectable cumulative effects are anticipated.

Although possible future activities cannot be reasonably defined and it is unlikely that concurrent exploration activities will occur at the same time as the TEEPSA drilling campaign in Block 5/6/7, with the implementation of the proposed mitigation measures, most of the potential impacts will be of short duration, typically ceasing once drilling is completed. Such impacts are, therefore, considered unlikely to contribute to future cumulative impacts, and thus no more significant than assessed in the preceding sections.

The one impact that is expected to continue into the long term is the impact relating to smothering of benthic fauna and demersal fish habitat due to cuttings discharge, which the drilling discharge modelling study predicted can last for up to 10 years. There is currently no indication of further interest to undertake exploration drilling in the blocks adjacent to Block 5/6/7, which could result in depositional overlap. In addition, demersal fishing does not occur off the continental shelf in the majority of Block 5/6/7; thus, cumulative impacts are not activated.

Although cumulative impacts from other hydrocarbon ventures in the area may increase in future, the cumulative impacts of the proposed drilling of exploration wells on fishing on the Western Agulhas Shelf edge can be considered of **LOW significance**.

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.

Table 4.16: Applications for petroleum exploration and mineral prospecting rights in the Southern Benguela region (South African West Coast and southern Namibia) since 2007, indicating which of these have been undertaken.

YEAR	RIGHT HOLDER / OPERATOR	BLOCK	ACTIVITY	APPROVAL	CONDUCTED / COMPLETED
SOUTH AFRICAN WEST COAST PETROLEUM EXPLORATION					
2007	PASA	Orange Basin	2D Seismic	Yes	Nov-Dec 2007
2008	PASA	West Coast	2D Seismic	Yes	Sep 2008
2008	PetroSA	Block 1	3D Seismic	Yes	Jan-Apr 2009
2011	Forest Oil (Ibhubesi)	Block 2A	3D Seismic	Yes	May-Jul 2011
2011	PetroSA / Anadarko	Block 5/6 (ER224); Block 7 (ER228)	2D / 3D Seismic and CSEM	Yes	2D: Dec 2012 – Feb 2013 3D: Jan–Apr 2020
2011	PetroSA	Block 1	Exploration drilling	Yes	unknown
2012	BHP Billiton (now Ricocure Azinam & Africa Oil)	Block 3B/4B	2D and 3D Seismic	Yes	unknown
2013	Spectrum	West Coast regional	2D Seismic	Yes	2D: April 2015
2013	PetroSA	Block 1	2D and 3D Seismic	Yes	3D: Feb-May 2013 (conducted by Cairn)
2013	Anadarko	Block 2C	2D and 3D Seismic, MBES, heat flow, seabed sampling	Yes	unknown
2013	Anadarko	Block 5/6/7	MBES, heat flow, coring	Yes	Jan-Mar 2013
2014	OK/Shell	Northern Cape Ultra Deep ER274	2D and 3D Seismic, MBES, magnetics, seabed sampling	Yes	2D: Feb-Mar 2021
2014	Shell	Deep Water Orange Basin	Exploration drilling	Yes	No (Shell relinquished block to TEEPSA)
2014	Cairn	ER 12/3/083	2D Seismic	Yes (obtained by PetroSA)	2D: Feb-Mar 2014
2014	Cairn	Block 1	Seabed sampling	Yes	unknown
2014 - 2015	Thombo	Block 2B (ER105)	Exploration drilling	Yes	No (Africa Energy preparing to drill in late 2022/23)
2014	New Age Energy	Southwest Orange Basin	2D Seismic	unknown	unknown
2015	Cairn	Block 1	Exploration drilling	unknown	unknown
2015	Sunbird	West Coast	Production pipeline (Ibhubesi)	Yes	No (EA was renewed for an additional 5 years on 30 June 2022)
2015	Rhino	Southwest coast (inshore)	2D Seismic, MBES	unknown	unknown
2015	Rhino	Block 3617/3717	2D and 3D Seismic, MBES	Yes	unknown
2017	Impact Africa / TEEPSA	Southwest Orange Deep	2D and 3D Seismic	unknown	unknown
2018	PGS	West Coast regional	2D and 3D Seismic	Yes	
2019	Anadarko	Block 5/6/7	2D Seismic	Yes	
2021	Searcher	West Coast regional	2D and 3D Seismic	Yes (currently appealed)	2D: Jan 2022 (incomplete)

YEAR	RIGHT HOLDER / OPERATOR	BLOCK	ACTIVITY	APPROVAL	CONDUCTED / COMPLETED
2021	TGS	West Coast regional	2D Seismic	Yes	No
2021	Tosaco	Block 1, ER362	3D Seismic	Withdrawn	-
2022	Ion	Deep Water Orange Basin	3D Seismic	Application in prep.	No
2022	Searcher	Deep Water Orange Basin	3D Seismic	Basic Assessment ongoing	No
2022	Shearwater	Deep Water Orange Basin	3D Seismic	Basic Assessment ongoing	No
2022	TGS	Deep Water Orange Basin	3D Seismic	Basic Assessment ongoing	No
2022	TEEPSA	Block 5/6/7	Exploration drilling	EIA ongoing	No - current project
2022	TEEPSA	Deep Water Orange Basin	2D and 3D Seismic, drilling	EA application yet to be submitted	No
SOUTHERN NAMIBIA PETROLEUM EXPLORATION					
2011	Signet	Block 2914B (now part of PEL39)	2D and 3D Seismic; development of production facility	unknown	unknown
2011	PGS	Block 2815	3D Seismic	Yes	3D: 2011 (HRT)
2013	Spectrum Namibia	Orange Basin multiclient	2D Seismic	Yes	2D: April 2014
2014	Shell Namibia	2913A; 2914B	3D Seismic	Yes	3D: 2015
2016	Spectrum	Southern Namibia regional	2D Seismic	Yes	2D: April 2019
2017	Shell Namibia	PEL39	Exploration drilling	Yes	Dec 2021
2019	Galp Namibia	PEL83	Exploration drilling	Yes	No (Applying for ECC extension)
2019	TEEPNA	Block 2913B (PEL56)	Exploration drilling	Yes	Drilling: Nov 2021 – Mar 2022
2020	TEEPNA	Block 2912, 2913B (PEL91; PEL56)	3D Seismic	Yes	Planned for Jan 2023
2020	TGS Namibia	Blocks 2711, 2712A, 2712B, 2713, 2811, 2812A, 2812B, 2913B in the Orange Basin	3D Seismic	Pending	No
2020	Tullow Namibia (Harmattan Energy Ltd)	Block 2813B (PEL90)	3D Seismic	EIA ongoing	No

YEAR	RIGHT HOLDER / OPERATOR	BLOCK	ACTIVITY	APPROVAL	CONDUCTED / COMPLETED
SOUTH AFRICAN SEA AREAS MINERALS PROSPECTING AND MINING					
2011	Aurumar	SASA 1C-9C SASA 12C, 14C-18C, 20C	Heavy minerals coring	Yes	Jan-Mar 2011 2C-5C: Geophysical & coring 7C-10C: Geophysical & coring 12C, 14C-18C & 20C: Only desktop
2013-2014	Belton Park Trading	SASA 2C-5C	Geophysical surveys, coring, bulk sampling	Yes	Survey: ongoing in 2C and 3C Sampling: ongoing in 2C and 3C Various prospecting operations undertaken over duration of prospecting right
2017	Belton Park Trading	SASA 2C (3C was incorporated into mining right area in 2019)	Mining	Yes	Ongoing prospecting and mining has taken place over various campaigns to date: SASA 2C: 9 Aug – 7 Nov 2018 SASA 2C: 13 Mar – 5 May 2019; SASA 2C: 9 Jul – 25 Oct 2019 SASA 2C & 3C: 27 Feb – 31 Aug 2020 Mining is currently ongoing
2018	De Beers Marine	SASA 6C	Geophysical surveys, coring, bulk sampling	Yes	Survey: May-Jul 2021 Sampling: Dec 2021 – Jan 2022
2020	Belton Park Trading	SASA 14B, 15B, 17B	Geophysical surveys, coring, bulk sampling	Yes but appeal still under review	
2020	Belton Park Trading	SASA 13C, 15C, 16C, 17C, 18C	Geophysical surveys, coring, bulk sampling	Yes but appeal still under review	
2021	De Beers Marine	SASA 4C & 5C	Geophysical surveys, coring, bulk sampling	Application in prep.	
2021	Samara Mining	SASA 4C & 5C	Geophysical surveys, coring, bulk sampling	Application contested and withdrawn	
2021-2022	Moonstone Diamond Marketing	SASA 11B, 13B	Geophysical surveys, coring, bulk sampling	Applications delayed. Second round EIAs in prep.	
2022	Trans-Atlantic Diamonds	SASA 14A	Geophysical surveys, coring, sampling	Yes	
2022	Trans-Atlantic Diamonds	SASA 11C	Geophysical surveys, coring, sampling	FBAR submitted to DMRE on 2 March 2022	

5 CONCLUSIONS AND RECOMMENDATIONS

The proposed exploration activities could potentially affect commercial fishing activities during all phases of the project. The following impacts on fisheries arising during planned operations were identified: 1) temporary safety zone around drilling unit; 2) permanent exclusion around abandoned wellhead(s); 3) release of drill cuttings into the marine environment; 4) noise emissions during drilling; 5) noise emissions during VSP. The potential impact of unplanned (accidental) events were identified as: 6) low volume release of diesel or hydraulic fuel from vessels or drilling unit; 7) a large-scale, uncontrolled blow-out of hydrocarbons at the well due to a failure of pressure control systems; and 8) loss of equipment to sea.

Table 5.1 lists the proportion of catch reported by each fishery sector in relation to the licence area, the proposed area of interest for drilling and affected areas. Table 5 lists the overall significance of each of the identified project impacts before and after the implementation of mitigation measures (listed in Table 5.3).

Table 5.1 Summary of proportional catch, by fishing sector, within Block 5/6/7, the proposed new area for well drilling and impacted areas.

Sector	% of National Catch					
	Within Block 5/6/7	Within AOI for drilling	Within Affected Area			
			Drilling unit (500 m)	Abandoned wellhead (500 m)	Sound (5 km)	Smothering (5 km)
Demersal Trawl	39.76	0.27	0.02	0.02	0.17	0.12
Midwater Trawl	14.61	0	0	N/A	0	N/A
Demersal Longline	51.99	0.12	0.02	N/A	0.2	0.15
Small Pelagic Purse-Seine	2.22	0	0	N/A	0	N/A
Large Pelagic Longline	14.67	5.79	3.9*	N/A	0.18	N/A
Tuna Pole-Line	70.50	13.74	0.14	N/A	1.24	N/A
Traditional linefish	0.5	0	0	N/A	0	N/A
West Coast Rock Lobster	0	0	0	N/A	0	N/A
South Coast Rock Lobster	0	0	0	N/A	0	N/A
Squid Jig	0.17	0	0	N/A	0	N/A
Demersal Shark Longline	0	0	0	N/A	0	N/A
Small-scale Fisheries	0	0	0	N/A	0	N/A
White Mussels	0	0	0	N/A	0	N/A
Oysters	0	0	0	N/A	0	N/A
Abalone Harvesting	0	0	0	N/A	0	N/A
Abalone Ranching	0	0	0	N/A	0	N/A
Netfish	0	0	0	N/A	0	N/A
Seaweed harvesting	0	0	0	N/A	0	N/A
Fisheries research	0	0	0	N/A	0	N/A

*The affected area has been raised to a radius of 30 km around the drilling unit due to the mobile (drifting) nature of gear set by the large pelagic longline sector.

Table 5.2 Summary table of fisheries impact significance ratings (pre- and post-mitigation) according to identified project actvities.

Ref:	Potential Impact Source	Project Phase	Impact Significance	
			Pre-Mitigation Impact	Residual Impact
1	Temporary Safety Zone around Drilling Unit	Operation	LOW - NEGLIGIBLE	LOW - NEGLIGIBLE
2	Presence of Subsea Infrastructure - Permanent Exclusion around Wellhead(s)	Demobilisation	MEDIUM	NO IMPACT
3	Discharge of Drill Cuttings	Operation	NEGLIGIBLE	NEGLIGIBLE
4	Drilling Noise	Operation	LOW – VERY LOW	LOW – VERY LOW
5	VSP Noise	Operation	LOW – VERY LOW	LOW – VERY LOW
6	Accidental Oil Spill: Minor	Unplanned Event	LOW – MEDIUM	LOW
7	Accidental Oil Spill: Major	Unplanned Event	VERY HIGH	HIGH
8	Accidental Loss of Equipment at Sea	Operation	LOW	LOW

Table 5.3 Summary table of proposed mitigation measures for each identfied impact.

No.	Mitigation measure – Temporary Safety Zone around Drilling Unit	Classification
1	At least three weeks prior to the commencement of the drilling operations, distribute a Notice to Mariners to key stakeholders prior to the well-drilling operations. The Notice to Mariners should give notice of (1) the co-ordinates of the drilling area, (2) an indication of the proposed operational timeframes, (3) the dimensions of the safety zone around the drilling unit (500 m – 2 km), and (4) 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. Stakeholders include the relevant fishing industry associations: FishSA, SA Tuna Association; SA Tuna Longline Association, Fresh Tuna Exporters Association, South African Deepsea Trawling Industry Association (SADSTIA) and South African Hake Longline Association (SAHLLA). Other key stakeholders: SANHO, South African Maritime Safety Association (SAMSA), and DFFE Vessel Monitoring, Control and Surveillance (VMS) Unit in Cape Town. These stakeholders should again be notified at the completion of drilling when the drilling unit and support vessels are off location.	Avoid/reduce at source
2	Request, in writing, the SANHO to broadcast a navigational warning via Navigational Telex (Navtext) and Cape Town radio for the duration of the well drilling operation.	Avoid
3	Manage the lighting on the drilling unit and support vessels to ensure that it is sufficiently illuminated to be visible to fishing vessels and compatible with safe operations.	Abate on site
4	Notify any fishing vessels at a radar range of 24 nm from the drilling unit via radio regarding the safety requirements around the drilling unit.	Abate on site
5	Implement a grievance mechanism that allows stakeholders to register specific grievances related to operations, by ensuring they are informed about the process and that resources are mobilised to manage the resolution of all grievances, in accordance with the Grievance Management procedure.	Abate on site
No.	**Mitigation measure – Permanent Safety Zone around Abandoned Well**	**Classification**
1	Abandoned wellhead and buoy anchor locations must be surveyed and accurately charted with the South African Navy Hydrographer (SANHO).	Abate
2	Avoid drilling within the boundaries of the current demersal trawl “ringfenced” area or remove wellhead structures if coincident with the trawl “ringfenced” area.	Avoid / restore

No.	Mitigation measure – Discharge of Drill Cuttings	Classification
1	Undertake pre-drilling site surveys (with ROV) to ensure there is sufficient information on seabed habitats, including the mapping potentially vulnerable habitats within 1 000 m of a proposed well site.	Avoid / reduce at source
2	Ensure that, based on the pre-drilling site survey and expert review of ROV footage, drilling locations are not located within a 1 000 m radius of any sensitive or potentially vulnerable habitats (e.g. hard grounds), species (e.g. cold corals, sponges) or sensitive structural features (e.g. rocky outcrops).	Avoid / reduce at source
3	Careful selection of drilling fluid additives taking into account their concentration, toxicity, bioavailability and bioaccumulation potential; Ensure only low-toxicity, low bioaccumulation potential and partially biodegradable additives are used. Maintain a full register of Material Safety Data Sheets (MSDSs) for all chemical used, as well as a precise log file of their use and discharge.	Avoid / reduce at source
4	If NADFs are used for drilling the risered sections, ensure regular maintenance of the onboard solids control package and avoid inappropriate discharge of NADF cuttings.	Abate on site
5	Monitoring requirements: • Test drilling fluids for toxicity, barite contamination and zero oil content (for WBM) and less than 6% (for NADF) to ensure the specified discharge standards are maintained. • Monitor (using ROV) cement returns and if significant discharges are observed on the seafloor terminate cement pumping, as far as possible. • Monitor (using ROV) hole wash out to reduce discharge of fluids as far as possible.	Reduce at source / abate on site
No.	**Mitigation measure – Emergency Oil Spill**	**Classification**
1	Prepare and implement a Shipboard Oil Pollution Emergency Plan and a well specific response strategy and plans (Oil Spill Contingency Plan and -Out Contingency Plan). In doing so take cognisance of the South African Marine Pollution Contingency Plan, which sets out national policies, principles and arrangements for the management of emergencies including oil pollution in the marine environment. There are three principal components underpinning an Oil Spill Response Plan: • Crisis management (Emergency Command and Control Management); • Spill response, containment and clean-up; and • Well control.	Avoid
2	Avoid, as far as possible, scheduling drilling operations during the Austral winter when the likelihood of shoreline oiling following the unlikely event of a blow-out is highest. In the case of exploration wells drilled in a sequence covering this period, response needs to be enhanced.	Avoid
3	Selection of response strategies that reduce the mobilisation / response timeframes as far as is practicable. Use the best combination of local and international resources to facilitate the fastest response.	
4	Schedule joint oil spill exercises including TEEPSA and local departments / organisations to test the Tier 1, 2 & 3 responses.	
5	Ensure contract arrangements and service agreements are in place to implement the OSCP, e.g. capping stack in Saldanha Bay and other international locations, SSDI kit, surface response equipment (e.g. booms, dispersant spraying system, skimmers, etc.), dispersants, response vessels, etc.	Abate on site / Restore
6	Use low toxicity dispersants that rapidly dilute to concentrations below most acute toxicity thresholds. Dispersants should be used cautiously and only with the permission of DFFE.	Abate on and off site
7	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.	Abate on site
8	In the event of a spill, use satellite-borne Synthetic Aperture Radar (SAR)-based oil pollution monitoring to track the behaviour and size of the spill and optimise available response resources	Abate off site

9	Ensure personnel are adequately trained in both accident prevention and immediate response, and resources are available on each vessel.	Avoid / reduce at source
10	Bunkering at sea: 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.	Avoid / Reduce at source
11	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 mobilised to manage the resolution of all grievances, in accordance with the Grievance Management procedure.	Abate on site
No.	**Mitigation measure – Loss of Equipment to Sea**	**Classification**
1	Ensuring that loads are lifted using the correct lifting procedure and within the maximum lifting capacity of the crane system.	Avoid
2	Minimise the lifting path between vessels.	Avoid
3	Undertake frequent checks to ensure items and equipment are stored and secured safely on board each vessel.	Avoid
4	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 licence area with the dates of abandonment / loss and locations and, where applicable, the dates of retrieval.	Repair / restore
5	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.	Repair / restore
6	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 mobilised to manage the resolution of all grievances, in accordance with the Grievance Management procedure.	Abate on site

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APPENDIX 1: ASSESSMENT METHODOLOGY

The spatial distribution of fishing effort and catch was mapped at an appropriate resolution for each fishing sector (based on the fishing method and resulting area covered by fishing gear). Fishing catch and effort within the licence block and focus drilling area were expressed as a percentage of the total effort and catch figures for each sector. This indicated the proportion of fishing ground that could be affected by the presence of the drilling unit in relation to each fishing sector.

The potential reduction in catch was estimated as:

$$Ci = CT \times \left(\frac{Di}{Dt}\right)$$

where

Ci = catch potentially lost as a result of exclusion from fishing grounds (tons)

CT = total catch recorded as taken in the impact area (in this case the entire survey area) during fishing period (tons)

Di = duration of impact (days)

Dt = total days fished in the survey area during fishing period (dependent on the seasonality of each fishery)

The convention used to evaluate the significance of the impact is provided below. The sensitivity of the receptor was derived from the baseline information. The impact magnitude (or consequence) was determined based on a combination of the “intensity”, “duration” and “extent” of the impact. Magnitude was assigned to the pre-mitigation impact (i.e. before additional mitigation measures are applied, but taking into account embedded controls specified as part of the project description) and residual impacts after additional mitigation is applied. Thereafter the impact significance rating was determined as a function of the intensity and the sensitivity of the impact. Significance was assigned to the predicted impact pre-mitigation and post-mitigation (residual) after considering all possible feasible mitigation measures in accordance with the mitigation hierarchy. Terminology, criteria and ratings are outlined further below.

Term	Definition
Nature of Impact	The direction of impact and whether it leads to an adverse effect (negative), beneficial effect (positive) or no effect (neutral)
Positive	An impact that is considered to represent an improvement to the baseline conditions or introduces a positive change to a receptor.
Negative	An impact that is considered to represent an adverse change from the baseline conditions or receptor, or introduces a new adverse effect.
Neutral	An impact that has no or negligible effect on the receptor.
Type	Cause and effect relationship between the project activity and the nature of effect on receptor
Direct	Impacts that result from a direct interaction between a proposed project activity and the receiving environment (e.g. effluent discharge and receiving water quality). Sometimes referred to as primary impacts.
Indirect	Impacts that are not a direct result of a proposed project, often produced away from or as a result of a complex impact pathway. Sometimes referred to as secondary impacts.
Induced	A type of indirect impact resulting from factors or activities caused by the presence of the Project but which are not always planned or expected (e.g. human in-migration along new access or for jobs creating increased demand on resources).
Residual	The impacts that remain after implementation of the project and all associated mitigation and other environmental management measures.

7.1.1 DEFINITIONS OF IMPACT ASSESSMENT CRITERIA AND CATEGORIES APPLIED

Definitions of the criteria used in assessing impact significance and the assigned categories, and the additional criteria used to describe the impacts, are summarised in the table below.

Criterion	Definition	Categories
Sensitivity	Sensitivity is a rating given to the importance and/ or vulnerability of a receptor (e.g. conservation value of a biodiversity feature or cultural heritage resource or social receptor.	Very Low/ Low Medium/ High/ Very High
Magnitude (or consequence)	A term describing the actual change predicted to occur to a resource or receptor caused by an action or activity or linked effect. It is derived from a combination of Intensity, Extent and Duration and takes into account scale, frequency and degree of reversibility	Very Low/ Low/ Medium/ High/ Very High
Intensity	A descriptor for the degree of change an impact is likely to have on the receptor which takes into account scale and frequency of occurrence.	Very Low/ Low Medium/ High
Extent	The spatial scale over which the impact will occur.	Site/ Local/ National Regional/ International /Transboundary
Duration	Time scale over which the consequence of the effect on the receptor/s will last. [Note that this does not apply to the duration of the project activity]. The terms 'Intermittent' and 'Temporary' may be used to describe the duration of an impact.	Short-term Medium-term Long-term Permanent
Probability	A descriptor for the likelihood of the impact occurring. Most assessed impacts are likely to occur but Probability is typically used to qualify and contextualise the significance of unplanned events or major accidents.	Unlikely/ Possible Likely/ Highly Likely Definite
Confidence	A descriptor for the degree of confidence in the evaluation of impact significance.	Low/ Medium High/ Certain
Mitigation potential	A descriptor for the degree to which the impact can be mitigated to an acceptable level.	None/ Very Low Low/ Medium/ High
Loss of Irreplaceable resources	A descriptor for the degree to which irreplaceable resources will be lost, fragmented or damaged.	Low/ Medium/ High
Reversibility	A descriptor for the degree to which an impact can be reversed.	Irreversible Partially Reversible Fully Reversible
Cumulative	A descriptor of the potential for an impact to have cumulative impacts to arise.	Unlikely/ Possible Likely

Sensitivity is a term that covers the 'importance' (e.g. value of an ecological receptor or heritage resource) or 'vulnerability' (e.g. ability of a social receptor to cope with change) of a receptor to a project-induced change. It takes into account 'Irreplaceability' - measure of the value of, and level of dependence on, impacted resources to society and/ or local communities, as well as of consistency with policy (e.g. conservation) targets or thresholds. Broad definitions of sensitivity ratings for abiotic receptors are defined below.

Sensitivity Rating	**Definition**
Social Receptors	**Individuals, communities or groups of stakeholders**
Very Low	Receptors who are not vulnerable or susceptible to project-related changes and have substantive resources and support to understand and anticipate Project impacts. Such receptors have the ability to avoid negative Project impacts, or to cope with, resist or recover from the consequences of a such an impact with negligible changes to their lives, or will derive little benefit or opportunities from the project.
Low	Receptors who have few vulnerabilities and are marginally susceptible to project-related changes but still have substantive resources and support to understand and anticipate a Project impact. Such receptors are able to easily adapt to changes brought about by the project with marginal impacts on their living conditions, livelihoods, health and safety, and community well-being, or will derive marginal benefits or opportunities from the project.
Medium	Receptors have some vulnerabilities and are more susceptible to project-related changes given they only have moderate access to resources, support, or capacity to understand and anticipate a Project impact. Such receptors are not fully resilient to Project impacts but are generally able to adapt to such changes albeit with some diminished quality of life. For positive impacts, these receptors are likely to derive a moderate level of benefit or opportunities from the project.
High	Receptors are vulnerable and susceptible to project-related changes, and have minimal access to resources, support, or capacity to understand and anticipate a Project impact. Such receptors are not resilient to Project impacts and will not be able to adapt to such changes without substantive adverse consequences on their quality of life. For positive impacts, these receptors are likely to derive a substantial level of benefits or opportunities from the project.
Very High	Receptors are highly vulnerable and have very low resilience to project-related changes. By fact of their unique social setting or context, such receptors have a diminished or lack of capacity to understand, anticipate, cope with, resist or recover from the consequences of a potential impact without substantive external support. For positive impacts, receptors are likely to derive substantial benefits or opportunities from the project which could lead to significant and sustained improvement in their quality of life.

7.1.2 DETERMINATION OF MAGNITUDE (OR CONSEQUENCE)

Definitions of Criteria Used to Derive Magnitude

The term ‘magnitude’ (or ‘consequence’) describes and encompasses all the dimensions of the predicted impact including:

- the nature of the change (what is affected and how);
- its size, scale or intensity;
- degree of reversibility; and
- its geographical extent and distribution.

Taking the above into account, Magnitude (or consequence) is derived from a combination of ‘Intensity’, ‘Duration’ and ’Extent’.

The criteria for deriving Intensity, Extent and Duration are summarised below.

Criteria	Rating	Description
Criteria for ranking of the INTENSITY of environmental impacts taking into account reversibility and scale	**VERY LOW**	Negligible change, disturbance or nuisance which is barely noticeable or may have minimal effect on receptors or affect a tiny proportion of the receptors.
	LOW	Minor (Slight) change, disturbance or nuisance which is easily tolerated and/or reversible in the short term without intervention, or which may affect a small proportion of receptors.
	MEDIUM	Moderate change, disturbance or discomfort caused to receptors or which is reversible over the medium term, and/or which may affect a moderate proportion of receptors.
	HIGH	Prominent change, or large degree of modification, disturbance or degradation caused to receptors or which may affect a large proportion of receptors, possibly entire species or community and which is not easily reversed.
Criteria for ranking the EXTENT / SPATIAL SCALE of impacts	**SITE**	Impact is limited to the immediate footprint of the activity and immediate surrounds within a confined area.
	LOCAL	Impact is confined to within the project concession / licence area and its nearby surroundings.
	REGIONAL	Impact is confined to the region, e.g. coast, basin, catchment, municipal region, district, etc.
	NATIONAL	Impact may extend beyond district or regional boundaries with national implications.
	INTERNATIONAL	Impact extends beyond the national scale or may be transboundary.
Criteria for ranking the DURATION of impacts	**SHORT TERM**	The duration of the impact will be < 1 year or may be intermittent.
	MEDIUM TERM	The duration of the impact will be 1-5 years.
	LONG TERM	The duration of the impact will be 5-25 years, but where the impact will eventually cease either because of natural processes or by human intervention.
	PERMANENT	The impact will endure for the reasonably foreseeable future (>25 years) and where recovery is not possible either by natural processes or by human intervention.

7.1.3 DETERMINING MAGNITUDE (OF CONSEQUENCE) RATINGS

Once the intensity, extent and duration are defined based on the definitions set out above, the magnitude (or consequence) of negative and positive impacts is derived based on the table below. It should be noted that there may be times when these definitions may need to be adjusted to suit the specific impact where justification should be provided. For instance, the permanent loss of the only known occurrence of a species in a localised area of impact can only achieve a "High" magnitude rating but could, in this instance, warrant a Very High rating. The justification for amending the rating should be indicated in the impact table.

Magnitude/ Consequence Rating	Description
VERY HIGH	Impacts could be EITHER: of ***high intensity*** at a ***regional level*** and endure in the ***long term***; OR of ***high intensity*** at a ***national level*** in the ***medium or long term***; OR of ***medium intensity*** at a ***national level*** in the ***long term.***
HIGH	Impacts could be EITHER: of ***high intensity*** at a ***regional level*** and endure in the ***medium term***;

Magnitude/ Consequence Rating	Description
	OR of ***high intensity*** at a ***national level*** in the ***short term***; OR of ***medium intensity*** at a ***national level*** in the ***medium term;*** OR of ***low intensity*** at a ***national level*** in the ***long term***; OR of ***high intensity*** at a ***local level*** in the ***long term***; OR of ***medium intensity*** at a ***regional level*** in the ***long term.***
MEDIUM	Impacts could be EITHER: of ***high intensity*** at a ***local level*** and endure in the ***medium term***; OR of ***medium intensity*** at a ***regional level*** in the ***medium term***; OR of ***high intensity*** at a ***regional level*** in the ***short term***; OR of ***medium intensity*** at a ***national level*** in the ***short term***; OR of ***medium intensity*** at a ***local level*** in the ***long term***; OR of ***low intensity*** at a ***national level*** in the ***medium term;*** OR of ***low intensity*** at a ***regional level*** in the ***long term.***
LOW	Impacts could be EITHER of ***low intensity*** at a ***regional level*** and endure in the ***medium term***; OR of ***low intensity*** at a ***national level*** in the ***short term***; OR of ***high intensity*** at a ***local level*** and endure in the ***short term***; OR of ***medium intensity*** at a ***regional level*** in the ***short term***; OR of ***low intensity*** at a ***local level*** in the ***long term***; OR of ***medium intensity*** at a ***local level*** and endure in the ***medium term.***
VERY LOW	Impacts could be EITHER of ***low intensity*** at a ***local level*** and endure in the ***medium term***; OR of ***low intensity*** at a ***regional level*** and endure in the ***short term***; OR of ***low or medium intensity*** at a ***local level*** and endure in the ***short term.*** OR **Zero to very low *intensity*** with any combination of extent and duration.

7.1.4 DETERMINATION OF IMPACT SIGNIFICANCE

The significance of an impact is based on expert judgement of the sensitivity (importance or vulnerability) of a receptor and the magnitude (or consequence) of the effect that will be caused by a project-induced change.

In summary, the impact assessment method is based on the following approach:

Significance = Magnitude x Sensitivity

Where Magnitude = Intensity +Extent + Duration

Once ratings are applied to each of these parameters the following matrix is used to derive Significance:

		SENSITIVITY				
		VERY LOW	**LOW**	**MEDIUM**	**HIGH**	**VERY HIGH**
MAGNITUDE (or CONSEQUENCE)	**VERY LOW**	**NEGLIGIBLE**	**NEGLIGIBLE**	**VERY LOW**	**LOW**	**LOW**
	LOW	**VERY LOW**	**VERY LOW**	**LOW**	**LOW**	**MEDIUM**
	MEDIUM	**LOW**	**LOW**	**MEDIUM**	**MEDIUM**	**HIGH**
	HIGH	**MEDIUM**	**MEDIUM**	**HIGH**	**HIGH**	**VERY HIGH**
	VERY HIGH	**HIGH**	**HIGH**	**HIGH**	**VERY HIGH**	**VERY HIGH**

The definitions and approach to determining "sensitivity" and "intensity" criteria are described below.

Broad definitions of impact significance ratings are provided in the table below. Impacts of 'High' and 'Very High' significance require careful evaluation during decision-making and need to be weighed up against potential long-term socioeconomic benefits of the project to inform project authorisation. Where there are residual biodiversity impacts of 'High' and 'Very High' significance this will require careful examination of offset feasibility and confirmation that an offset is possible prior to decision-making.

Significance Rating	Interpretation
Very High	**Impacts** where an accepted limit or standard is far exceeded, changes are well outside the range of normal variation, or where long-term to permanent impacts of large magnitude (or consequence) occur to highly sensitive resources or receptors. For **adverse residual impacts** of very high significance, there is no possible further feasible mitigation that could reduce the impact to an acceptable level or offset the impact, and natural recovery or restoration is unlikely. The impact may represent a possible fatal flaw and decision-making will need to evaluate the trade-offs with potential social or economic benefits. **Positive** social impacts of very high significance would be those where substantial economic or social benefits are obtained from the project for significant duration (many years).
High	**Impacts** where an accepted limit or standard is exceeded; impacts are outside the range of normal variation or adverse changes to a receptor are long-term. Natural recovery is unlikely or may only occur in the long-term and assisted and ongoing rehabilitation is likely to is required to reduce the impact to an acceptable level. High significance **residual impacts** warrant close scrutiny in decision-making and strict conditions and monitoring to ensure compliance with mitigation or other compensation requirements. **Positive** social impacts of high significance would be those where considerable economic or social benefits are obtained from the project for an extended duration in the order of several years.
Medium	Moderate **adverse changes** to a receptor where changes may exceed the range of natural variation or where accepted limits or standards are exceeded at times. Potential for natural recovery in the medium-term is good, although a low level of residual impact may remain. Medium impacts will require mitigation to be undertaken and demonstration that the impact has been reduced to as low as reasonably practicable (even if the **residual impact** is not reduced to Low significance). **Positive** social impacts of medium significance would be those where a moderate level of benefit is obtained by several people or a community, or the local, regional or national economy for a sustained period, generally more than a year.
Low	**Minor effects** will be experienced, but the impact magnitude (or consequence) is sufficiently small (with and without mitigation) and well within the range of normal variation or accepted standards, or where effects are short-lived. Natural recovery is expected in the short-term, although a low level of localised residual impact may remain. In general, impacts of low significance can be controlled by normal good practice but may require monitoring to ensure operational controls or mitigation is effective. **Positive** social impacts of low significance would be those where a few people or a small proportion of a community in a localised area may benefit for a few months.
Very Low	Very minor effects on resources or receptors are possible but the predicted effect represents a minimal change to the distribution, presence, function or health of the affected receptor, and **no mitigation is required**.
Negligible	Predicted impacts on resources or receptors of very low or low sensitivity are imperceptible or indistinguishable from natural background variations, and **no mitigation is required**.

7.1.5 ADDITIONAL ASSESSMENT CRITERIA

Additional criteria that are taken into consideration in the impact assessment process and specified separately to further describe the impact and support the interpretation of significance, include the following:

- **Probability (Likelihood) of the impact occurring** (which is taken into account mainly for unplanned events);

- **Degree of Confidence in the impact prediction;**
- **Degree to which the impact can be mitigated;**
- **Degree of Resource Loss** (i.e. the extent to which the affected resource/s will be lost, taking into account irreplaceability); and
- **Reversibility** – the degree to which the impact can be reversed.
- **Cumulative Potential –** potential for cumulative impacts with other planned projects or activities.

Definitions for these supporting criteria are indicated below.

Criteria	Rating	Description
Criteria for determining the PROBABILITY of impacts	**UNLIKELY**	Where the possibility of the impact to materialise is very low either because of design or historic experience, i.e. ≤ 5% chance of occurring.
	POSSIBLE	Where the impact could occur but is not reasonably expected to occur i.e. 5-35% chance of occurring.
	LIKELY	Where there is a reasonable probability that the impact would occur, i.e. > >35 to ≤75% chance of occurring.
	HIGHLY LIKELY	Where there is high probability that the impact would occur i.e. >75 to <99% chance of occurring.
	DEFINITE	Where the impact would occur regardless of any prevention measures, i.e. 100% chance of occurring.
Criteria for determining the DEGREE OF CONFIDENCE of the assessment	**LOW**	Low confidence in impact prediction (≤ 35%)
	MEDIUM	Moderate confidence in impact prediction (between 35% and ≤ 70%)
	HIGH	High confidence in impact prediction (> 70%).
	CERTAIN	Absolute certainty in the impact prediction (100%)
Criteria for the DEGREE TO WHICH IMPACT CAN BE MITIGATED	**NONE**	No mitigation is possible or mitigation even if applied would not change the residual impact.
	VERY LOW	Some mitigation is possible but will have marginal effect in reducing the residual impact or its significance rating.
	LOW	Some mitigation is possible and may reduce the residual impact, possibly reducing the impact significance.
	MEDIUM	Mitigation is feasible and will reduce the residual impact and may reduce the impact significance rating.
	HIGH	Mitigation can be easily applied or is considered standard operating practice for the activity and will reduce the residual impact and impact significance rating.
Criteria for DEGREE OF IRREPLACEABLE RESOURCE LOSS	**LOW**	Where the activity results in a marginal effect on an irreplaceable resource.
	MEDIUM	Where an impact results in a moderate loss, fragmentation or damage to an irreplaceable receptor or resource.
	HIGH	Where the activity results in an extensive or high proportion of loss, fragmentation or damage to an irreplaceable receptor or resource.
Criteria for REVERSIBILITY - the degree to which an impact can be reversed	**IRREVERSIBLE**	Where the impact cannot be reversed and is **permanent**.
	PARTIALLY REVERSIBLE	Where the impact can be partially reversed and is temporary
	FULLY REVERSIBLE	Where the impact can be completely reversed.
	UNLIKELY	Low likelihood of cumulative impacts arising.

Criteria	Rating	Description
Criteria for POTENTIAL FOR CUMULATIVE IMPACTS – the extent to which cumulative impacts may arise from interaction or combination from other planned activities or projects	**POSSIBLE**	Cumulative impacts with other activities or projects may arise.
	LIKELY	Cumulative impacts with other activities or projects either through interaction or in combination can be expected.

7.1.6 APPLICATION OF THE MITIGATION HIERARCHY

A key component of this ESIA process is to explore practical ways of avoiding or reducing potentially significant impacts of the proposed project. These are commonly referred to as mitigation measures and are incorporated into the proposed project as part of the ESMP. Mitigation is aimed at preventing, minimising or managing significant negative impacts to as low as reasonably practicable (ALARP) and optimising and maximising any potential benefits of the proposed project. The mitigation measures are established through the consideration of legal requirements, best practice industry standards and specialist input from the ESIA team.

The mitigation hierarchy, as specified in IFC Performance Standard 1, which is widely regarded as a best practice approach to managing risks, is based on a hierarchy of decisions and measures, as presented in Figure 1.3 and described in Table 1.2. This is 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.

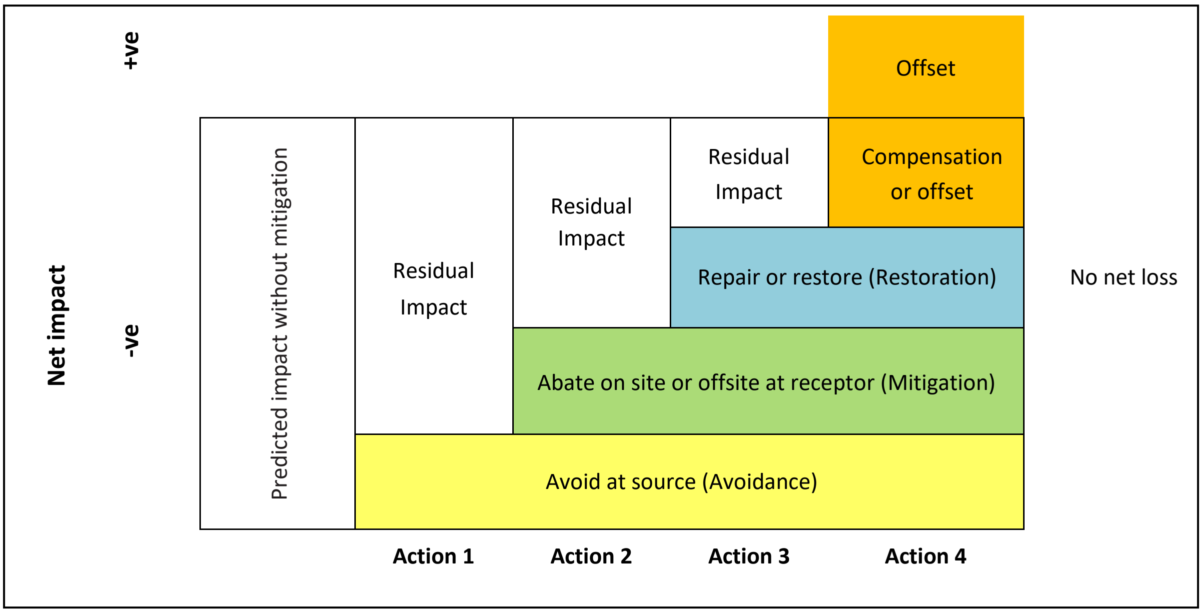

Figure 0.1: Mitigation hierarchy

Table 0.2: Sequential application of the mitigation hierarchy

Avoid at Source	Avoiding or reducing at source is essentially 'designing' the Project so that a feature causing an impact is designed out (e.g. a waste stream is eliminated).
Abate on Site	This involves adding something to the basic design or procedures to abate the impact (often called 'end-of-pipe') or altered (e.g. reduced waste volume) and is referred to as minimisation Pollution controls fall within this category.
Abate Offsite/at Receptor	If an impact cannot be abated on-site then measures can be implemented off-site – an example disposing of waste generated on-board at a proper waste facility onshore. Measures may also be taken to protect the receptor.
Repair or Restore	Some impacts involve unavoidable damage to a resource, e.g. shoreline pollution arising from an oil spill. Repair essentially involves restoration and reinstatement type measures, such as clean-up of the shoreline.
Compensate or Offset	Where other mitigation approaches are not possible or fully effective, then compensation, in some measure, for loss, damage and general intrusion might be appropriate. An example could be compensation for loss of earnings if fisheries were to be permanently impacted by a Project activity.

APPENDIX 2: SMALL-SCALE FISHING CO-OPERATIVE/ COMMUNITY DETAILS PER PROVINCE

environment, forestry & fisheries

Department: Environment, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA

SMALL-SCALE FISHING CO-OPERATIVE/ COMMUNITY DETAILS PER PROVINCE

Nr	Province	Distric Municipality		local Municipality	Sub total	Community	Nearest Town	Total fishers
1	KZN	Ethekwini Metropolitan	190	ethekwini	190	UMGABABA	Durban	29
2						MEREBANK	Durban	70
3						CROSSMOOR	Durban	31
4						ISIPHINGO	Durban	28
5						CLAIRWOOD	Durban	32
6		Ilembe	147	Kwadukuza	83	THUKELA	Mandeni	44
7						GROUTVILE	Stanger	
8						NONOTI	Stanger	39
9				Mandeni	64	WANGU	Mandeni	
10						AMATIKULU	Mandeni	33
11						DOKODWENI	Mandeni	31
12		King Chwetshayo	399	uMhlathuze	34	ESIKHALENI+NOZALELA	Richards Bay	34
13				Umfolozi	365	NZALABANTU+ AQUADENE	Richards Bay	45
14						NHLABANE	Richards Bay	59
16						KWA-MBONAMBI	Richards Bay	37
17						SOKHULU	Richards Bay	224
18		ugu	456	Ray Nkonyeni	304	GAMALAKHE	Port Shepstone	36
19						NZIMAKWE	Port Edward	20
20						ISIHLONYANENI	Port Shepstone	169
21						MVUTSHINI	Port Shepstone	22
22						PORT EDWARD	Port Edward	57
23				Umzumbe	79	KWA-XOLO	Port Edward	79
24				Umdoni	73	MNAFU	Port Shepstone	73
25		Umkhanyakude	816	Umhlabuyalingana	364	KWA-GEORGE	Manguzi	17
26						MAZAMBANE	Manguzi	75
27						KWA-DAPHA	Manguzi	26
28						MANZENGWENYA+MPUKANE	Manguzi	26
29						MAHLUNGULA+MVUTSHANA	Manguzi	54
30						MABIBI	Mbazwana	30
31						KWAMBILA	Mbazwana	115
32						NKOVUKENI	Manguzi	21
33				Mtubatuba	452	QAKWINI	Mtubatuba	39
34						DUKUDUKU & KHAYELISHA	Mtubatuba	61
35						MFEKAYI	Mtubatuba	35
36						NIBELA	Hluhluwe	108
37						MPEMBENI	Richards Bay	143
38						NKUNDUSI	Mtubatuba	66
39	**Total**							
40	EC	ALFRED NZO	221	MBIZANA	221	MZAMBA	BIZANA	66
41						MTHOLANI		27
42						XHOLOBENI		28
43						MDATYA		21
44						LUPHITHINI		35
45						MTHENTHU		44
46		O.R TAMBO	2409	INGQUZA HILL	324	NDENGANE/KHANYAYO	LUSIKISIKI	66
47						RHOLE/DIMFI/KHONJWAYO		110
48						MBOTYI		124
49						CUTWINI		24
51				PORT ST. JOHNS	1124	SICAMBENI/VUKANDLULE	PORT ST JOHNS	66
52						MTUMBANA		40
53						PORT ST. JOHNS		47
54						NOQHEKWANA/ BOLANI		101
55						LUPHOKO		29
56						MTHAMBALALA/LUJAZO		56
57						MANTEKU		81
58						TSWELENI/SIHLANJENI		75
59						NJELA/MVELELO		74

environment, forestry & fisheries

Department: Environment, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA

SMALL-SCALE FISHING CO-OPERATIVE/ COMMUNITY DETAILS PER PROVINCE

Nr	Province	Distric Municipality		local Municipality	Sub total	Community	Nearest Town	Total fishers
60						RHEBHU		128
61						LUTATWENI		68
62						CWEBENI		93
63						MTHALALA		29
64						MADAKENI		141
65						MAGCAKINI		47
66						MAWOTSHENI		49
68						MDZWINI		72
69						HLULEKA		114
70				NYANDENI	572	MAMOLWENI	NGQELENI	92
71						MGCIBE/LWANDILE		202
72						TSHANI		92
74						MATHOKAZINI		41
75						SIZINDENI		46
76						MAWOTSHENI		47
77				KING SABATA DYALINDYEBO	389	NGOKO	MQANDULI	40
78						JONGA		53
79						RHINI		45
80						MTHONJANA		117
81		AMATHOLE	1768	MBASHE	86	GINYINTSIMBI		86
82					867	MPAME		164
83						NQILENI		153
84						QATYWA/GUSI		130
85						CWEBE		60
86						NTLANGANO/MENDWANA		41
87						NGOMA		20
88						MPUME		40
89						NTUBENI	MQANDULI	52
90						MAHASANA XAZINI &TENZA		58
91						FOLOKHWE/JOTELA		49
92						QHORA		32
93						NXAXHO/TAKAZI A		68
95		AMATHOLE DISTRICT		MNQUMA	146	CHEBE		146
96					521	WAVECREST		226
97						GCINA/GQUNQE	CENTANI	170
98						NGCIZELA		100
99						QOLORHA/KEI FARM		25
101		AMATHOLE DISTRICT		GREAT KEI	43	KEI MOUTH/MORGANS BAY	KOMGA	43
102		BUFFALO CITY		BUFFALO CITY	105	PARKSIDE/GOUNUBIE/BRAELYN/	EAST LONDON	105
103						TYOLOMNQA		38
105						HAMBURG	PEDDIE	76
106				NGQUSHWA	186	WESLEY		48
107						BENTON		24
109						NEMATO		39
110						KENTON-ON-SEA		23
111		SARAH BAARTMAN		NDLAMBE	182	KLIPFONTEIN	PORT ALFRED	61
112			756			WENTZEL PARK		33
113						MARSELLE		26
115						KWAZAKHELE/SWARTKOPS/		130
116		NELSON MANDELA BAY		NELSON MANDELA BAY	222	GELVANDALE/ SCHAUDERVILLE/ BLOEMENDALE/ CHATTY	GQEBERHA	92
118		SARAH BAARTMAN		KOUGA	86	PELLSRUS/LOERIE	GQEBERHA	38
119						HUMANSDORP/		48
120				KOUKAMMA	80	MOUNTAINVIEW/ CLARKSON/	HUMANSDORP	39
121						SANDRIFT/ THORNHAM/		41
122	**Total**							

123		Eden	180	Knysna	114	Hornlee	Knysna	72
124						Smutsville/ Sedgefield	Knysna	42
125				Bitou	37	Kranshoek	Knysna	37
126				Hessequa	29	Melkhoutfontein	Knysna	29
127		Overberg	680	Overstrand	553	Eluxolweni (Pearly Beach)	Gansbaai	69
128						Stanford	Gansbaai	66
129						Buffelsjagsbaai	Gansbaai	61
130						Blompark, Gansbaai	Gansbaai	30
131						Hawston	Hermanus	196
132						Zwelihle	Hermanus	21
133						kleinmond	Hermanus	55
134						Mount Pleasant	Hermanus	55
135				Cape Agulhas	127	Struisbaai	Bredasdorp	58
136						Arniston	Bredasdorp	69
137		City Of Cape Town	710	City of Cape Town Metro	710	Sir Lowry's Pass	City of Cape Town	25
138						Strand	City of Cape Town	62
139						Khayelitsha/ Khayelitsha Site B	City of Cape Town	49
140						Grassy Park	City of Cape Town	39
141						Mitchels Plain	City of Cape Town	37
142						Imizamo Yethu	City of Cape Town	45
143						Kalk Bay	City of Cape Town	84
144						Langa	City of Cape Town	28
145						Mamre	City of Cape Town	27
146						Vrygrond	City of Cape Town	27
147						Hangberg	City of Cape Town	172
148						Ocean View	City of Cape Town	115
149		West Coast	820	Berg rivier	30	Velddrif	Saldanha bay	30
150				Saldanha bay	384	Steenberg's Cove	Saldanha bay	21
151						pneusbaai/ Columbine/ Duyker Isl	Saldanha bay	21
152						Langebaan	Saldanha bay	38
153						Vredenberg	Saldanha bay	43
154						Paternoster	Saldanha bay	100
155						Saldanha Bay	Saldanha bay	50
156						Saldanha Bay, White City	Saldanha Bay	2
157						Sandy Point	Saldanha Bay	1
158						Yzerfontein	Saldanha Bay	16
159						Laingville	Saldanha bay	92
160				Cederberg	221	Lamberts Bay	Lamberts Bay	103
161						Elandsbaai	Lamberts Bay	118
162				Matzikama	158	Lutzville wes	Doringbaai	1
163						Doringbaai	Lamberts Bay	88
164						Ebenheaser	Lamberts Bay	58
165						Papendorp	Doringbaai	11
166				Swartland	17	Darling	City of Cape Town	17
167				Saldanha bay	10	Hopefield	City of Cape Town	10
168		City Of Cape town	140	City of Cape Town Metro	140	Phillipi	City of Cape Town	14
169						Redhill Summung	City of Cape Town	1
170						Retreat	City of Cape Town	11
171						Atlantis	City of Cape Town	18
172						Belhar	City of Cape Town	3
173	WC					Bloubergstrand	City of Cape Town	16
174						Delft	City of Cape Town	6
175						Gordons Bay	City of Cape Town	3
176						Gugulethu	City of Cape Town	5
177						Hanover Park	City of Cape Town	6
178						Kraaifontein	City of Cape Town	8
179						Lavenerhill / Rondevelei	City of Cape Town	16
180						Macassar	City of Cape Town	2
181						Masakhane	City of Cape Town	10
182						Masiphumelele	City of Cape Town	5
183						Nyanga	City of Cape Town	1
184						Brackenfell	City of Cape Town	1
185						Steenberg	City of Cape Town	4
186						Strandfontein	City of Cape Town	10
187		Eden	158	Bitou	44	Witterdrift	Knysna	1
188						Green Valley	Knysna	4
189						New Horizon	Knysna	5
190						Qolweni Location	Plettenberg Bay	6

191						Kurkland	Plettenberg Bay	19
192						KwaNokuthula/ Bossiesgif	Plettenberg Bay	9
193				Mossel Bay	30	KwaNonqaba	Mossel Bay	3
194						Mossel Bay/Herbertsdale	Mossel Bay	1
195						Asla	Mossel Bay	5
196						Dailmeida	Mossel Bay	3
197						Gouritzmond	Mossel Bay	18
198				George	11	Paridise park	Geroge	1
199						Pine Trees	Geroge	10
200				Hessequa	32	Stilbaai	Albertinia/	16
201						Slangrivier	Heilelberg/	9
202						maaklikheid/ Riversdale/ San Seba	Heilelberg/	7
203				Knysna	41	Rheenendal	Knysna	6
204						Tarka, Newsunnyside	Knysna	2
205						Kleinbrak Power Town	Knysna	8
206						Touwsranten	Knysna	10
207						White Location Kynsna	Knysna	1
208						Covie	Knysna	14
209		Overberg	60	Cape Agulhas	32	Bredasdorp	Bredasdorp	14
210						Elim	Bredasdorp	18
211				Theewaterskloof	3	Botriver Fish	Kleinmond	3
212				Overstrand	12	Pringle Bay	Kleinmond	5
213						Betty's Bay (Mooitsig)	Kleinmond	7
214				Overstrand	13	Westdene	Hermanus	13
215		Cape wine lands	0	Drakenstein	0	Mbekweni (Paarl)	Hermanus	0
216		West Coast				Graafwater	Lamberts Bay	0
217						Leipoltville	Lamberts Bay	0
218		City Of Cape Town	0	City of Cape Town Metro	0	Cross Roads	City of Cape Town	0
219						Elsies River	City of Cape Town	0
220						Heideveld	City of Cape Town	0
221						Helderberg	City of Cape Town	0
222						Samora Machel	City of Cape Town	0
223		Eden	0	George	0	New Beggining	Geroge	0
224						Pacalsdorp	Geroge	0
225						Parkdene (George)	Geroge	0
226						Deep Waters	Geroge	0
227						Tembalethu, George	Geroge	0
228				Knysna	0	Thubelisha	Knysna	0
229						Kleinkranz (Wilderness)	Knysna	0
230						Wilderness Heights	Knysna	0
231		Overberg		Theewaterskloof	0	Myddleton	Kleinmond	0
232	**Total**							
233	NC	Namakwa	103	Richtersveld	75	Port Nolloth	Port Nolloth	75
234				Kamiesberg	28	Hondeklipbaai	Port Nolloth	28
Total								
GRAND TOTAL			**10013**		**10013**			**10013**

APPENDIX 3: CURRICULUM VITAE

SARAH WILKINSON SACNASP-Registered Professional Natural Scientist (Membership number 115666)

Geographical information systems, mapping and data analysis of southern African fisheries

Date of Birth: 20 June 1979

Nationality: South African / British

Academic Record: University of Cape Town, South Africa; BSc Honours (2001)
University of Cape Town; BSc (Oceanography and Botany 1998 – 2000)

Employment Record: Capricorn Marine Environmental (Pty) Ltd (2003 – 2019)
Institute of Plant Conservation, University of Cape Town (2002)

Languages: English (First language); Afrikaans & French (Basic written & spoken)

Key Experience:

- Geographical information systems, mapping and data analysis with focus on fisheries, oil and gas specialist assessments.
- Specialist assessments on the impact of offshore hydrocarbon exploration and installation activities on fisheries in South Africa, Namibia, Mozambique and Angola (in accordance with scoping and EIA requirements). **A selection of projects over the last five years is listed overleaf and a full list of project reports is available on request.**
- Management of Marine Mammal Observer (MMO), Passive Acoustic Monitoring (PAM) and Fisheries Liaison Services for seismic survey vessels in the offshore sub-Saharan region (a full list of over 100 deployments is available on request).
- Management of the industry-funded ship-based scientific observer programmes for the South African Pelagic Fishing Industry Association (SAPFIA) and the SA Deepsea Trawling Industry Association (SADSTIA).
- GIS support and analysis of the South African fishery catch and effort for use in the Offshore Marine Protected Area Project - contracted by the South African National Biodiversity Institute (SANBI).
- A review on the effects of trawling on benthic habitat in part fulfilment of the Marine Stewardship Council certification of the South African hake trawl fishery (Client: South African Deepsea Trawling Industry Association (SADSTIA).
- Spatial mapping of the proposed expanded Saldanha Bay Aquaculture Development Zone (ADZ) in line with the goals of operation Phakisa.
- Offshore Marine Protected Areas Project: spatial distribution/ mapping of South Africa’s commercial fisheries for the South African National Biodiversity Institute
- Hake longline sector footprint: Spatial distribution of fishing effort and overlap with benthic habitats of the South African Exclusive Economic Zone (2002 – 2012) for WWF South Africa
- “Ringfencing the trawl footprint”:- Desktop study for the South African Deepsea Trawling Industry Association

A complete list of Fisheries Impact Assessment Reports and Environmental Monitoring Close-Out Reports is available on request.

SOUTH AFRICA EXPERIENCE : Selected projects undertaken over the past five years

Client	Activity	Area	Date
Total E&P South Africa	Well Drilling	Block 11B/12B	Jun 2020
Total E&P South Africa	Seismic Survey/Well drill	South Outeniqua	Jun 2020
ACER / Equiano Cable System	Subsea Cables (Telecommunications)	Melkbosstrand, West coast, South Africa	Nov 2019
Total E&P South Africa	Seismic Survey	Block 11B/12B	Oct 2019
Total E&P South Africa	Well Drilling	Southeast Coast	Jul 2019
METISS Cable System	Subsea Cables (Telecommunications)	East Coast	Mar 2019
Petroleum Geo-Services	Seismic Survey	West & Southwest Coasts	Oct 2018
Belton Park Trading 127 (Pty) Ltd	Marine Mining	2C & 3C	Sep 2018
IOX	Subsea Cables	South Coast	Jun 2018
De Beers Marine	Marine Mining	6C	Jun 2018
ENI	Well Drilling	East Coast	Jun 2018
Petroleum Geo-Services	Seismic Survey	East & South Coasts	Jan 2018
Alexkor	Marine Mining	1A-C,2A,3A,4A-B	Sep 2017
Impact Africa Ltd	Seismic Survey	Orange Basin	Jul 2017
Sungu Sungu Oil (Pty) Ltd	Seismic Survey	Pletmos Basin	Mar 2017
PetroSA (Pty) Ltd	Subsea Pipeline	E-BK, Block 9	Feb 2017
ACE Cable / MTN (Pty) Ltd	Subsea Cables	West Coast	Sep 2016
West Coast Resources (Pty) Ltd	Marine Mining	6A-8A	Jul 2016
Belton Park Trading 127 (Pty) Ltd	Marine Mining	2C	May 2016
Spectrum ASA	Seismic Survey	West Coast	Jan 2016
Schlumberger	Seismic Survey	East Coast	Nov 2015
Rhino Oil & Gas Exploration	Seismic Survey	Blocks 3617/3717	Nov 2015
Belton Park Trading 127 (Pty) Ltd	Marine Mining	2C-5C	Jan 2015
Aquaculture development zone	Identification of suitable areas for expansion of aquaculture within Saldanha Bay		

NAMIBIAN EXPERIENCE : Selected projects undertaken over the past five years

Client	Activity	Area	Date
Total E&P Namibia	Seismic Survey	2912 & 2913B	Jul 2020
ACER / Equiano	Subsea Cable	Regional	Jun 2020
GALP/Windhoek PEL 23 & 28 B.V.	Well Drilling	PEL82 & PEL83	Jul 2019
Shell Namibia B.V.	Seismic Survey	PEL39	May 2018
Shell Namibia B.V.	Well Drilling	PEL39	Oct 2017
Spectrum Geo Ltd	Seismic Survey	Regional (North)	Jun 2017
GALP	Seismic Survey	PEL82 & PEL83	May 2017
Spectrum Geo Ltd	Seismic Survey	Regional (South)	Oct 2016
LK Mining	Marine Mining	EPL5965	May 2016
Murphy Lüderitz Oil Co. Ltd	Well Drilling	2613A & 2613B	Jul 2015
Xaris Energy Namibia	Subsea Pipeline Installation	Walvis Bay	Jul 2015
Nabirm Energy Services (Pty) Ltd	Seismic Survey	2113A	Jan 2015
Namdeb	Mapping of benthic habitat types, Southern Namibia inshore and nearshore region		

Courses and Symposia :

- 7th and 5th International Symposia on GIS/Spatial Analyses in Fishery and Aquatic Sciences, Hakodate, Japan & Wellington, New Zealand. International Fishery GIS Society
- Joint Nature Conservation Committee-certified Marine Mammal Observer Training (Intelligent Ocean Training Services)

- Passive Acoustic Monitoring Training (Intelligent Ocean Training and Consultancy Services and Seiche Measurements Ltd)
- Bureau of Ocean Energy Management, Regulation and Enforcement Gulf of Mexico: Protected Species Observer Training
- ArcGIS I, II and Spatial Analyst (GIMS: ESRI South Africa)
- Maxsea Navigational Software (TimeZero)
- Marine Stewardship Council Chain of Custody Training Course (Moody Marine Ltd)
- SAQA-approved learning facilitator

Publications:

Massie, P, Wilkinson S & D Japp 2015. Hake longline sector footprint: Spatial distribution of fishing effort and overlap with benthic habitats of the South African Exclusive Economic Zone (2002 – 2012). Capricorn Marine Environmental, Cape Town 15 pages.

Sink KJ, Wilkinson S, Atkinson LJ, Leslie RW, Attwood CG and McQuaid KA 2013. Spatial management of benthic ecosystems in the South African demersal trawl fishery. South African National Biodiversity Institute, Pretoria.22 pages.

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Wilkinson, S. and D. Japp. 2009. Spatial boundaries of the South African hake-directed trawling industry: trawl footprint estimation prepared for the South African Deepsea Trawling Industry Association (SADSTIA) - unpublished

Benguela Current Large Marine Ecosystem State of Stocks Review: Report No.1 (2007). Eds D.W. Japp, M.G. Purves and S. Wilkinson, Cape Town.

Description and evaluation of hake-directed trawling intensity on benthic habitat in South Africa: Prepared for the South African Deepsea Trawling Industry Association in fulfilment of the Marine Stewardship Council certification of the South African hake-directed trawl fishery; condition 4. December 2005. Fisheries & Oceanographic Support Services cc, Cape Town

Purves, MG, Wissema J, Wilkinson S, Akkers T & D. Agnew. 2006. Depredation around South Georgia and other Southern Ocean fisheries. Presented at the Symposium: 'Fisheries Depredation by Killer and Sperm Whales: Behavioural Insights, Behavioural Solutions', Pender Island, British Columbia, Canada from Oct. 2-5, 2006.

Gremillet D., Pichegru L., Kuntz G., Woakes A.G., Wilkinson S., Crawford, R.J.M. and P.G. Ryan. 2007. A junk-food hypothesis for gannets feeding on fishery waste. Proc. R. Soc. B. doi:10.1098/rspb.2007.1763. Online publication.

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Education:

Institution (Date from - Date to)	**Degree(s) or Diploma(s) obtained:**
Merchant Navy Academy General Botha, Cape Town (1975 to 1980)	Chief Navigating Officer (Foreign) – July 1980 to 1983
University of Cape Town (undergraduate) 1983 to 1985	Bachelor of Science (Zoology, Marine Biology and Oceanography)
Rhodes University 1986-1986	Bachelor of Science Honours Ichthyology and Fisheries Science (Cum Laude)
Rhodes University 1987 to 1989 and Sea Fisheries Research Institute	Masters Degree in Ichthyology and Fisheries Science (Cum Laude)
Rhodes University MBA 2006	Resource Economics

Key Experience	Project Management and Appraisal Environmental impact Assessments (marine) Marine Stewardship Council (MSC) assessor

Relevant Professional Experience (selected)

- South Africa: Head of Offshore Research - *Sea Fisheries Research Institute* (SFRI / DAFF) undertook 8 years of direct research and training of sea staff on biomass surveys as Chief Scientist;
- Consultant has worked extensively in the region including South Africa, Mozambique, Angola, Mozambique, Uganda, Namibia, Kenya, Tanzania and West Indian Ocean Fisheries Sectors since 1990;
- Benguela System : Benguela Current Commission (BCC) Strategic Impact Assessment (SEA)
- World Bank fisheries consultant – development and implementation of fisheries and aquaculture components : 1) MACEMP (Tanzania); 2) KCDP (Kenya) 3) SWIOFP (West Indian Ocean) 4) SWIOFish 1 (Current – WIO countries focus is Tanzania 5) LVEMP 2 (Lake Victoria)
- Environmental Impact Assessment of the Aquaculture Development Zone in Mossel Bay (South Africa)
- Scoping assessment and EIA of the potential for and Aquaculture Development Zone in Saldanha Bay, South Africa (pending)
- Lake Victoria – field trip and overview of the "Source of the Nile" tilapia cage culture including provision of juvenile grow out and adult cage culture (conducted through LVEMP2 and the World Bank with the Lake Victoria Fisheries Organization and NAFIRI)

Date	Location	Company& reference person	Position	Description
Regional and International Experience				
1987 to 1996	South Africa	Sea Fisheries Research Institute and Marine and Coastal Management (Ref. Dr Augustyn)	Head of Offshore Research	Fisheries Research head – Management of Offshore resources including Demersal, Large Pelagic and Small Pelagic resources. Ref. Is Dr J. Augustyn (Dept Agriculture, Forestry and Fisheries, Cape Town. (johann@sadstiia.co.za)
1996 to 2016	Cape Town South Africa	Capricorn Fisheries Monitoring and Fisheries & Oceanographic Support Services	Consultant and Director	Many consulting projects with the FAO, World Bank, Benguela Current LME. Also developed the Regional Observers Programme. Specialization : Fisheries Management and Research ref. Xavier Vincent : xvincent@worldbank.org
2008 - 2009	Namibia	Benguela Current Commission	Consultant	State of Stock review – Benguela Current Commission. Hashali Hamukuaya hashali@benguelacc.org)
2009 to 2016 (ongoing)	Mombasa - Kenya)	Development of the Kenya Coastal Development Project (KCDP) – World Bank and FAO	Fisheries Expert	Thus was an ongoing consultancy (5 years) developing the KCDP with the World Bank Team – project participation was on near continuous basis until project effectiveness in June 2011. Portfolio : Fisheries Management, Research and Development : Ref is AG. Glauber – World Bank Office, Dar Es Salaam aglauber@worldbank.org
2007 to 2012	Tanzania and Zanzibar	Appraisal of the Tanzania *Marine and Coastal Environment Project* (MACEMP) – World Ban k / FAO	Fisheries Expert	Ongoing consultancy every six months to Tanzania – Project appraisal and Mid-Term review. Presently project is winding down and new MACEMP two phase being developed. Portfolio : Fisheries Management, Research and Development : Ref is AG. Glauber – World Bank Office, Dar Es Salaam aglauber@worldbank.org
2005 to 2016	Kenya, Tanzania, Mozambique and IOC countries	World Bank and FAO – Fisheries Expert Project development and implementation (South West Indian Ocean Fisheries Shared Growth and Governance Project (SWIOFish 1)	Fisheries Expert	Consultancy up to 2015 – fisheries components – development and implementation. Specialization : Fisheries Management and Development. Ref ; AJ Glauber aglauber@worldbank.org
2004 to 2007	IOTC	IOTC	Fisheries Experts	Provision of trained tuna tagging technicians and Cruise leaders for the IOTC Tuna Tagging programme (Note: this was done through CapFish under contract to MEP). Ref : Gerard Dominique (IOTC) . gerard.domingue@iotc.org
2009 to ongoing	IOTC	IOTC	Fisheries Observers	Provision of Observers for Transhipment vessels (ongoing) Gerard Dominique (IOTC) gerard.domingue@iotc.org

2004 to 2014	FAO	FAO – Jessica Sanders / Ross Shotton	Fisheries Expert	Consultancy undertaken for technical works relating to 1. South West Indian Ocean Fisheries 2. Regional (Indian Ocean) fisheries reporting (catches) 3. Observer training (Madagascar) 4. Development of High Sea Guidelines (FAO)
2009 to 2016	FAO and WWF	FAO - and WWF USA	Fisheries Expert	Fishery Improvement Process – fishery pre-assessments for MSC and follow-up. Contract is current. Portfolio : Fisheries Management and Development. Domingos Gove (dgove@wwfesarpo.org
2013	Angola Namibia (BCC)	ACP Fish 2	Fisheries Expert	Development of horse mackerel national plans and transboundary management (BCC)
2004-current	International	MSC Assessments – RSA Hake, Tristan da Cunha lobster, Russian Pollock and numerous pre-assessments and peer rev.	Fisheries expert : P2 and P3	Full assessments through CABs (Moody, Intertek, MRAG, Tavel, FCI, BV, Acroura)

ADDITIONAL INFORMATION

Major Projects - Summary

- Resource Assessment:
- Submission of management advice on hake (TAC assessments from 1989 to 1997);
- Biological assessment of hake species in South African waters and determination of ageing and stock structure;
- Design of hake-directed biomass surveys and cruise leader on up to four demersal surveys a year from 1989 to 1997;
- Demersal Working Group co-ordinator from 1991 to 1997 responsible for the management advice on hake and other demersal species;
- Project management (Scientist responsible) of hake-directed longline experiment in SA from 1992-1996

Aquaculture-Specific

- Post graduate degrees in Fisheries science included bot fresh water and marine aquaculture
- East African project undertaken with the World Bank include major fisheries components which incorporate development of aquaculture (fresh and marine)
- Scoping studies and Impact assessments of Aquaculture Development Zones in Mossel Bay (South Africa)
- Scoping studies and EIA of ADZ in Saldanha Bay (this project is not yet activated and is pending subject to tender and financing)
- World Bank Project (LVEMP2) – consultant has been providing specialist fisheries advice to the LVFO including aquaculture field work in the Jinga / Lake Victoria including the use of Mukene as both feed and for human consumption
- Assessment of the Saldanha Bay Aquaculture Development Zone (ADZ – current)

Fishery Economics and Governance :

- Preparation of sector economic reports for RSA fisheries to assist with rights allocation procedures: Hake Longline, Inshore Trawl (Hake and Sole), Shark longline, South Coast Rock Lobster, Patagonian Toothfish, Deepwater Fishery, Midwater Trawl & Hake Handline
- Economic Assessment of the Wetfish and Freezer Trawl apportionment of Hake in Namibia
- BCLME – Ecosystem Approach to Fisheries – Cost Benefit Analysis (March 2006)

- Review of the West Indian Ocean Tuna Fishery and Potential Opportunities and Options for the Development of the Port of Victoria (Seychelles) – Completed March 2008
- Assessment of economic loss due to hydrocarbon development – numerous ongoing projects, PetroSA, Forrest Oil west coast gas, CNR well drilling and many others.
- Value-Adding of Anchovy *Engraulis encrasicolus* in South Africa and potential for poverty relief.
- Governance of Kenya Fisheries – Consultancy and report prepared for IOC Smartfish programme (2011)

Other Projects Completed :

- Comparative assessment (socio-economic) of trawl and Longline fisheries in Benguela Region (BCLME).
- Evaluation of deepwater groundfish fishery in South West Indian Ocean 2004/2005 – FAO.
- Review of Ecosystem Approach to Fisheries Management for South African Fisheries (BCLME – MCM project).
- Review of South Africa's Indian Ocean fisheries – management and policy.
- Development of the South West Indian Ocean Fisheries Programme Implementation Plan – World Bank / FAO – Completed March 2007 (preparation of Project Documents for World Bank and GEF).
- Ecosystem Approach to Fisheries – BCLME project LMR/EAF/03/01 – Contracted consultant including Risk Assessments and Benefit Cost estimators for EAF – Ongoing as of 5 November 2006.
- Indian Ocean Tuna Tagging Programme – 2004-2007 collaborative programme with McAllister Elliot and Partners (UK) and Capricorn Fisheries Monitoring cc (RSA)
- Indian Ocean Tuna Commission – 2009 Collaborative programme between MRAG (UK) and Capricorn Fisheries Monitoring cc for the provision of Observers and monitors on Indian Ocean tuna transhipment vessels.
- International Commission for the Conservation of Atlantic Tunas – 2007 Collaborative programme between MRAG (UK) and Capricorn Fisheries Monitoring cc for the provision of Observers and monitors on Atlantic tuna transhipment vessels.
- Domestic contract awarded (Sept. 2007) for the monitoring of national and high seas tuna longline fisheries, all trawl and small pelagic sectors and deep water rock lobster trap fisheries
- FAO / World Bank – review of Tanzania MACEMP programme with WB surveillance team (2008, 2009, 2010, 2011, 2012)
- FAO / World Bank – initiation of the South West Indian Ocean Fisheries Project – development of Project Implementation Manual and Observer programme (Mombasa – 2007- 2009)
- FAO / World Bank – Project development – Kenya Coastal Development Project (KCDP) – Ongoing 2010-2015
- FAO – EAF-Nansen Programme – Mozambique Sofala Bank Shrimp fishery management plan – development of effort management recommendations.
- FAO World Bank – Lake Victoria LVEMP project. Project management and support to Lake Victoria Fisheries Organisation.
- FAO World Bank – South West Indian Ocean Fisheries Shared Growth and Governance Project (Tanzania effective from June 2015)
- ICCAT Tuna Transhipment Programme Observers – CapFish project executant (2009 to 2012) – ongoing
- IOTC Tuna Transhipment Programme Observers – CapFish project executant (2010-2012) – ongoing
- Tuna Longline – RSA Observer deployments – 100% coverage on Deep Water Fishing Nations (RSA) – Project executant (2007-2012) – on-going
- IOTC Tuna – review of economic reports undertaken by WWF (10 country reports and summaries) – May 2012

Marine Stewardship Council :

- Numerous fisheries assessed including Russian Pollock, Tristan da Cunha Lobster, RSA Hake and many others including many pre-assessments
- Fishery Improvement projects ongoing : Kenya Lobster, Mozambique shallow and deepwater shrimp and Namibian Hake assessment
- Assessment of the PNA Western Pacific tuna Fishery (current September 2016)
- Review of the Mozambique linefish fishiery (MSC preassessment) and SASSI assessment (WWF – South Africa) (Current September 2016)

Lecturing and Document Preparation:

- Extensive lecturing and seminar presentations (30 years) as well as detailed project and document preparation experience.
- Presentation of 5 x International courses in Namibia on International Agreements, UNCLOS, RFO's etc to Inspectors, Observers and Fisheries Managers.

PUBLICATIONS

JAPP, D.W. 1988 - The status of the South African experimental longline fishery for kingklip *Genypterus capensis* in Divisions 1.6, 2.1 and 2.2. *Colln. Scient. Pap. int. Comm. SE Atl. Fish.* **15(2).** 35-39

JAPP, D.W. 1989 - An assessment of the South African longline fishery with emphasis on stock integrity of kingklip *Genypterus capensis* (Pisces: Ophidiidae). **M.Sc. Thesis**, Rhodes University: [iii] + 138pp

JAPP, D.W. and A.E. PUNT 1989 - A preliminary assessment of the status of kingklip *Genypterus capensis* stocks in **ICSEAF** Division 1.6 and Subarea 2. *ICSEAF Document SAC/89/S.P.:* 15 pp (mimeo).

JAPP, D.W. 1990 - ICSEAF otolith interpretation guide No.3 - kingklip (publication completed but not published due to dissolving of ICSEAF).

JAPP, D.W. 1990 - A new study on the age and growth of kingklip *Genypterus capensis* off the south and west coasts of South Africa, with comments on its use for stock identification. *S. Afr. J. mar. Sci.* **9:** 223-237.

JAPP, D.W. 1993 - Longlining in South Africa. In: *Fish fishers and fisheries* L.E. Beckley and R.P. van der Elst (Eds). *Proceedings of the second South African linefish symposium, Durban, 23-24 October 1992.* **Special Publication No 2:** 134-139.

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JAPP, D.W. 1997 - Discarding practices and bycatches for fisheries in the Southeast Atlantic Region (Area 47). *In* I.J. Clucas & D.G. James, eds. 1997. *Papers presented at the Technical Consultation on Reduction of Wastage in Fisheries.* Tokyo. FAO Fisheries Report No. 547 (Suppl.). Rome, FAO.

JAPP, D.W. 1999 - Management of elasmobranch fisheries in South Africa. In: *Case studies of the management of elasmobranch fisheries* Edited by R. Shotton. *FAO Fisheries Technical Paper 378/1* : 199-217.

JAPP, D.W. 1999 - Allocation of fishing rights in the South African hake fishery. In: *Case studies of Rights allocations*. *FAO Fisheries Technical Paper 411*.

JAPP, D.W. 2006 - Country Review : South Africa (Indian Ocean). *Review of the state of world marine capture fisheries management : Indian Ocean*. *FAO Fisheries Technical Paper 488*.

JAPP, D.W. 2008. Scientific rationale and alternatives for the introduction of Fishery Management Areas for hake. Unpub report. *South African Deep Sea Trawling Industry Association.*

JAPP, D.W. P. SIMS and M.J. SMALE 1994 - A Review of the fish resources of the Agulhas Bank. *S. Afr. J. Sci.* **70:** 123-134.

JAPP, D.W. 2010. Discussion Paper Prepared for Workshop on the Implementation of the FAO Guidelines for the Management of Deep-sea Fisheries in the High Seas. Pusan, South Korea (May 2009).

JAPP, D.W. 2010. Pre Assessment Report for the South African Longline Fishery for Hake Client: WWF (RSA) and Ocean Fresh. Capricorn Fisheries Monitoring cc. 3 February 2010 (final)

JAPP, D.W. 2012. Rapid Fishery Pre-Assessment for Marine Stewardship Council (MSC) Namibian Hake : *Merluccius paradoxus* and *M. capensis* undertaken for MRAG Americas

JAPP, D.W. 2012 . South African large pelagic (tuna) assessment. MRAG Americas: WWF ABNJ Tuna Project Baseline Analysis

JAPP, D.W. 2014. Development of a Training and Capacity Building Programme for Developing Country Fisheries Pursuing MSC certification: Principle 2 - Ecosystems Working towards Marine Stewardship Council Certification in a Developing Country – Identifying the gaps, needs and means to achieving certification

JAPP, D.W and A. JAMES 2005 - Potential exploitable deepwater resources and exploratory fishing off the South African coast and the development of the deepwater fishery on the south Madagascar Ridge. *FAO Fisheries Proceedings 3/2.* Deep Sea 2003 : Conference on the Governance and Management of Deep-sea Fisheries. R. Shotton ed.

JAPP, D.W., M. PURVES and S. WILKINSON. 2007. Benguela Current Large Marine Ecosystem State of Stocks Review 2007. Report No. 1 (2007) BCLME.

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JAPP, D.W. and H. CURRIE-POTGIETER. 2009. FAO case studies : Marine Protected Areas. *The development and status of Marine Protected Areas in South Africa and Namibia.* (In press, FAO)

JAPP, D.W. AND M. SMITH 2012. Fisheries, Mammals and Seabirds specialist study Environmental Impact Assessment. Namibian Marine Phosphate (Pty) Ltd.: Dredging of marine phosphates from ML 170 Report (Revised 8 March 2012)

JAPP, D.W., KELLEHER, K, D. BOYER. 2013. Preparation of the Horse Mackerel (*Trachurus trecae*) Management Plan for Angola. ACP - Support for the devising of the management plan for the Horse Mackerel fishery Angola and Namibia Project ref. N° SA-1.2-B5 REL Region: Southern Africa Country: Namibia, Angola 27 October 2013

JAPP, D.W. AND A. HERVAS. 2013. Pre-Assessment Report – Uruguayan Hake fishery. Food Certification International Ltd Client : FRIPUR & Oceanfresh

COCHRANE, K, D.W. JAPP *et al.* 2007 : Results and conclusions of the project "*Ecosystem approach to fisheries management in the Benguela Current Large Marine Ecosystem"* . FAO Fisheries Circular No. 1026.

COCHRANE, K, C.J. AUGUSTYN, T. FAIRWEATHER, D.W. JAPP, K. KILONGO, J IITEMBU, N. MOROFF, J.P. ROUX, L.SHANNON, B. VAN ZYL and F. VAZ VELHO. 2009. Benguela Current Large Marine Ecosystem – Governance and management for an Ecosystem Approach to Fisheries in the region. *Coastal management, 37:235-254.*

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