ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR EXPLORATION DRILLING AND ASSOCIATED ACTIVITIES IN BLOCK 3B/4B OFF THE WEST COAST OF SOUTH AFRICA

FISHERIES SPECIALIST ASSESSMENT

MARCH 2024

Prepared for the Environmental Assessment Practitioner:

Environmental Impact Management Services

On behalf of the applicant:

African Oil SA Corp

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CAPRICORN MARINE ENVIRONMENTAL PTY LTD

EXPLORATION DRILLING ACTIVITIES

BLOCK 3B/4B, WEST COAST, SOUTH AFRICA

Fisheries Baseline and Impact Assessment Report

16 March 2024

EXPERTISE AND DECLARATION OF INDEPENDENCE

This report was prepared by Vivienne Dames and Sarah Wilkinson of Capricorn Marine Environmental (Pty) Ltd. Vivienne Dames has an MSc in Ichthyology and Fisheries Sciences at the Rhodes University (RU) specialising in fisheries ecology, disturbance and conservation. Sarah Wilkinson has a BSc (Hons) degree from UCT and specialises in spatial and temporal analysis (GIS) of South African and Namibian fisheries.

This specialist report was compiled for Environmental Impact Management Services (EIMS) as part of the Environmental and Social Impact Assessment (ESIA) for Exploration Drilling within Block 3B/4B, situated offshore South Africa. We hereby declare that we are financially and otherwise independent of Africa Oil SA Corp and of EIMS.

This report has been subject to independent review by Dr Kevern Cochrane.

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15 March 2024

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Review of CapMarine Environmental and Social Impact Assessment (ESIA) for Exploration Drilling and Associated Activities in Block 3B/4B off the West Coast of South Africa

This is to certify that I have reviewed the above report produced by CapMarine and, subject to addressing the minor comments referred to in the reviewed copy and to the best of my ability, find the report comprehensive and satisfactory.

Yours,

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EXECUTIVE SUMMARY

Africa Oil SA Corp. and its partners ("the applicant") hold and Exploration Right (reference number 12/3/339) over Licence Block 3B/4B. The licence area is located in the Orange Basin, off the West Coast of South Africa, roughly between Saldanha, Western Cape, in the south and the mouth of the Groenrivier, Northern Cape in the north at approximately 120 – 275 km offshore. The application area covers 17 581 km^2 in extent, in water depths ranging from 500 to 2 500 m.

The applicant is proposing to undertake exploration well drilling within two focus areas within the block. The northern Area of Interest (AOI) for exploration drilling is ~1636 km^2 and the central Area of Interest is ~3068 km^2 in extent. Water depths across the AOIs range between 1000 m and 2000 m.

Environmental Impact Management Services (EIMS) has been appointed as the independent Environmental Assessment Practitioner (EAP) to undertake a full Scoping and Environmental and Social Impact Assessment (ESIA) process for the proposed additional 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) SONAR surveys, 5) drilling and 6) VSP. The potential impact of unplanned (accidental) events were identified as: 7) low volume release of diesel or hydraulic fuel from vessels or drilling unit; 8) a large-scale, uncontrolled oil spill of hydrocarbons at the well due to a failure of pressure control systems; and 9) 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	LOW
2	Presence of Subsea Infrastructure - Permanent Exclusion around Wellhead(s)	Demobilisation	NO IMPACT	NO IMPACT
3	Discharge of Drill Cuttings	Operation	NEGLIGIBLE	NEGLIGIBLE
4	Vessel and Drilling Noise	Operation	LOW	LOW
5	VSP Noise	Operation	LOW	LOW
6	SONAR survey	Operation	LOW	LOW
7	Accidental Oil Spill: Minor	Unplanned Event	LOW - MEDIUM	LOW
8	Accidental Oil Spill: Major	Unplanned Event	HIGH	MEDIUM
9	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.

Temporary exclusion

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 only the large pelagic longline sector, which is active within the proposed area of interest for well drilling particularly during the winter months of May, June and July. The impact of exclusion on these sectors is assessed to be of overall LOW significance to the large pelagic longline sector, after the implementation of mitigation measures.

Permanent exclusion

A wellhead within the AOI is not expected to present an impact on any fisheries that do not set fishing gear at the seabed. The abandonment of wellheads is not expected to impact the demersal trawl fishery as the area of interest is located outside of the current spatial footprint of the sector.

Discharge of drill cuttings

The discharge of well cuttings and drill fluids 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 WBM 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 sediment deposit area around the discharge point is likely to extend to a maximum of 175 m (orientated towards an axis from NW to SE due to currents). The resulting plume and depositional footprint would however not be expected to coincide with spawning areas for any fisheries sector. The localised extent of the impact the overall significance of the impact to fisheries is considered to be NEGLIGIBLE.

Noise

VSP pulses are predicted to cause immediate physiological impacts (both mortality and recovery injury) for fishes directly adjacent to the VSP source (60 m). Potential effects of behavioural disruption from VSP pulses for all fish species are predicted within 3.0 km of the drilling location.

Zones of cumulative Sound Exposure Level (SEL) impact from repetitive VSP pulses[1] was assessed to be within 45 m for mortal injury of fish, fish eggs and larvae, 70 m for recoverable injury and temporary threshold shift (TTS) within 450 m of the drilling location (i.e. the location of the VSP source). The noise impact during VSP operations, was assessed based on the distance of these zones of impact from fishing grounds. The impact was assessed to be of LOW significance.

Non-impulsive noise generated by shipping and during drilling operations are not expected to cause mortality or potential mortal injury to fish species. The predicted distance to potential behavioural disturbance is expected to occur within 420 m from the noise source.

Sonar surveys using MBES sources have much lower noise emissions than seismic airgun sources and have extremely narrow source directivity along the cross-track direction (i.e. perpendicular to the vessel's track). It is reasonable to expect that the fixed location receivers would be exposed predominantly to acoustic energy from a single pulse during the entire survey. The vertical sound fields from a single MBES pulse of the sonar survey at both along-track (direction of the vessel's track) and cross-track directions were modelled. High-

[1] 125 pulses over a 6 hour period

frequency sonar from single MBES pulse is not expected to cause an adverse hearing impact on fish species or behavioural disturbance.

The overall noise impact resulting from the project activities is assessed to be of LOW significance after the implementation of mitigation measures. Mitigation measures are aimed at advance notification to affected vessel operators so that fishing effort may be directed away from the drilling area. The large pelagic longline sector operates within the AOI for well drilling and mitigation measures aimed at reducing the impact on the sector could include timing the drilling to take place during the period January to May which coincides with a period of seasonally low fishing activity within the area.

Unplanned events – oil spill

The possible fates and trajectories of an oil spill from a subsea blowout were modelled for the possibilities of encountering condensate and crude oil. For both condensate and crude oil, results of the oil spill modelling study indicated that the general direction of the surface oil drift from a subsea blowout is in a NW direction and offshore of the main fishing grounds.

For condensate, the maximum drift is expected during Quarter 1 at a distance of 42 km NNW of the release point. Results suggest that a blow-out occurring between July and September would result in the greatest oil amount on surface. There is almost no oil on surface expected due to the evaporation and dispersion processes on condensate. Oil is not predicted to reach the shore. In terms of surface presence probabilities, Namibian waters could be impacted by surface oil with very low probabilities (3.3%) in the worst-case scenario. In terms of water column contamination, there would be a high probability of oil dispersal in the water column between 725 m and 900 m depth for capping only and between 775 m and 875 m for full response deployment. The plume remains relatively contained around the release point, spreading to a maximum of 5 km to the NNW. There is no coastal area impact predicted. The area affected by water column contamination does not coincide with sensitive nursery environments for development of key fish species. The impact of a blowout at the wellhead was assessed to be of medium significance with the implementation of appropriate mitigation measures. Mitigation measures would require the implementation of an oil spill contingency plan including well capping facilities for uncontained blow-outs. For condensate, surface response and SSDI deployment has very little added effect as a mitigation measure since the properties of condensate already result in dispersion in the water column and evaporation upon arrival at the surface.

As the dispersion and dissolution during the rise of crude oil is very low compared to condensate, the impact of the release of crude oil is not significant for the water column but is instead focussed at the surface. For crude oil, the maximum drift is expected during Quarter 1 at a distance of 687 km NW of Release Point D. The probability of surface contamination extending into Namibian waters is very high. Results suggest that a blow-out occurring during Quarters 2 and 3 (in particular during April and between July and August) would result in the greatest amount of oil on surface. There is no coastal impact for the two types of release modelled for any Quarter of the year, due to the currents in the area driving the release drift towards NW, opposite to the coastal area. However attention should be paid to Quarters 2 and 3 for release Point D and for Quarter 2 for release Point A in that if the oil on surface is not recovered 60 days after the start of the spill, some remaining oil on surface could reach the South African coastline. The impact of a blowout at the wellhead was assessed to be of high significance which could be reduced to medium significance with the implementation of appropriate mitigation measures. Mitigation measures would require the implementation of an oil spill contingency plan including well capping facilities for uncontained blow-outs, Subsea Dispersant Injection (SSDI) and surface response.

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

AOI	Area of Interest
ADZ	Aquaculture Development Zone
BAT	Best Available Techniques
CapMarine	Capricorn Marine Environmental (Pty) Ltd
CPUE	Catch Per Unit Effort
DAFF	Department of Agriculture, Forestry and Fisheries
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
FAO	Food and Agricultural Organisation
FLO	Fisheries Liaison Officer
FRAP	Fishery Rights Allocation Process
GRT	Gross Registered Tonnage
H&G	Headed and Gutted
Hz	Hertz
ICCAT	International Convention for the Conservation of Atlantic Tunas
IOTC	Indian Ocean Tuna Commission
kg	Kilogram
m	Metres
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002)
MFMR	Ministry of Fisheries and Marine Resources
mt	Metric tonnes
MSC	Marine Stewardship Council
NatMIRC	National Marine Information and Research Centre
NEMA	National Environmental Management Act 107 of 1998, as amended
PUCL	Precautionary Upper Catch Limit
RAS	Recirculating Aquaculture System
RFMO	Regional Fisheries Management Organisation
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
SAMSA	South African Maritime Safety Authority
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
t	Tonnes
TAC	Total Allowable Catch

TAE	Total Allowable Effort
ToR	Terms of Reference
VMS	Vessel Monitoring System
μPa	Micropascal

1 INTRODUCTION

1.1 BACKGROUND

Africa Oil South Africa Corp (AOSAC) and its partners, Azinam Ltd and Ricocure (Pty) Ltd (the Joint Venture (JV) Partners – hereafter jointly referred to as the Applicant), currently hold an exploration right (reference number 12/3/339) over Licence Block 3B/4B. The licence area is located in the Orange Basin, off the West Coast of South Africa, roughly between Saldanha, Western Cape, in the south and the mouth of the Groenrivier, Northern Cape in the north at approximately 120 – 275 km offshore. The licence block covers an area of approximately 17 581 km^2, in water depths ranging from 300 to 2 600 m.

The applicant proposes to drill up to five exploration wells within two focus areas within the block. The northern Area of Interest (AOI) for exploration drilling is ~1636 km^2 and the central Area of Interest is ~3068 km^2 in extent. The coordinates of the application area, the location of Licence Block 3B/4B and AOI is shown in Figure 1.1.

Point	Lat	Long
A1	-31.0003	14.74908
A2	-31.0003	15.94489
A3	-31.4503	15.94489
A4	-31.4503	15.96588
A5	-31.8836	15.96588
A6	-31.8836	16.28247
A7	-32.417	16.28247
A8	-32.417	16.41589
A9	-32.6003	16.41589
A10	-32.6003	16.54932
A11	-32.708	16.54932
A12	-32.708	16.60468
A13	-33.0002	16.60468
A14	-33.0003	16.24933
A15	-32.7503	16.24933
A16	-32.7503	15.74908
A17	-32.2503	15.74908
A18	-32.2503	15.49908
A19	-32.0003	15.49908
A20	-32.0003	14.99908
A21	-31.2503	14.99908
A22	-31.2503	14.74908

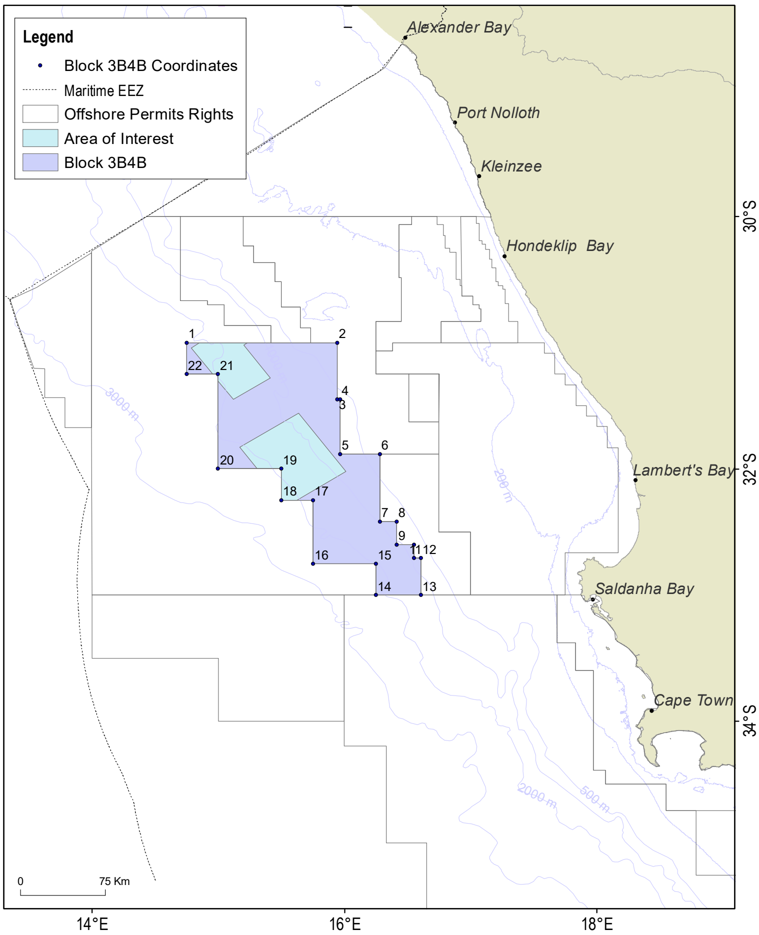


Figure 1.1: Locality of Licence Block 3B/4B and the Area of Interest (AOI) for proposed exploration drilling.

These proposed exploration activities trigger several listed activities in terms of the Environmental Impact Assessment (EIA) Regulations 2014 (as amended), and as such requires an Environmental Authorisation (EA) before such activities can commence. Africa Oil SA Corp, as the Operator of the Block, is the applicant for the Environmental Authorisation. Environmental Impact Management Services (EIMS) has been appointed as the independent Environmental Assessment Practitioner (EAP) to undertake a full Scoping and EIA process for the proposed additional exploration activities (hereafter collectively referred to as "Environmental and Social Impact Assessment" or "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, AOI 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

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 ESIA Report (EIMS, 2023).

Table 1.1: Summary of key project components.

Licence Block No.:	Licence Block 3B/4B
Exploration Right No.:	12/3/339 ER
Exploration and Appraisal Well Drilling	
Number of exploration and appraisal wells	5 wells
Area of Interest for proposed drilling	~4704 km^2
Well depth (below seafloor)	Variable depending on depth of resource which is not currently known. A notional well depth of 3 750 m is assumed for the ESIA
Water depth range	• Water depth range of area of interest: 1000 m to 2000 m • Notional water depth of 1499 m
Duration to drill each well	• Mobilisation phase: up to 45 days • Drilling phase: o Exploration well: Up to four months per well o Appraisal well: Up to four months • Well plugging and abandonment: up to 15 days • Demobilisation phase: up to 10 days
Commencement of drilling and anticipated timing	Commencement is not confirmed, but possibly between first quarter of 2024 (Q1 2024) and fourth quarter of 2024 (Q4 2024) to drill first well.
Proposed drilling fluids (muds)	Water-based Muds (WBM) will be used during the first (riserless) drilling stage and Non-Aqueous Drilling Fluid (NADF) during the second (risered) drilling stage.
Drilling and support vessels	• Semi-submersible drilling unit or drillship • Three support vessels during mobilisation, riserless and demobilisation periods. Two during the risered phase. These vessels will be on standby at the drilling site, 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 (DST) per appraisal well, with each test taking up 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

Drop core sampling	
Purpose	Sampling of seabed sediment
Method	• Piston core • Box core
Number	20 cores
Duration	5 weeks
Location	Within area of interest for drilling (no specific target identified)
Safety Zone	500 m
Sonar surveys	
Purpose	Investigate the structure if the ocean bed sediments
Method	• Multi beam echo-sounder (70-100 kHz) • Single beam echo-sounder (38-200 kHz) • Sub-bottom profiler (2-16 kHz)
Duration / Extent	Up to 10 days per well site / 150 km^2 across a depth range of 700 m and 1900 m
Location	Not confirmed but localised areas within the whole block
Safety zone	500 m

1.3.1 PRE-DRILLING SURVEYS

Pre-drilling surveys will be undertaken prior to drilling in order to confirm baseline conditions at the drill site and to identify and delineate any seabed and sub-seabed geo-hazards that may impact the proposed exploration drilling operations. Pre-drilling surveys may involve a combination of sonar surveys, sediment sampling, water sampling, sledge camera's and ROV activities.

Sonar Surveys

Pre-drilling sonar surveys may involve multi- and single beam echo sounding and sub-bottom profiling. These surveys would not be limited to a specific time of the year but would be of short duration (around 10 days per survey) and focused on selected areas of interest within the block. The interpretation of the survey would take up to four weeks to complete.

Echo Sounders

The majority of hydrographic depth/echo sounders are dual frequency, transmitting a low frequency pulse at the same time as a high frequency pulse. Dual frequency depth/echo sounding has the ability to identify a vegetation layer or a layer of soft mud on top of a layer of rock. AOSAC is proposing to utilise a single beam echo-sounder with a frequency range of 38 to 200 kHz. In addition, it is proposed to also utilise multibeam echo sounders (70 - 100 kHz range and 200 dB re 1μPa at 1m source level) that are capable of receiving many return "pings". This system produces a digital terrain model of the seafloor.

Sub-Bottom Profilers

Sub-bottom profilers are powerful low frequency echo-sounders that provide a profile of the upper layers of the ocean floor. Bottom profilers emit an acoustic pulse at frequencies ranging between 2 and 16 kHz, typically producing sound levels in the order of 200-230 db re 1μPa at 1m.

Seabed Sediment Coring

Seabed sediment sampling may involve the collection of sediment samples in order to characterise the seafloor and for laboratory geochemical analyses in order to determine if there is any naturally occurring hydrocarbon seepage at the seabed or any other type of contamination prior to the commencement of drilling.

No specific target area has as yet been identified for the sediment sampling. It is currently anticipated that up to 20 samples could be taken across the entire area of interest potentially removing a cumulative volume of ~ 35 m^3. The sediment sampling process would take between three to five weeks to complete, depending on weather conditions.

Piston and box coring (or grab samples) techniques may be used to collect the seabed sediment samples. These techniques are further described below.

Piston Coring

Piston coring (or drop coring) is one of the more common methods used to collect seabed geochemical samples. The piston coring rig is comprised of a trigger assembly, the coring weight assembly, core barrels, tip assembly and piston. The core barrels are 6 - 9 m in lengths with a diameter of 10 cm.

The recovered cores are visually examined at the surface for indications of hydrocarbons (gas hydrate, gas parting or oil staining) and sub-samples retained for further geochemical analysis in an onshore laboratory.

Box Coring

Box corers are lowered vertically to the seabed from a survey vessel by. At the seabed the instrument is triggered to collect a sample of seabed sediment. The recovered sample is completely enclosed thereby reducing the loss of finer materials during recovery. On recovery, the sample can be processed directly through the large access doors or via complete removal of the box and its associated cutting blade. AOSAC is proposing to take box core samples (50 cm x 50 cm) at a depth of less than 60 cm.

1.3.2 WELL LOCATION AND DRILLING PROGRAMME

AOSAC is proposing to drill up to five exploration wells within an Area of Interest within Block 3B/4B. The expected target drilling depth is not confirmed yet and a notional well depth of 3 750 m below sea floor (Water depth range 500 m – 1700 m) is assumed at this stage. 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). AOSAC's strategy for future drilling is that drilling could be undertaken throughout the year (i.e. not limited to a specific seasonal window period).

The schedule for drilling the wells is not confirmed yet; however, the earliest anticipated date for commencement of drilling is between first quarter of 2024 (Q1 2024) and third quarter of 2024 (Q3 2024).

1.3.3 MAIN PROJECT COMPONENTS

Various types of drilling technology can be used to drill an exploration well (e.g. barges, jack-up rigs, semi-submersible drilling units (rigs) and drill-ships) depending on, inter alia, the water depth and marine operating conditions experienced at the well site. Based on the anticipated sea conditions, AOSAC 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. The final rig selection will be made depending upon availability and final design specifications.

- A semi-submersible drilling unit (Figure 1.2, right) is essentially a drilling rig located on a floating structure of pontoons. When at the well location, the pontoons are partially flooded (or ballasted), with seawater, to submerge the pontoons to a pre-determined depth below the sea level where wave motion is minimised. This gives stability to the drilling vessel thereby facilitating drilling operations.
- A drill-ship (Figure 1.2, left) is a fit for purpose built drilling vessel designed to operate in deep water conditions. The drilling "rig" is normally located towards the centre of the ship with support operations from both sides of the ship using fixed cranes. The advantages of a drill-ship over the majority of semi-submersible units are that a drill-ship has much greater storage capacity and is independently mobile, not requiring any towing and reduced requirement of supply vessels.

Figure 1.2: Example of a drill rig, the Noble Globetrotter II (left) and of a semi-submersible, the Deepwater Nautilus, being transported on a heavy-lift ship.

Support Vessels

The drilling unit would be supported / serviced by up to three support vessels, which would facilitate equipment, material and waste transfer between the drilling unit and onshore logistics base. A supply vessel will always be on standby near the drilling unit to provide support for firefighting, oil containment / recovery, rescue in the unlikely event of an emergency and supply any additional equipment that may be required. Support vessels can also be used for medical evacuations or transfer of crew if needed.

Helicopters

Transportation of personnel to and from the drilling unit would be provided by helicopter from Springbok Airport (fixed wing trip from Cape Town) using local providers. It is estimated that there may be up to four return flights per week between the drilling unit and the helicopter support base at Springbok (i.e. 17 weeks (˜120 days) x 4 = 68 trips per well). The helicopters can also be used for medical evacuations from the drilling unit to shore (at day- or night-time), if required, in which case the flights are likely to be directly to Cape Town.

Onshore Logistics Base

The primary onshore logistics base will most likely be located at the Port of Cape Town (preferred option), but alternatively at the Port of Saldanha.

The shore base would provide for the storage of materials and equipment that would be shipped to the drilling unit and back to storage for onward international freight forwarding. The shore base would also be used for offices, waste management services, bunkering vessels, and stevedoring / customs clearance services.

1.3.4 MOBILISATION PHASE

The mobilisation phase will entail the required notifications, establishment of the onshore base, appointment of local service providers, procurement and transportation of equipment and materials from various ports and airports, accommodation arrangements and transit of the drilling unit and support vessels to the drilling area.

The drilling unit and supply vessels could sail directly to the well site from outside South African waters or from a South African port, depending on which drilling unit is selected, and where it was last used.

Core specialist and skilled personnel would arrive in South Africa onboard the drilling unit and the rest of the personnel will be flown to Cape Town.

Drilling materials, such as casings, mud components and other equipment and materials will be brought into the country on the drilling unit itself or imported via a container vessel directly to the onshore logistics base from where the supply vessels will transfer it to the drilling unit. Cement and chemicals will be sourced locally, where available.

1.3.5 OPERATION PHASE

Final Site Selection and Seabed Survey

The selection of the specific well locations will be based on a number of factors, including further detailed analysis of the seismic and pre-drilling survey data and the geological target. A Remote Operating Vehicle (ROV) will be used to finalise the well position based on inter alia the presence of any seafloor obstacles or the presence of any sensitive features that may become evident.

Well Drilling Operation

The 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 (sections of steel pipe), each slightly smaller in diameter, are placed in the hole and permanently cemented in place (cementing operations are described below). The hole diameter decreases with increasing depth.

The casings provide structural integrity to the newly drilled wellbore, in addition to isolating potentially dangerous high-pressure zones from each other and from the surface. With these zones safely isolated, and the formation protected by the casing, the well will be drilled deeper with a smaller drill bit, and also cased with a smaller sized casing. For the current project, it is anticipated that there will be five sets of subsequently smaller hole sizes drilled inside one another, each cemented with casing, except the last phase that will remain an open hole.

Drilling is essentially undertaken in two stages, namely the riserless and risered drilling stages (Figure 1.3). A typical well design is summarised in Table 1.2 and Table 1.3 below. The well design ultimately depends upon factors such as planned depths, expected pore pressures and anticipated hydrocarbon-bearing formations. Several types of drilling fluids with different compositions and densities would be used for drilling operations. The composition of the muds is provided in the drillings discharge modelling Report (Livas 2023a). This may vary slightly depending on the contractor's selection and may be modified to suit operational needs.

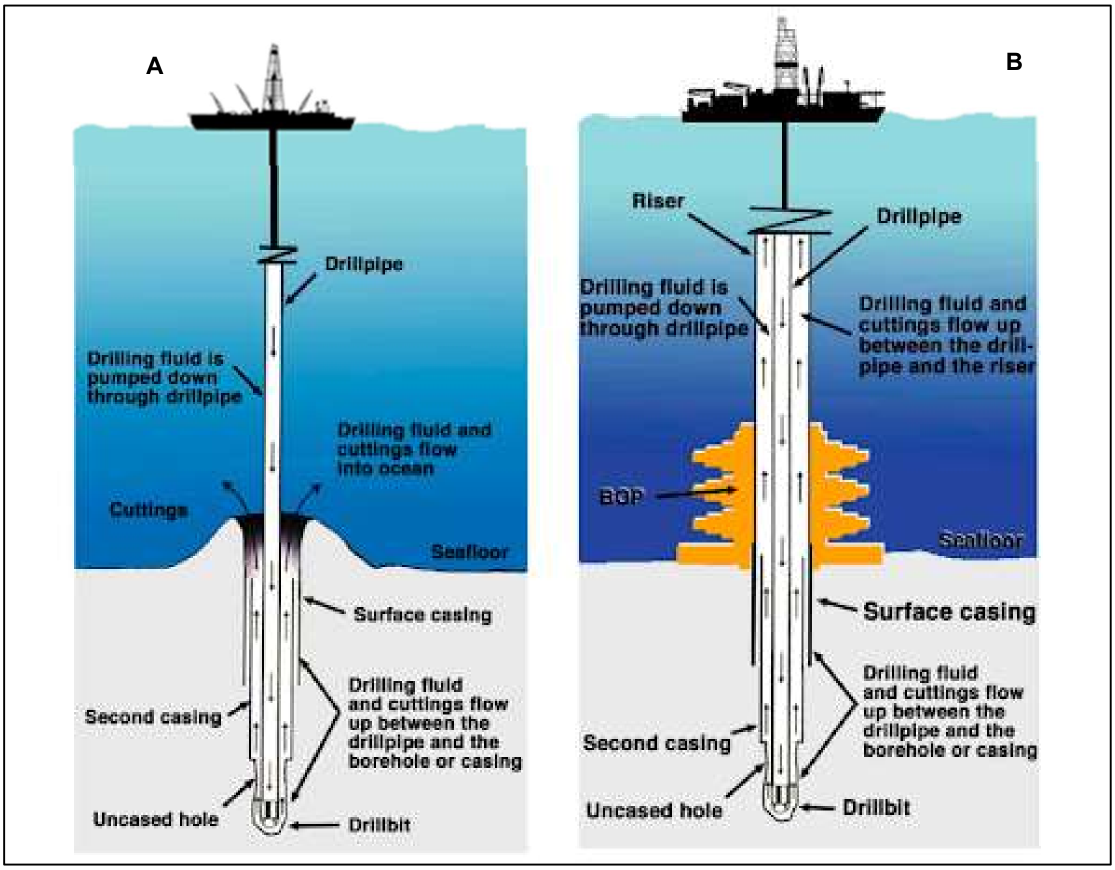


Figure 1.3: Drilling stages: (a) Riserless Drilling Stage; and (b) Risered Drilling Stage.

Table 1.2: Cuttings and mud volumes per phase for notional base case well design and estimated drilling discharges using water-based muds as the drilling fluid.

Drill Section	Hole diameter (inches)	Depth of section (m)	Type of drilling fluid used	Mass of drilling fluid discharged (tonnes)	Volume of cuttings released (m^3)	Drilling fluid and cuttings discharge location
Riserless drilling stage						
1	36"	70	Seawater, viscous sweeps & WBM	209	40	At sea bottom
2	26"	320		135	76	
-	Suspension / Displacement before drilling Section 3	-	High Viscous Gel sweeps / KCl Polymer PAD mud	30	-	1 m above seabed
Total Riserless		**390**		374	116	
Risered drilling stage						
3	17.5"	700	KCl/Glycol WBM	133*	74	10 m below mean sea level
4	12.25"	1 250		109*	61	
5	8.5"	1 160		61*	27	
Total Risered		**3 110**		**303**	**162**	
Total		**3 500**	-	**677**	**278**	-

Note: * Total quantity of mud discharged including Oil On Cuttings (OOC) @ 6% by weight of cuttings (metricT) + Other constituents.

Table 1.3: Cuttings and mud volumes per phase for notional base-case well design and estimated drilling discharges using Non-Aqueous Drilling Fluid (NADF) for the deeper sections.

Drill Section	Hole diameter (inches)	Depth of section (m)	Type of drilling fluid used	Mass of drilling fluid discharged (tons)	Mass of cuttings released (tonnes)	Drilling fluid and cuttings discharge location
Riserless drilling stage						
1	36"	100	Seawater, viscous sweeps & WBM	338	160	At sea bottom
2	26"	775		541	879	
-	Suspension / Displacement before drilling Section 3	-	High Viscous Gel sweeps / CaCl Polymer PAD mud	1 047	-	1 m above seabed
Total Riserless		**875**		1 926	1 039	
Risered drilling stage						
3	17.5"	800	NADF	57	411	10 m below mean sea level
4	12.25"	1 325		46	334	
5	8.5"	750		13	92	
Total Risered		2 875		116	837	
Totals	-	**3 750**	-	**2 042**	**1 876**	-

Note: * Total quantity of mud discharged including Oil On Cuttings (OOC) @ 6.9% by weight of cuttings (metricT) + Other constituents.

Initial (riserless) drilling stage

The process of preparing the first section of a well is referred to as "spudding." Sediments just below the seafloor are often very soft and loose, thus to keep the well from caving in and to carry the weight of the wellhead, a 30- or 36 inch diameter structural conductor pipe is drilled and cemented into place or in some cases jetted.

For the proposed wells, the drill and cement option is preferred. It is usually implemented where the nature of the seafloor sediments (hard sediments) necessitate drilling. A hole of diameter 36 inches will be drilled and the conductor pipe will be run into the hole and cemented into place. The cement returns exit the bottom of the conductor and travel up the annular space between the conductor and the hole with some cement being deposited on the seabed around the conductor pipe.

When the conductor pipe and low-pressure wellhead are at the correct depth, approximately 70 m deep (depending upon substrate strength), a new drilling assembly will be run inside the structural conductor pipe and the next hole section will be drilled by rotating the drill string and drill bit.

Below the conductor pipe, a hole of approximately 26 inches in diameter will be drilled to a depth of approximately 320 m below the seabed. The rotating drill string causes the drill bit to crush rock into small particles, called “cuttings”. While the wellbore is being drilled, drilling fluid is pumped from the surface down through the inside of the drill pipe, the drilling fluid passes through holes in the drill bit and travels back to the seafloor through the space between the drill string and the walls of the hole, thereby removing the cuttings from the hole. At a planned depth the drilling is stopped and the bit and drill string is pulled out of the hole. A surface casing of 20 inch diameter is then placed into the hole and secured into place by pumping cement through the casing at the bottom of the hole and back up the annulus (the space between the casing and the borehole). The 20-inch casing will have a high-pressure wellhead on top; which provides the entry point to the subsurface and it is the connection point to the Blow-out Preventor (BOP).

These initial hole sections will be drilled using seawater (with viscous sweeps) and WBM. All cuttings and WBM from this initial drilling stage will be discharged directly onto the seafloor adjacent to the wellbore.

Risered Drilling Stage

The risered drilling stage commences with the lowering of a BOP and installing it on the wellhead. The BOP is designed to seal the well and prevent any uncontrolled release of fluids from the well (a ‘blow-out’). A lower marine riser package is installed on top of the BOP and the entire unit is lowered on riser joints. The riser isolates the drilling fluid and cuttings from the external environment, thereby 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. Considering that the wells are planned to be drilled to a total depth of 3500-3750 m below the mud line, temperatures at the bottom of the well (BHST) are in the range of 140°C, with high Pore Pressures for downhole conditions, it is likely that only WBM’s would not be suitable. The drilling fluid emerges through nozzles in the drill bit and then rises (carrying the rock cuttings with it) up the annular space between the sides of the hole to the drilling unit.

The cuttings are removed from the returned drill mud, sampled for analysis and discharged overboard. The rock cuttings are analysed and logged in terms of their depth and rock description, which forms the basis of building a stratigraphic record of the types of rocks penetrated. This information is used to build a stratigraphic column. Any fossils present in the rocks can be used to help establish a geologic age for the stratigraphic layers that are drilled. In instances where NADFs are used, cuttings will be treated to reduce oil content and discharged overboard. Operational discharges are discussed further in Section 1.3.7.

The hole diameter decreases in steps with depth as progressively smaller diameter casings are inserted into the hole at various stages and cemented into place. The expected target drilling depth is not yet confirmed but the notional well depth is between 3 500 m and 3 750 m below the seafloor with a final hole diameter between of 8.5 and 12.25 inches and a casing diameter of between 7 and 9.6 inches.

Cementing Operation

Cementing is the process of pumping cement slurry through the drill pipe and / or cement stinger at the bottom of the hole and back up into the space between the casing and the borehole wall (annulus). Cement fills the annulus between the casing and the drilled hole to form an extremely strong, nearly impermeable seal, thereby permanently securing the casings in place. To separate the cement from the drilling fluid in order to minimise cement contamination a cementing plug and/or spacer fluids are used. The plug is pushed by the drilling fluid to ensure the cement is placed outside the casing filling the annular space between the casing and the hole wall.

Cementing has four general purposes: (i) it isolates and segregates the casing seat for subsequent drilling, (ii) it protects the casing from corrosion, (iii) it provides structural support for the casing, and (iv) it stabilises the formation.

To ensure effective cementing, an excess of cement is often used. Until the marine riser is set, excess cement from the first two casings emerges out of the top of the well onto the seafloor. This cement does not set and is slowly dissolved into the seawater.

Offshore drilling operations typically use Portland cements, defined as pulverised clinkers consisting of hydrated calcium silicates and usually containing one or more forms of calcium sulphate. The raw materials used are lime, silica, alumina and ferric oxide. The cement slurry used is specially designed for the exact well conditions encountered.

Additives can be used to adjust various properties in order to achieve the desired results. There are over 150 cementing additives available. The amount (concentrations) of these additives generally make up only a small portion (<10%) of the overall amount of cement used for a typical well. Usually, there are three main additives used: retarders, fluid loss control agents and friction reducers. These additives are polymers generally made of organic material and are considered non-toxic.

Once the cement has set, a short section of new hole is drilled, then a pressure test is performed to ensure that the cement and formation are able to withstand the higher pressures of fluids from deeper formations.

Well Logging and Testing

Once the target depth is reached, the well would be logged and could be tested dependent on the drilling results.

Well logging involves the evaluation of the physical and chemical properties of the sub-surface rocks, and their component minerals, including water, oil and gas to confirm the presence of hydrocarbons and the petrophysical characteristics of rocks. It is undertaken during the drilling operation using Wireline Logging or Logging While Drilling (LWD) to log core data from the well. Information from engineering and production logs, as well as mud logging, may also be used.

Vertical Seismic Profiling (VSP) is an evaluation tool used 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 with a gun pressure of 450 per square inch (psi), which is operated from the drilling unit at a depth of between 7 m and 10 m. During VSP operations, four to five receivers are positioned in a section of the borehole and the airgun array is discharged approximately five times at 20 second intervals at each station. The generated sound pulses are reflected through the seabed and are recorded by the receivers to generate a profile along a 60 to 75 m section of the well. This process is repeated for different stations in the well and may take up to six hours to complete approximately 125 shots, depending on the well's depth and number of stations being profiled.

Well or flow testing is undertaken to determine the economic potential of the discovery before the well is either abandoned or suspended. One test would be undertaken per exploration well should a resource be discovered and up to two tests per appraisal well. Each test would take up to 7 days to complete (5 days of build-up and 2 days of flowing and flaring). For well flow-testing, hydrocarbons would be burned at the well site. A high-efficiency flare is used to maximise combustion of the hydrocarbons. Burner heads which have a high burning efficiency under a wide range of conditions will be used.

The volume of hydrocarbons (to be burned) and possible associated produced water from the reservoir which could be generated during well testing cannot be reliably predicted due to variations in gas composition, flow rates and water content. Burners are manufactured to ensure emissions are kept to a minimum. The estimated volume of hydrocarbons to be burned cannot be predicted with much accuracy because the actual test requirements can only be established after the penetration of a hydrocarbon-bearing reservoir. However, an estimated 10 000 bbl oil could be flared per test, i.e. up to 20 000 bbl over the two tests associated with an appraisal well. If produced water is generated during well testing, it will be separated from the hydrocarbons.

Well Sealing and Plugging

The purpose of well sealing and plugging is to isolate permeable and hydrocarbon bearing formations. Well sealing and plugging aims to restore the integrity of the formation that was penetrated by the wellbore. The principal technique applied to prevent cross flow between permeable formations is plugging of the well with cement, thus creating an impermeable barrier between two zones.

Once drilling and logging have been completed, the exploration wells will be sealed with cement plugs, tested for integrity and abandoned according to international best practices. Cement plugs will be set to isolate hydrocarbon bearing and / or permeable zones and cementing of perforated intervals (e.g. from well logging activities) will be evaluated where there is the possibility of undesirable cross flow. These cement plugs are set in stages from the bottom up. Up to three cement plugs would be installed: e.g. one each for isolation of the deep reservoir and the main reservoir; and a third as a second barrier for the main reservoir.

The integrity of cement plugs can be tested by a number of methods. The cement plugs will be tag tested (to validate plug position) and weight tested, and if achievable then a positive pressure test (to validate seal) and/or a negative pressure test will be performed. Additionally, a flow check may be performed to ensure sealing by the plug. Once the well is plugged, seawater will be displaced before disconnecting the riser and the BOP.

1.3.6 DEMOBILISATION PHASE

After wells have been plugged and tested for integrity, they may be abandoned with wellhead left in place on the seabed in line with industry practices worldwide. Where appropriate, 'over trawlable' protective equipment is applied to abandoned wellheads. The risk assessment criteria will consider factors such as the water depth and use of the area by other sectors (e.g., fishing). It is worth noting that irrespective of whether the wellhead and over trawlable protective equipment is retained the well bore itself will be plugged.

The operator may place monitoring equipment on wellheads for monitoring well properties and data collection to be used for future development scheme design and input.

With the exception of the over-trawlable protective equipment (if required) over abandoned wellheads and drilling discharges deposited on the seabed, no further physical remnants of the drilling operation will be left on the seafloor. A final clearance survey check will be undertaken using an ROV. The drilling unit and support vessels will demobilise from the offshore licence area and either mobilise to the following drilling location or relocate into port or a regional base for maintenance, repair or resupply.

1.3.7 DISCHARGES, WASTES AND EMISSIONS

The proposed drilling operations (including mobilisation and demobilisation) will result in various discharges to water, the generation of waste and emissions. All vessels will have equipment, systems and protocols in place for prevention of pollution by oil, sewage and garbage in accordance with international MARPOL requirements. Any oil spill related discharges would be managed by an Oil Spill Contingency Plan (OSCP). Onshore licenced waste disposal sites and waste management facilities will be identified, verified and approved prior to commencement of drilling operations.

Discharges to Sea

Drilling Cuttings and Mud

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. Drilling discharges would be disposed at sea in line with accepted drilling practices as defined by the UK and Norway. This is in line with most countries (including South Africa) for early exploration development phases. The rationale for this is based on the low density of drilling operations in the vast offshore area and the high energy marine environment. As such, AOSAC proposes to use the “offshore treatment and disposal” option for their drilling campaign in Block 3B/4B in the Deep Water Orange Basin. The same method was applied and approved for drilling other deep water exploration wells in Block 11B/12B (namely Brulpadda and Luiperd wells) off the South Coast of South Africa.

During the riserless drilling stage, all cuttings and WBM will be discharged directly onto the seafloor adjacent to the wellbore. Where NADFs are used (possibly during the risered drilling stage, if WBMs are not able to provide the necessary characteristics), these are sometimes treated onshore and disposed, treated to recover oil and disposed offshore and sometimes re-injected into wells. For the current project, in instances where NADFs are used, cuttings will be treated offshore to reduce oil content to <6.9% Oil On Cutting (OOC) and discharged overboard. During this drilling stage the circulated drilling fluid will be cleaned and the cuttings discharged into the sea at least 10 m below sea level. The drill cuttings will be treated to reduce their mud content using shakers and a centrifuge. The assumed types and mass/volumes of discharges are detailed in Table **1.3**.

Cuttings released from the drilling unit during the risered drilling stage will be dispersed by the current and settle to the seafloor. The rate of cuttings discharge decreases with increasing well depth as the hole diameter becomes smaller and penetration rates decrease. Discharge is intermittent as actual drilling operations are not continuous while the drilling unit is on location. Discharge is 10m below sea level

Further drilling fluid will be released 1 m above the seafloor during well suspension and displacement (between drilling section 2 and 3), as detailed in Table **1.3**.

The expected fall and spatial extent of the deposition of discharged cuttings have been investigated in the Drilling Discharges Modelling Study (Livas 2023a), the results of which will inform the marine biodiversity assessment.

Cement and Cement Additives

Typically, cement and cement additives are not discharged during drilling. However, during the initial cementing operation (i.e. surface casing), excess cement emerges out of the top of the well and onto the seafloor in order to ensure that the conductor pipe is cemented all the way to the seafloor. During this operation a maximum of 150% of the required cement volume may be pumped into the space between the casing and the borehole wall (annulus). In the worst-case scenario, approximately 50 m^3 of cement could be discharged onto the seafloor.

BOP Hydraulic Fluid

As part of routine opening and closing operations the subsea BOP stack elements will vent some hydraulic fluid into the sea at the seafloor. It is anticipated that between approximately 500 and 1 000 litres of oil-based hydraulic emulsion fluid could be vented per month during the drilling of a well. BOP fluids are completely biodegraded in seawater within 28 days.

Produced Water

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. The hydrocarbon component will be burned off via the flare booms, while the water is temporarily collected in a slop tank. The water is then either directed to:

- a settling tank prior to transfer to supply vessel for onshore treatment and disposal; or
- a dedicated treatment unit where, after treatment, it is either:
  - (i) if hydrocarbon content is < 30 mg/l, discharged overboard; or
  - (ii) if hydrocarbon content is > 30 mg/l, subject to a 2nd treatment or directed to tank prior to transfer to supply vessel for onshore treatment and disposal.

Reinjection of the produced water may be considered if volumes are large and cannot be managed onboard the drilling unit.

Vessel Machinery Spaces (Bilge Water)

Vessels will occasionally discharge treated bilge water. Bilge water is drainage water that collects in a ship's bilge space (the bilge is the lowest compartment on a ship, below the waterline, where the two sides meet at the keel). In accordance with MARPOL Annex I, bilge water will be retained on board until it can be discharged to an approved reception facility, unless it is treated by an approved oily water separator to <15 ppm oil content and monitored before discharge. The residue from the onboard oil/water separator will be treated / disposed of onshore at a licenced hazardous landfill site.

Deck Drainage

Deck drainage consists of liquid waste resulting from rainfall, deck and equipment washing (using water and a water-based detergent). Deck drainage will be variable depending on the vessel characteristics, deck activities and rainfall amounts.

In areas of the drilling unit where oil contamination of rainwater is more likely (i.e. the rig floor), drainage is routed to an oil / water separator for treatment before discharge in accordance with MARPOL Annex I (i.e. 15 ppm oil and grease maximum). There will be no discharge of free oil that could cause either a film, sheen or discolouration of the surface water or a sludge or emulsion to be deposited below the water's surface. Only non-oily water (i.e. <15 ppm oil and grease, maximum instantaneous oil discharge monitor reading) will be discharged overboard. If separation facilities are not available (due to overload or maintenance) the drainage water will be retained on board until it can be discharged to an approved reception facility. The oily residue from the onboard oil / water separator will be treated / disposed of onshore at an approved hazardous landfill site.

Brine generated from onboard desalination plant

The waste stream from the desalination plant is brine (concentrated salt), which is produced in the reverse osmosis process. The brine stream contains high concentration of salts and other concentrated impurities that may be found in seawater. Water chemical agents will not be used in the treatment of seawater and therefore the brine reject portion would be in a natural concentrated state. Based on previous well drilling operations, freshwater production amounts to approximately 40 m^3/day, which will result in approximately 35 g salt for each litre water produced (i.e. approx. 1 400 kg salt/brine per day).

Sewage and Grey Water

Discharges of sewage (or black water) and grey water (i.e. wastewater from the kitchen, washing and laundry activities and non-oily water used for cleaning) will occur from vessels intermittently throughout the project and will vary according to the number of persons on board, estimated at an average of 200 litres per person. All sewage discharges will comply with MARPOL Annex IV.

Sewage and grey water will be treated using a marine sanitation device to produce an effluent with:

- A Biological Oxygen Demand (BOD) of <25 mg/l (if the treatment plant was installed after 1/1/2010) or <50 mg/l (if installed before this date);
- Minimal residual chlorine concentration of 0.5 mg/l; and
- No visible floating solids or oil and grease.

Food (Galley) Wastes

The disposal into the sea of food waste is permitted, in terms of MARPOL Annex V, when it has been comminuted or ground to particle sizes smaller than 25 mm and the vessel is en route more than 3 nautical miles (approximately 5.5 km) from land. Disposal overboard without macerating is permitted for moving vessels greater than 12 nautical miles (approximately 22 km) from the coast. On the drilling unit, all food waste will be macerated to particles sizes <25 mm and the daily discharge is typically about seven tonnes per month.

Ballast Water

Ballast water is used during routine operations to maintain safe operating conditions onboard a ship by reducing stress on the hull, providing stability, improving propulsion and manoeuvrability, and compensating for weight lost due to fuel and water consumption.

Ballast water is discharged subject to the requirements of the 2004 International Convention for the Control and Management of Ships' Ballast Water and Sediments. The Convention stipulates that all ships are required to implement a Ballast Water Management Plan and that all ships using ballast water exchange will do so at least 200 nautical miles (nm) (± 370 km) from nearest land in waters of at least 200 m deep when arriving from a different marine region. Where this is not feasible, the exchange should be as far from the nearest land as possible, and in all cases a minimum of 50 nm (±93 km) from the nearest land and preferably in water at least 200 m in depth. Project vessels will be required to comply with this requirement.

Detergents

Detergents used for washing exposed marine deck spaces will be discharged overboard. The toxicity of detergents varies greatly depending on their composition. Water-based detergents are low in toxicity and are preferred for use. Preferentially biodegradable detergents should be used. Detergents used on work deck space will be collected with the deck drainage and treated as described under deck drainage above.

Noise Emissions

The key sources generating underwater noise are vessel propellers (and positioning thrusters), with a contribution from the pontoons (e.g. noise originating from within the pontoons and on-deck machinery), supply vessels and from drilling activities. This is expected to result in highly variable sound levels, being dependent on the operational mode of each vessel. The pre-drilling sonar surveys and VSP survey would generate a short-term noise, taking 4 weeks and less than nine hours to complete, respectively.

The main sources of noise from these activities are categorised below.

- Pre-drilling sonar surveys may involve multi- and single beam echo sounding and sub-bottom profiling. These surveys would be undertaken between the 700 m and 1900 m depth ranges covering a survey area of approximately 150 km^2. Each wellsite survey would take up to 10 days to complete. A single beam echo-sounder operates within a frequency range of 38 to 200 kHz, whereas multibeam echo sounders operate in the 70 - 100 kHz range and have a 200dB re 1µPa at 1m source level. Sub-bottom profilers emit an acoustic pulse at frequencies ranging between 2 and 16 kHz, typically producing sound levels in the order of 200-230 db re 1µPa at 1m.
- Drilling noise: Drilling units generally produce underwater noise in the range of 10 Hz to 100 kHz (OSPAR commission, 2009) with major frequency components below 100 Hz and average source levels of up to 190 dB re 1 µPa at 1 m (rms) (the higher end of this range from use of bow thrusters). These noise levels will be assumed as indicative for the current project.
- Propeller and positioning thrusters: Noise from propellers and thrusters is predominately caused by cavitation around the blades whilst transiting at speed or operating thrusters under load in order to maintain a vessel's position. The noise produced by a drilling unit's dynamic positioning systems can be audible for many kilometres. Noise produced is typically broadband noise, with some low tonal peaks. The supply vessels will also contribute to an overall propeller noise generation.
- Machinery noise: Machinery noise is often of low frequency and can become dominant for vessels when stationary or moving at low speeds. The source of this type of noise is from large machinery, such as large power generation units (diesel engines or gas turbines), compressors and fluid pumps. Sound is transmitted through different paths, i.e. structural (machine to hull/pontoons to water) and airborne (machine to air to hull to water) or a mixture of both. The nature of sound is dependent on a number of variables, such as the type and size of machinery operating; and the coupling between machinery and the vessel body. Machinery noise is typically tonal in nature. A ROV will be used to conduct a sweep of the drilling site to identify any debris; however, this is not expected to form a significant noise source.
- Well logging noise: If relevant, VSP will be undertaken in order to generate a high-resolution image of the geology in the well's immediate vicinity. It is expected to use a small dual airgun array, comprising a system of three 150 cubic inch airguns and three 150 cubic inch airguns with a total volume of 450 cubic inches of compressed nitrogen at about 2 000 psi. VSP source will generate a pulse noise level in the 5 to 1 000 Hz range. The volumes and the energy

released into the marine environment are significantly smaller than what is required or generated during conventional seismic surveys. The airguns will 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 150 shots. A VSP is expected to take up to six hours per well to complete, depending on the well's depth and number of stations being profiled.

- Well testing noise: Flaring would produce some air-borne noise above the sea level where flaring is implemented for up to two days of flowing and flaring.
- Equipment in water: Noise is produced from equipment such as the drill string. The noise produced will be low relative to the drilling noise and the dynamic positioning system.
- Helicopter noise: Helicopters will also form a source of noise, which can affect marine fauna both in terms of underwater noise beneath the helicopter and airborne noise.

The extent of project-related noise above the background noise level may vary considerably depending on the specific vessels used and the number of supply vessels operating. It will also depend on the variation in the background noise level with weather and with the proximity of other vessel traffic (not associated with the project).

An Underwater Noise Modelling Study has been undertaken to determine the underwater noise transmission loss with distance from well site and compare results with threshold values for marine fauna to determine zones of impact. These modelling results will be used in the assessment of impacts on marine fauna.

Light Emissions

Operational lighting will be required on the drilling unit and supply vessels for safe operations and navigation purposes during the hours of darkness. Where feasible, operational lights will be shielded in such a way as to minimise their spill out to sea.

Heat Emissions

Flaring during well testing generates heat emissions from the combustion of hydrocarbons at the burner head.

1.4 SUMMARY OF KEY POTENTIAL FISHERIES IMPACTS

The key potential fisheries impacts are presented in Table 1.4, as identified during the Scoping Phase.

Table 1.4: Project components and identified key potential impacts on fisheries.

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. Pre-drilling Surveys	Seabed Coring	Safety zone	Exclusion of fishing operations from safety zone around drillship
	SONAR Surveys	Safety zone	Exclusion of fishing operations from safety zone around drillship
		Increased underwater noise levels	Disturbance / behavioural changes to marine fauna

3. 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
4. Demobilisation Phase	Abandonment of well on seafloor	Safety zone	Exclusion of fishing operations from safety zone around abandoned wellhead
5. 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 2017 to 2021 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] 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.

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.

3 DESCRIPTION OF RECEIVING ENVIRONMENT: FISHERIES BASELINE

3.1 OVERVIEW OF FISHERIES SECTORS

South Africa is home to a diverse and complex marine environment, with two distinct ecosystems along its extensive 3 623 km coastline. The western coastal shelf boasts highly productive commercial fisheries, similar to other upwelling ecosystems around the world, while the east coast is known for its high species diversity and endemics but has a less productive fishing industry. Licence Block 3B/4B is situated within the southern Benguela Large Marine Ecosystem, which is considered one of the largest and most productive of the world's coastal upwelling systems.

Fisheries in South Africa are regulated and monitored by the DFFE, which is responsible for ensuring the sustainable use of marine resources. The DFFE plays a critical role in managing and conserving the country's marine environment, including the allocation of fishing rights, setting sustainable total allowable catch (TAC) and total allowable effort (TAE), and developing flexible Operational Management Procedures (OMPs) that can accommodate changes in fish populations.

All fishing activities, as well as the processing, sale, and trade of marine resources in South Africa, are subject to regulation under the Marine Living Resources Act of 1998. This act provides the legal framework for the conservation and management of marine resources and ensures their sustainable use, while also protecting the marine ecosystem from the negative impacts of human activities such as oil and gas exploration. The DFFE is responsible for monitoring and controlling these activities to prevent damage to the marine environment and ensure the sustainability of South Africa's fishing industry.

The fisheries sector is worth around R8 billion a year and the commercial sector directly employs approximately 28 000 people with many thousands more people depending on fisheries resources to meet basic needs in the small-scale and recreational sectors.

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*). These species play a crucial role in the marine food chain, serving as a food source for larger predatory fish and marine mammals.

The traditional linefishery targets a large assemblage of species close to shore including snoek (*Thyrsites atun*), Cape bream (*Pachymetopon blochii*), geelbek (*Atractoscion aequidens*), Silver kob (*Argyrosomus inodorus*), yellowtail (*Seriola lalandi*) and other reef fish. This type of fishing has a long history in South Africa, with many communities relying on this fishery as a source of livelihood and food. The traditional line fishery operates mostly inshore and utilises hook and line, but excludes the use of longlines.

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 along 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 industry employs over 313 people who are permanent and approximately 1450 people who are employed seasonally. Most of the employed people are women from previously disadvantaged backgrounds. *E. maxima* is primarily used by the abalone aquaculture industry as abalone feed.

Marine aquaculture in South Africa involves the farming of species such as abalone, mussels, and oysters in ocean-based pens or cages. This industry has shown steady growth in recent years as demand for sustainably farmed seafood products has increased. The aquaculture sector creates jobs and contributes to the economy in coastal communities, while also helping to relieve pressure on wild fish stocks. The South African government has actively supported the development of the aquaculture industry through the implementation of regulations and initiatives aimed at promoting sustainable and responsible practices.

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.

The recreational fishing sector in South Africa includes a diverse range of activities, from shore and boat-based angling to spearfishing and collecting of marine species. This sector targets a wide range of line fish species, some of which are also targeted by commercial operators. Divers participate in the collection of rock lobsters and other subtidal invertebrates. Bait collection is another popular activity, where mussels, limpets, and red bait are gathered for use as bait. Net fisheries are limited to cast netting within the recreational sector. These activities provide an important source of recreation for South Africans and help to support the local economy by providing a source of livelihood for many people involved in the sector.

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. To reduce user conflicts between commercial and recreational fishing, and to, protect stocks during breeding periods, certain areas have been declared closed areas.

The Small-Scale Fisheries sector in South Africa is relatively new and permits the harvesting of a variety of species for commercial and consumptive use. This sector is established through the allocation of rights to co-operative groups and management co-operatives that represent over 230 small-scale fishing communities along the South African coastline (refer to Appendix 2). These co-operatives are comprised of more than 10 000 individual fishers who work together to harvest a variety of species for commercial purposes. The small-scale fisheries sector provides important livelihoods and food security for these communities, and the allocation of rights through co-operative management helps to ensure that the sector is sustainable and equitable.

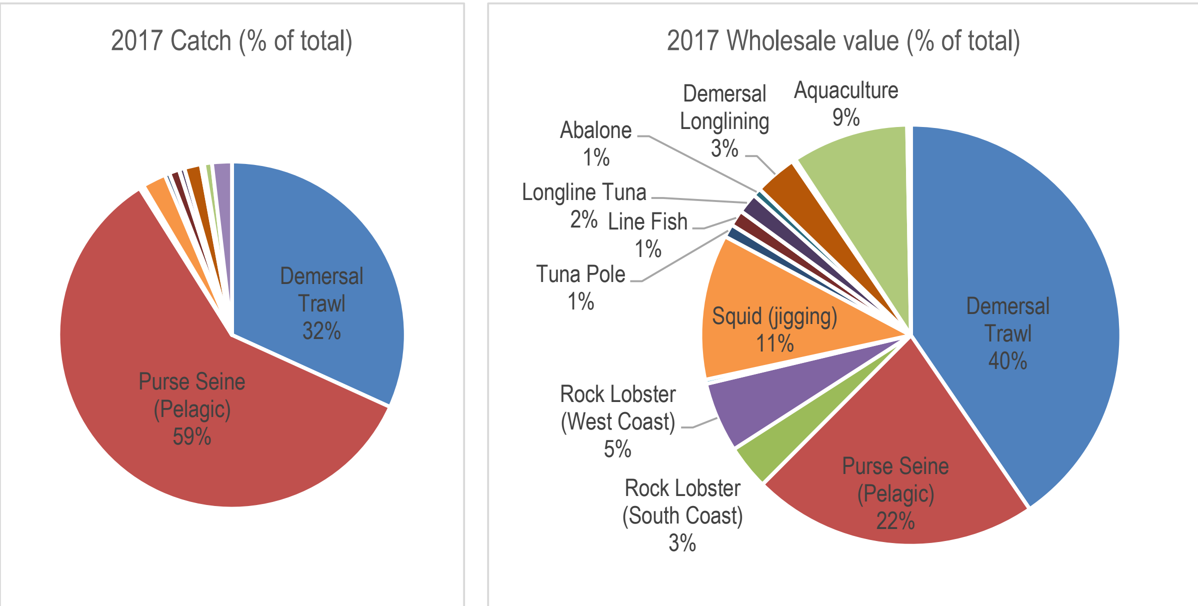


Figure 3.1: Pie chart showing percentage of landings by weight (left) and wholesale value (right) of each commercial fishery sector as a contribution to the total landings and value for all commercial fisheries sectors combined (2017). Source: DEFF, 2019.

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)*, Silver kob (*Argyrosomus inodorus)*, yellowtail (*Seriola lalandi)*, Sparidae, Serranidae, Carangidae, Scombridae, Sciaenidae
South coast rock lobster	South Coast	Cape Town, Gqeberha	*Palinurus gilchristi*

Sector	Areas of Operation	Main Ports in Priority	Target Species
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

Spawning is the process by which fish lay and fertilize eggs, which then develop into new individuals. This process is critical for maintaining and replenishing fish populations. In South Africa, the timing and location of spawning for many fish species is influenced by environmental factors such as water temperature, light levels, and ocean currents.

Recruitment, on the other hand, is the process by which juvenile fish grow and mature, and eventually join the adult population. This is an important stage in the life cycle of a fish, as the survival and growth of young fish can have a major impact on the overall health of the population.

The southern African coastline is characterized by strong ocean currents. On the eastern seaboard, the warm western boundary Agulhas Current flows close to the coast before moving away from the coast on the Agulhas Bank and eventually returning to the Indian Ocean. On the western seaboard, powerful jet currents form in the southern Benguela region due to the strong thermal differences caused by upwelling and the influence of the Agulhas Current and its eddies. Generally, the surface waters in the Benguela Current flow northward and are subject to strong losses off the coast near Luderitz, where upwelling is particularly active.

There are several mechanisms that contribute to the dispersal and loss of productive shelf waters, such as eddies, filaments, retroflections, and offshore Ekman drift, which pose challenges for the successful retention of planktonic eggs and larvae from broadcast spawners. To overcome these challenges, most fish species in southern Africa have evolved selective reproductive patterns that ensure sufficient progeny are retained or reach the nursery grounds along the coastline. Three important and one minor reproductive habitats occur between Mozambique and Angola and are utilized by a wide range of pelagic, demersal, and inshore-dwelling fish species, comprising spawning areas, transport mechanisms, and nursery grounds. The three key nursery grounds for commercially important species can be identified in South African waters as a) the Natal Bight b) the Agulhas Bank and 3) the inshore Western Cape coasts. The central Namibian shelf region is also identified as important, but to a lesser extent of a - c. 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). According to Hutchings (1992, 1994), despite the wide shelf and high primary productivity in southern Africa, fish yields are not particularly high. This suggest that the oceanographic climate is potentially restrictive to spawning success.

There are a number of factors that can negatively affect the success of recruitment in South Africa's marine fisheries, including overfishing, habitat destruction, pollution, and changes in ocean temperature and chemistry. In order to sustain healthy fish populations, it is important for management agencies to monitor and understand the factors that influence spawning and recruitment, and to implement measures to protect and conserve these processes. Most research on spawning and recruitment of commercially important species was completed in the 1990s to early 2000s, with no follow up to see if these patterns may have changed as a result of the negatively factors mentioned above.

The West Coast spawning ground

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). These principal commercial fish species undergo a critical migration pattern in the Agulhas and Benguela ecosystems (refer to Figure 3.2).

Many species of pelagic fish that are commonly found in the major upwelling systems in the region use the central or western Agulhas Bank as a spawning area. This area is known for its surface waters that flow towards the northwest and coastal upwelling that occurs during late summer. The convergent water mass formed by this process turns into a coastal jet current that moves along the west coast, including the highly active upwelling centers at Cape Town and Cape Columbine. This jet current plays a crucial role in transporting eggs and larvae to the west coast nursery grounds, where the young fish can grow and mature. At Cape Columbine, the jet current appears to diverge, with different components flowing offshore, alongshore, and inshore.

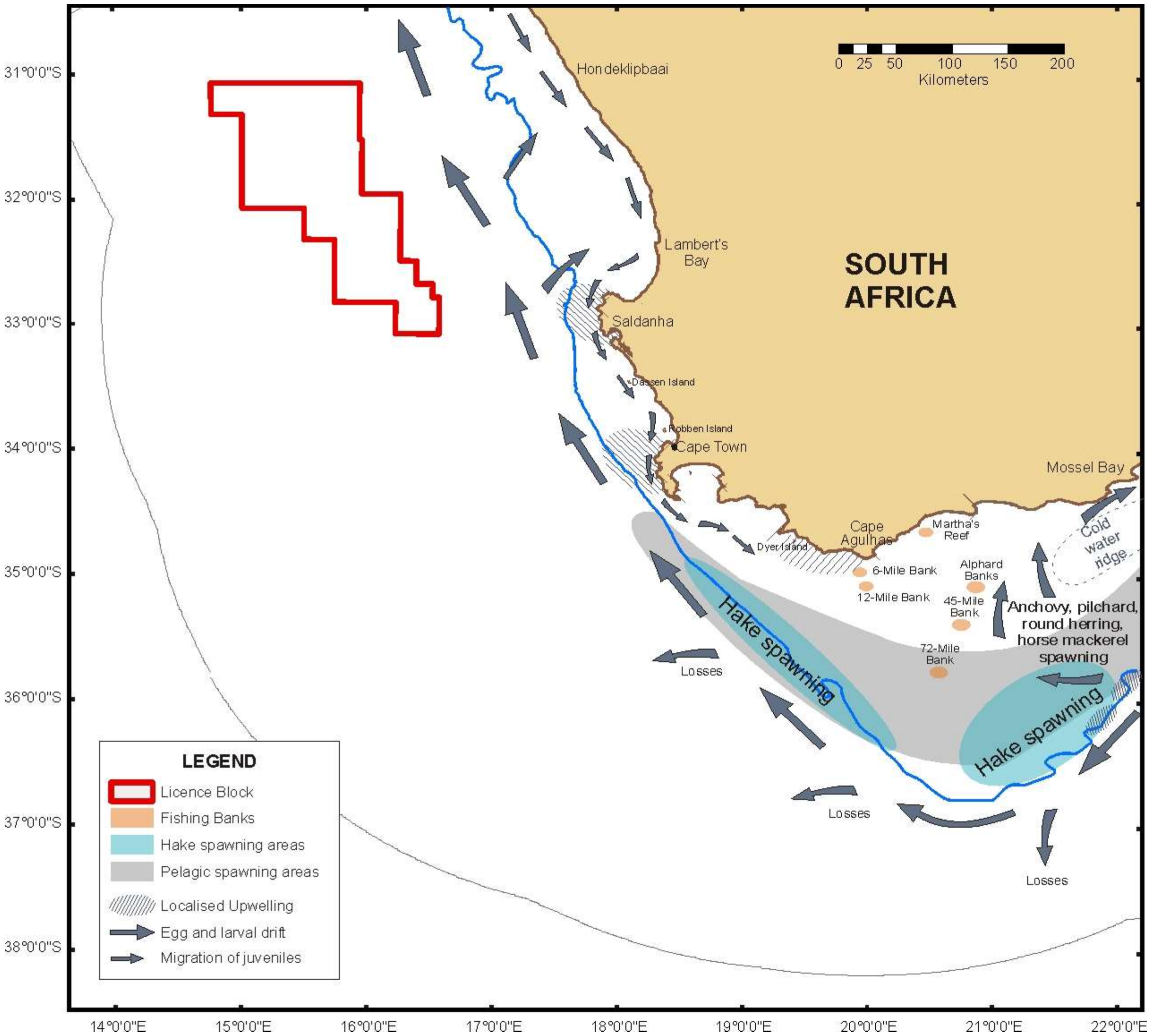


Figure 3.2: Block 3B/4B (red polygon) in relation to major spawning areas in the southern Benguela region (Source: Pulfrich, 2023 adapted from Cruikshank, 1990).

Horse mackerel

Horse mackerel spawns in the east/central Agulhas Bank during the winter months and the young juveniles can be found close inshore along the southern Cape coastline (20–26°E) However, during the summer months, there is a significant overlap with the inshore west coast nursery habitat (Barange *et al.* 1998). As the horse mackerel mature, they become more demersal and move offshore before migrating back to the Agulhas Bank as adults.

Anchovies

Anchovies spawn on the entire Agulhas Bank from October to March with the highest spawning activity occurring during mid-summer (November–December; van der Lingen and Huggett, 2003; See Figure 3.3). In some years, when the Agulhas Bank water strongly intrudes north of Cape Point, there is a shift in the anchovy spawning to the west coast (van der Lingen *et al.* 2001). The bulk of the anchovy recruits can be found along the west coast, with less than 5% found on the inshore south coast (Hampton 1992; See Figure 3.4). Older anchovies tend to shift further east to the central and eastern parts of the Agulhas Bank and often spawn between the cool ridge and the Agulhas Current (Roel *et al.* 1994). Since 1994, there has been a noticeable eastward shift in the anchovy spawning distribution to the east-central Agulhas Bank. While anchovies are known to spawn on the east coast shelf, the narrow shelf limits the population size of the spawners (Armstrong *et al.* 1991; Beckley and Hewitson 1994).

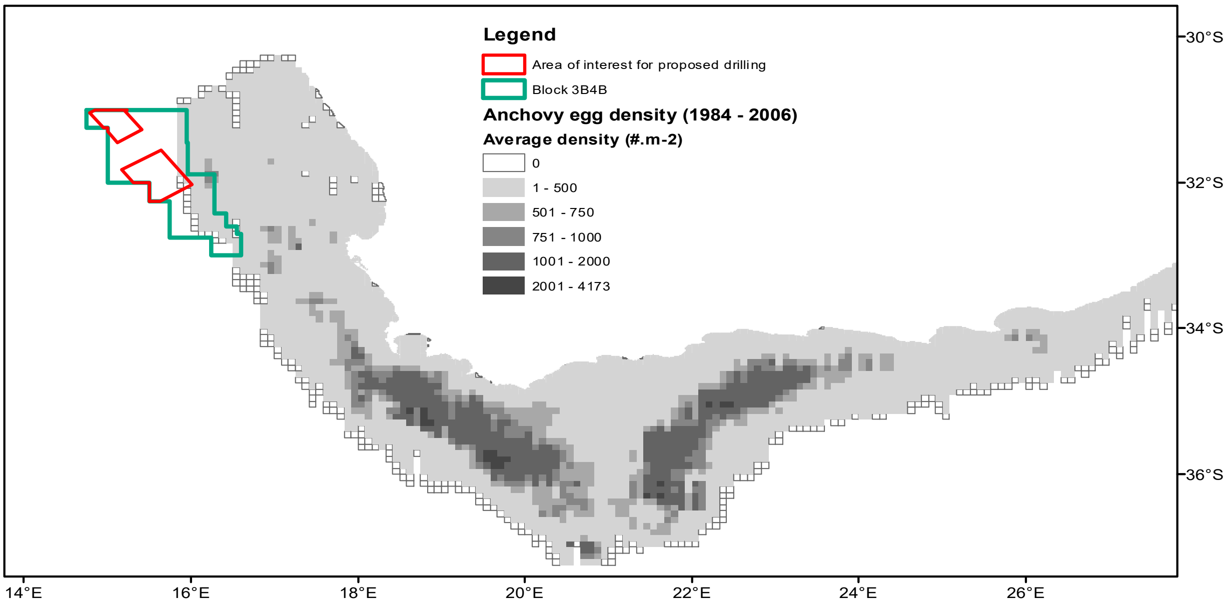


Figure 3.3: Block 3B/4B (Green polygon) and the area of interest for drilling (Red polygon) in relation to the distribution of anchovy spawning areas, as measured by egg densities (DFFE).

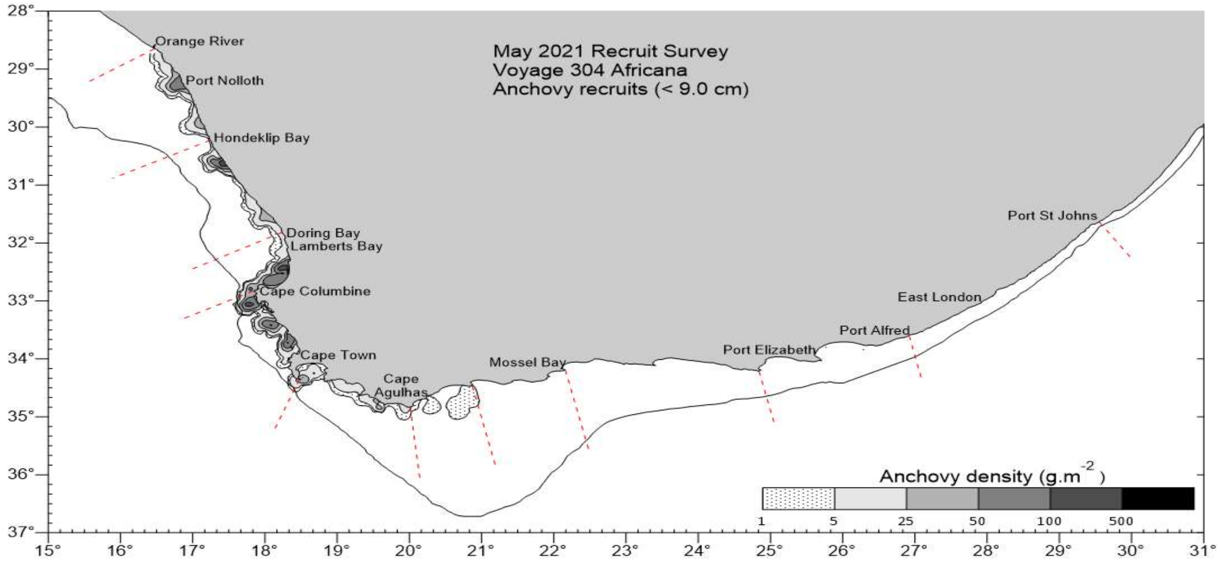


Figure 3.4: Distribution and relative abundance of anchovy recruits (< 9 cm) (Source: DFFE Small Pelagic Scientific Working Group FISHERIES/2021/JUL/SWG-PEL/51draft

Sardines

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; See Figure 3.5). In the West Coast Spawning Ground the stock of interest is the CTS.

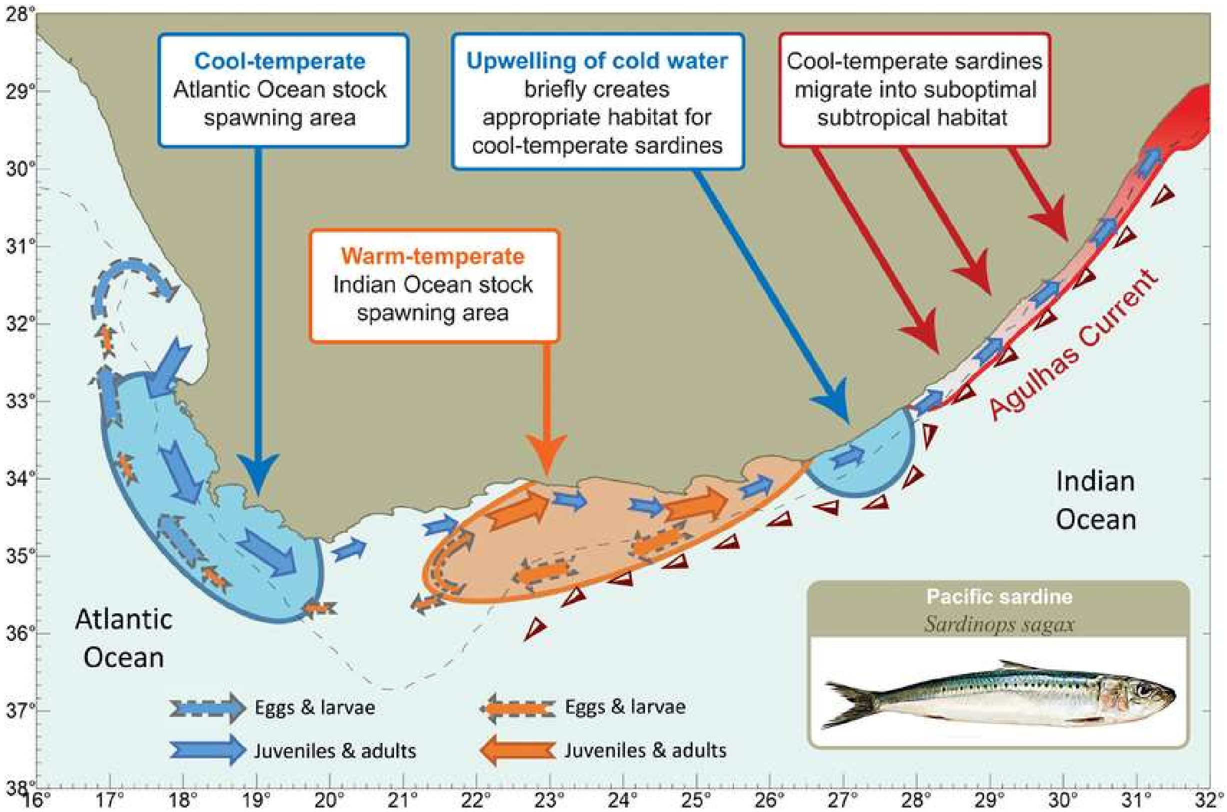


Figure 3.5 Stock structure of Pacific sardine, *S. sagax*, in South African waters. The spawning area in the Atlantic Ocean (blue) is numerically dominated by cool-temperate sardine, and the spawning area in the Indian Ocean (orange) is dominated by warm-temperate sardines (Source: Teske *et al.* 2021)

Sardines spawn in a similar area to anchovies during November and generally have two spawning peaks in early spring and autumn, which occur on either side of the peak anchovy spawning period. There has been a recent shift westwards in the sardine spawning distribution in November, with the majority of spawning now occurring on the west coast between latitudes 31°S and 35°S, and to a lesser extent, off the central and eastern Agulhas Bank, concurrent with anchovy (Beckley and van der Lingen 1999; See Figure 3.6). Sardine spawning also occurs on the east coast and even off KwaZulu-Natal, where sardine eggs can be found from July to November. Importantly, the eggs of both anchovies and sardines are frequently found far offshore on the Agulhas Bank, sometimes extending over the shelf break, and they spawn in a narrow zone between the cool upwelling ridge and the rapidly flowing Agulhas Current.

On the western seaboard, the sardine eggs that are deposited in the peripheral shelf areas are susceptible to being moved away from the coast by powerful equatorial winds that cause Ekman drift. Additionally, the eggs and larvae can be caught up in filaments or Agulhas Rings and transported further out to sea. Sardines have a lengthy spawning season that spans from late winter to spring and from autumn, when the southern winds are not at their strongest. The majority of the new recruits on the west coast likely originate from eggs laid either before or after the summer southern wind peak (See Figure 3.7). Juveniles shoal and then begin a southward migration. It is at this stage that both anchovy and sardine are targeted by the small pelagic purse seine fishery.

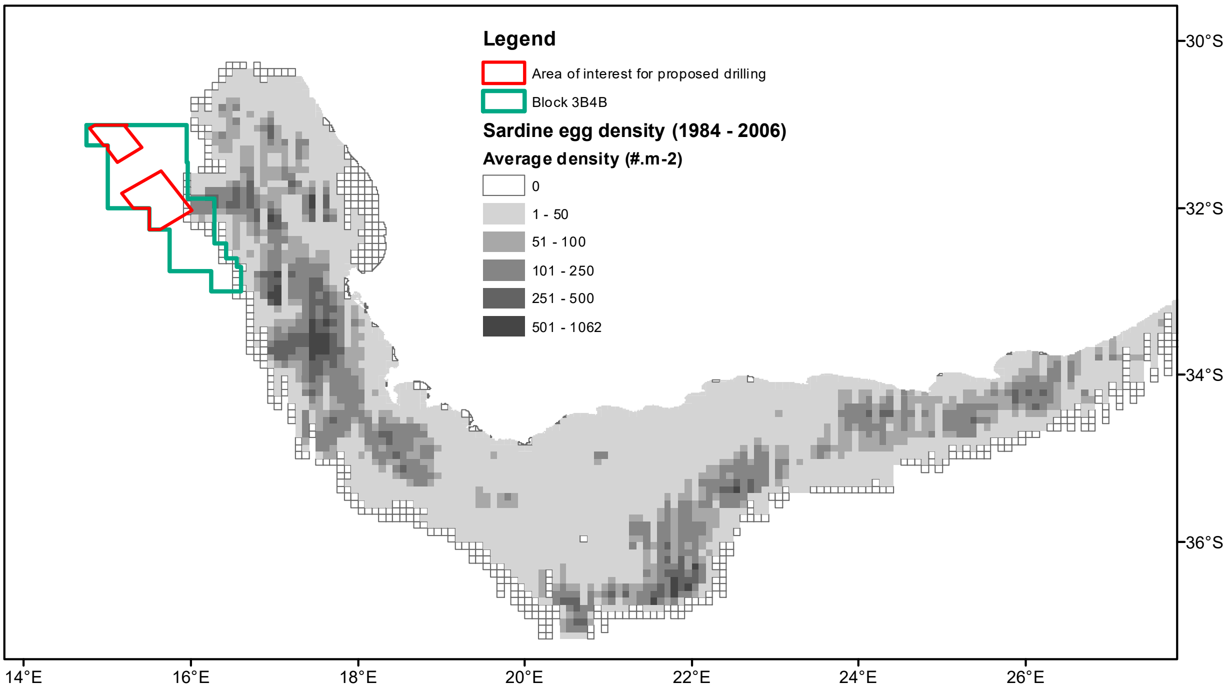


Figure 3.6: Block 3B/4B (Green polygon) and the area of interest for drilling (Red polygon) in relation to the distribution of sardine spawning areas, as measured by egg densities (collected during spawner biomass surveys by DFFE over the period 1984 to 2006).

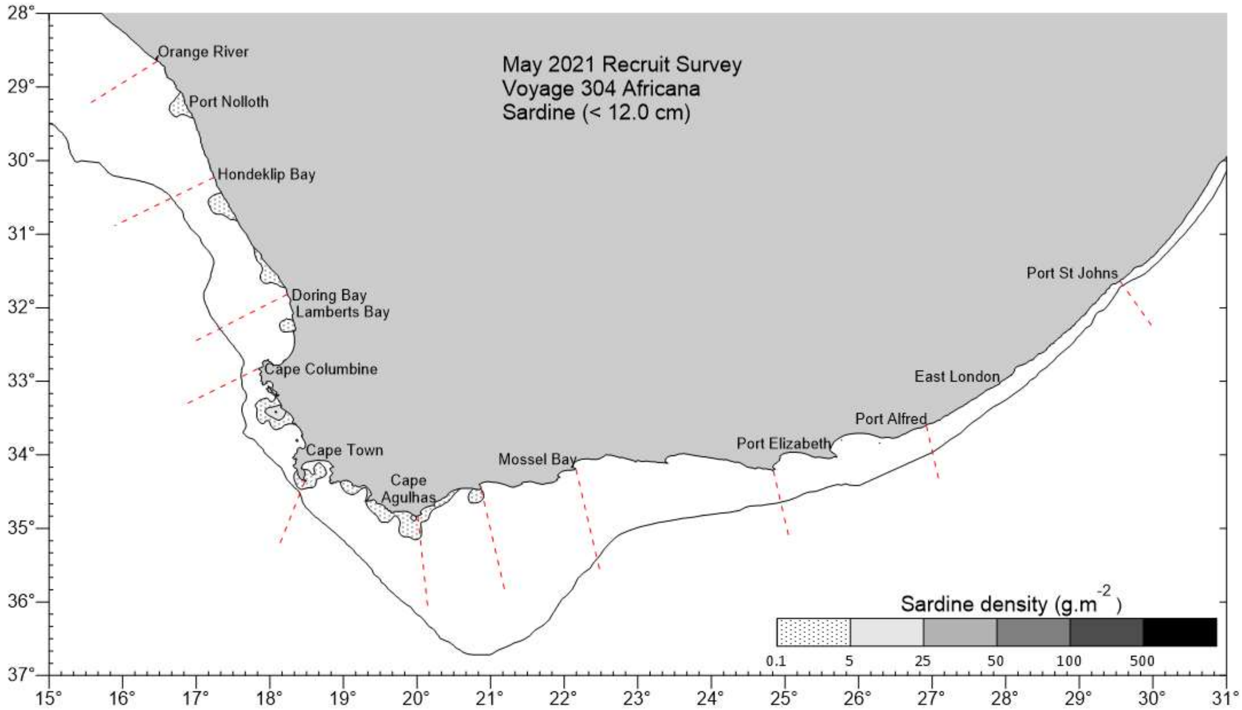


Figure 3.7: Distribution and relative abundance of sardine recruits (< 12 cm) (Source: DFFE Small Pelagic Scientific Working Group FISHERIES/2021/JUL/SWG-PEL/51draft

Hake species

The two hake species, shallow-water hake (*M. capensis*) and deep-water hake (*M. paradoxus*), have different spawning patterns in terms of depth and timing. Hake spawn throughout the year, with peaks in October/November and March/April, and are serial spawners (Johann Augustyn, SADSTIA and Dave Japp, CapMarine pers com.). Although the Namibian spawning ground will be discussed separately it is important to note that deep-water hake (*M. paradoxus*) do not spawn in Namibian waters, but shallow-water hake (*M. capensis*) does. Adult hakes generally migrate offshore during June to August and it is here that they are targeted by commercial fisheries. However, it's important to note that the timing and extent of adult hake movements can vary depending on factors such as water temperature, food availability, and environmental conditions.

Shallow-water hake spawn mainly over the shelf, at depths less than 200 m, while deep-water hake spawn in deeper waters beyond the shelf. Although both species spawn throughout their distributional range, high spawning concentrations occur mid-shelf off Cape Columbine and on the western Agulhas Bank, with peak spawning areas observed at 31.0°-32.5°S and 34.5°-36.0°S (Jansen et al., 2015; Refer to Figure 3.9).

The depth at which the hake species spawn differs as well, with *M. paradoxus* spawning at bottom depths between 200 m and 650 m, and *M. capensis* spawning at an average depth of 180 m. The distribution of their eggs also varies, with *M. paradoxus* eggs distributed over greater bottom depths (340 m – 1500 m) than *M. capensis* eggs (120 m to 300 m) (Stenevik et al., 2008; See Figure 3.8).

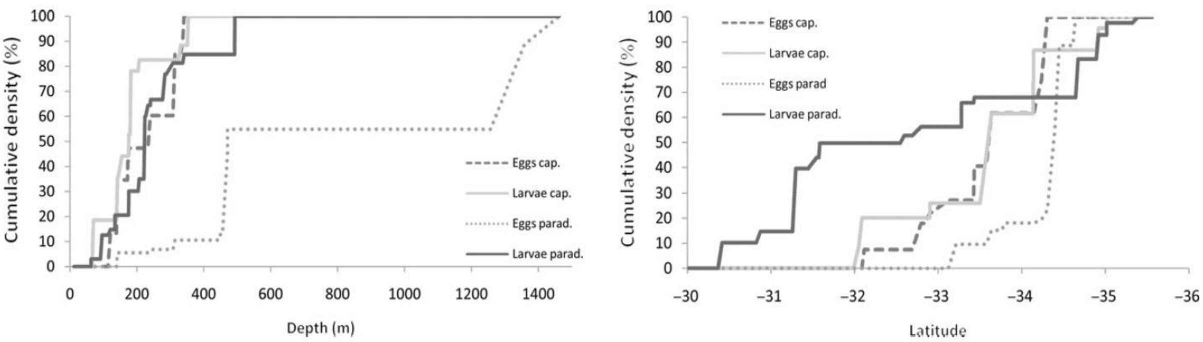


Figure 3.8: Cumulative density plots of Cape hake eggs and larvae sorted by (left panel) increasing seafloor depth and (right panel) increasing latitude (degrees south) (Source: Stenevik *et al.*, 2008).

Water currents play a crucial role in the transport of hake spawning products. The offshore drift route along the outer shelf carries the eggs and larvae of both species away from the coast and into the deep ocean, while inshore drift transports larvae along the west coast to the Orange Banks, with *M. paradoxus* mainly concentrated around the 100 m depth contour (Stromme et al., 2015). Eggs spawned inshore are likely to be transported in the slower inshore branch of the current from the western Agulhas Bank to inshore areas farther north (Grote et al., 2012 in Jansen et al., 2015). The vertical distribution of hake eggs and larvae is between the surface and 200 m depth, with the highest concentrations in the 50 – 100 m depth range (Stenevik et al., 2008).

Compared to pelagic species, the eggs and larvae of hake are found deeper in the water column, making them less vulnerable to Ekman transport (Sundby et al., 2001; Hutchings et al., 2002 in Stenevik et al., 2008).

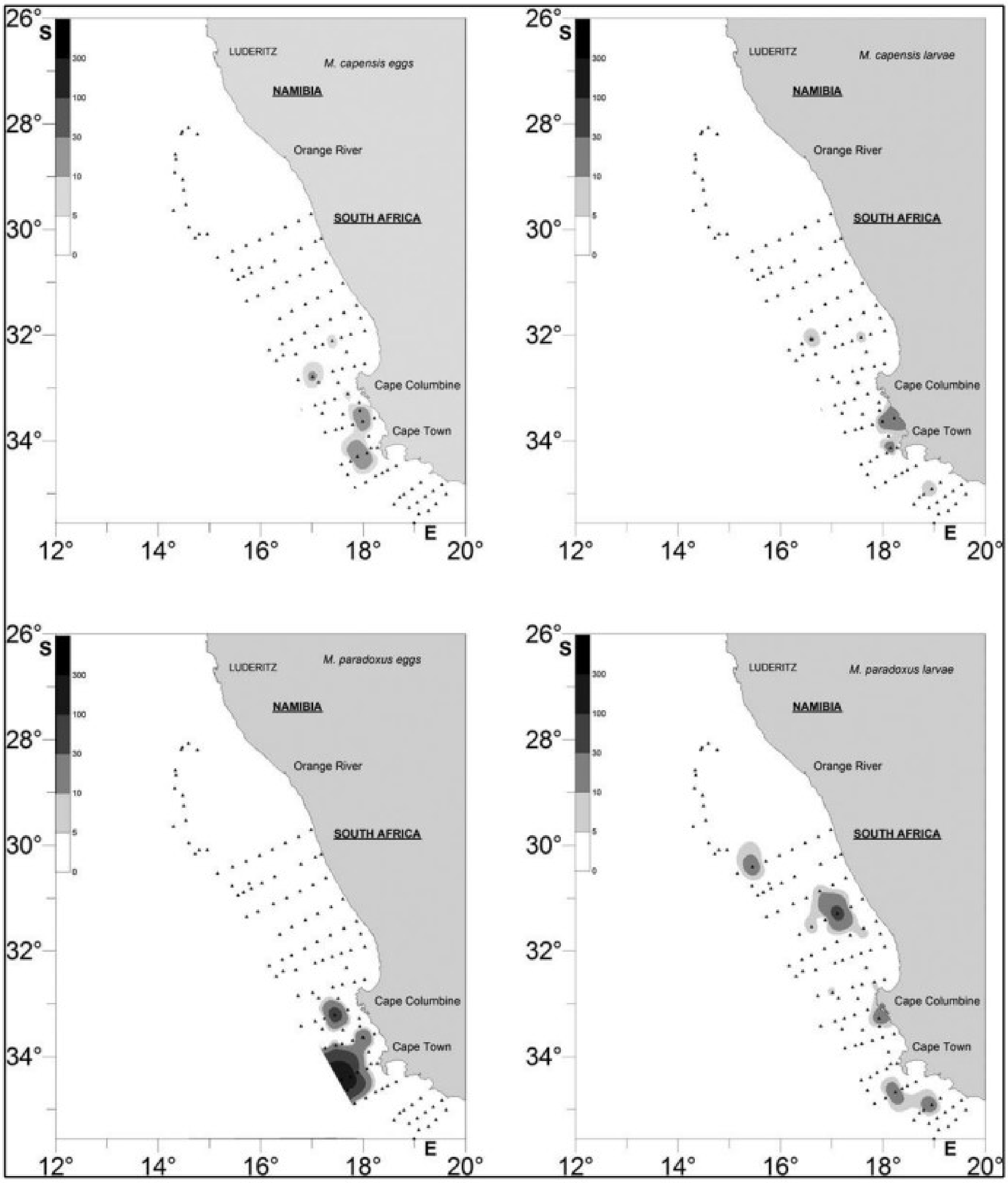


Figure 3.9: Station map showing the distribution of eggs (left) and larvae (right) of Cape hakes (*M. capensis* upper and *M. paradoxus* lower) during a research survey conducted between September and October 2005. Numbers per 10 m^2 (Stenevik *et al*., 2008).

Snoek

Snoek (*Thyrsites atun*) is a valuable commercial species and is targeted during their inshore migration period by the linefishery and small-scale fishers. It is also landed by the demersal trawl fishery as a by-catch species. Snoek is also a significant predator of small pelagic fish in the Benguela ecosystem. The South African population reaches 50% sexual maturity at a fork length of around 73 cm (3 years). Spawning takes place 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. Eggs and larvae are transported by prevailing currents to a primary nursery ground located north of Cape Columbine and a secondary nursery area situated to the east of Danger Point, both shallower than 150 m (Figure 3.10). Juveniles grow between 33 and 44 cm in their first year (3.25 cm/month) and remain on the nursery grounds until maturity. Their onshore-offshore distribution between 5 and 150 m isobaths is determined primarily by prey availability and includes a seasonal inshore migration in autumn in response to clupeoid recruitment.

Adults can be found throughout the distribution range of the species, and while they move offshore to spawn, there is a southward dispersion as the spawning season progresses. Their longshore movement is apparently random and without a seasonal basis. The relative condition of both sexes declines significantly during spawning, with females experiencing higher mesenteric fat loss despite consuming prey at a greater rate. Sex ratios and indices of prey consumption suggest that females on the west coast move inshore to feed between spawning events, while those found farther south along the western Agulhas Bank remain on the spawning ground throughout the season. This difference in behavior is attributed to the higher offshore abundance of clupeid prey on the western Agulhas Bank, as determined from diet and prey consumption rates (Griffiths, 2002; refer to Figure 3.10 for the spawning grounds and nursery areas for snoek).

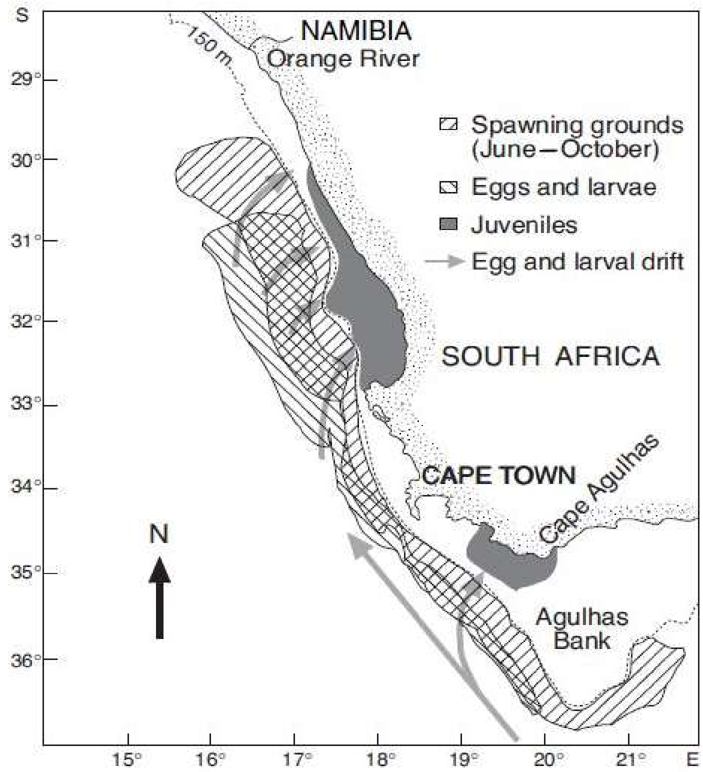


Figure 3.10: Conceptual model depicting the life history of snoek (left; Source: Griffiths, 2002) in the southern Benguela ecosystem, including spawning grounds, distribution and transport of eggs and larvae, and the nursery areas.

Squid

Although the West Coast spawning ground is of little importance to Squid (*Loligo* spp.) spawning, paralarvae have been found West of Cape Agulhas so for the purpose of the current application it will feature here. Squid spawn in the nearshore zone on the eastern Agulhas Bank, principally in shallow waters (<50 m) between Knysna and Gqeberha (Figure 3.11). 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).

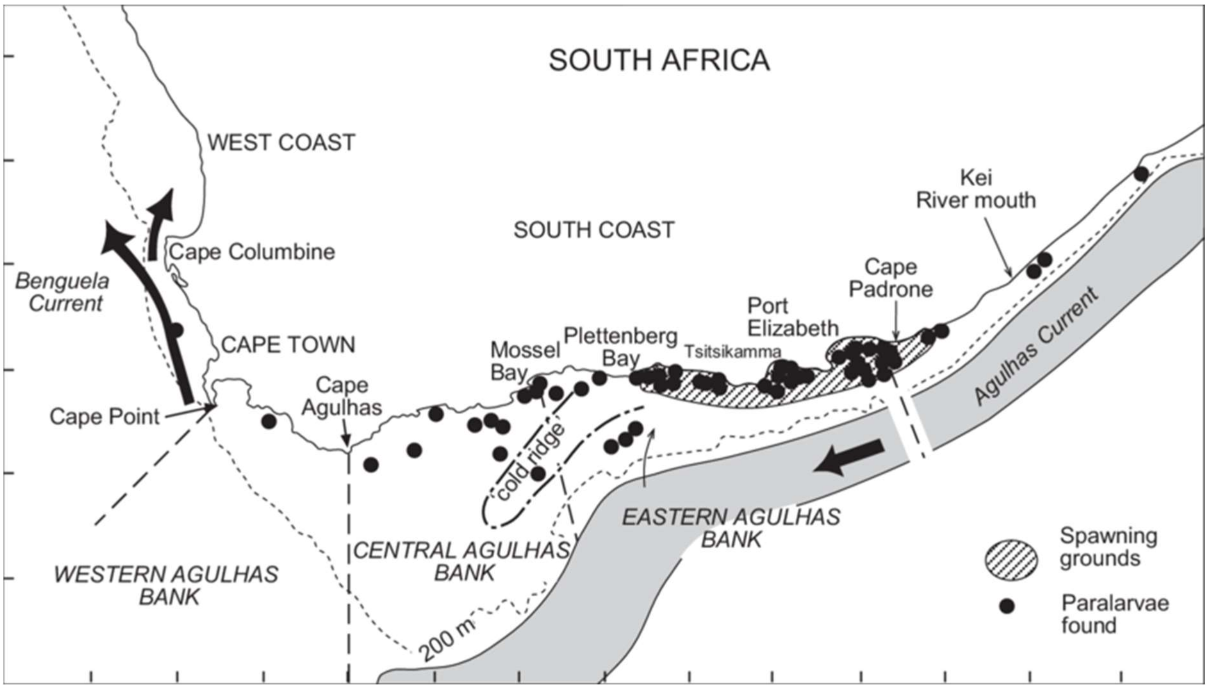


Figure 3.11 Main spawning grounds of Squid (Loligo spp.) on the eastern Agulhas Bank, east of the 'cold ridge'. Positions where paralarvae have been found are indicated (data from Augustyn *et al.* 1994).

Central Namibian spawning and nursery ground

The spawning of several types of fish, including hake, sardines, and horse mackerel, occurs in the waters off the coast of Namibia, from the Lüderitz upwelling center in the north down to the Angola-Benguela Front in the south (Sundby *et al.* 2001; Figure 3.12). The circulation patterns in this area are complex, with eddying and southward and onshore transport occurring beneath the surface drift to the northwest (Sundby *et al.* 2001). Sardine spawning peaks offshore in September and October, and larvae occur slightly further out to sea, with recruits appearing closer to shore (Sundby *et al.* 2001). Spawning also occurs in mid-summer in the Angola-Benguela Front region (Crawford *et al.* 1987), and warm water from the Angolan Current pushes southwards into central Namibian waters during late summer, which may transport pelagic spawning products into nursery grounds off central Namibia (Shannon 1985).

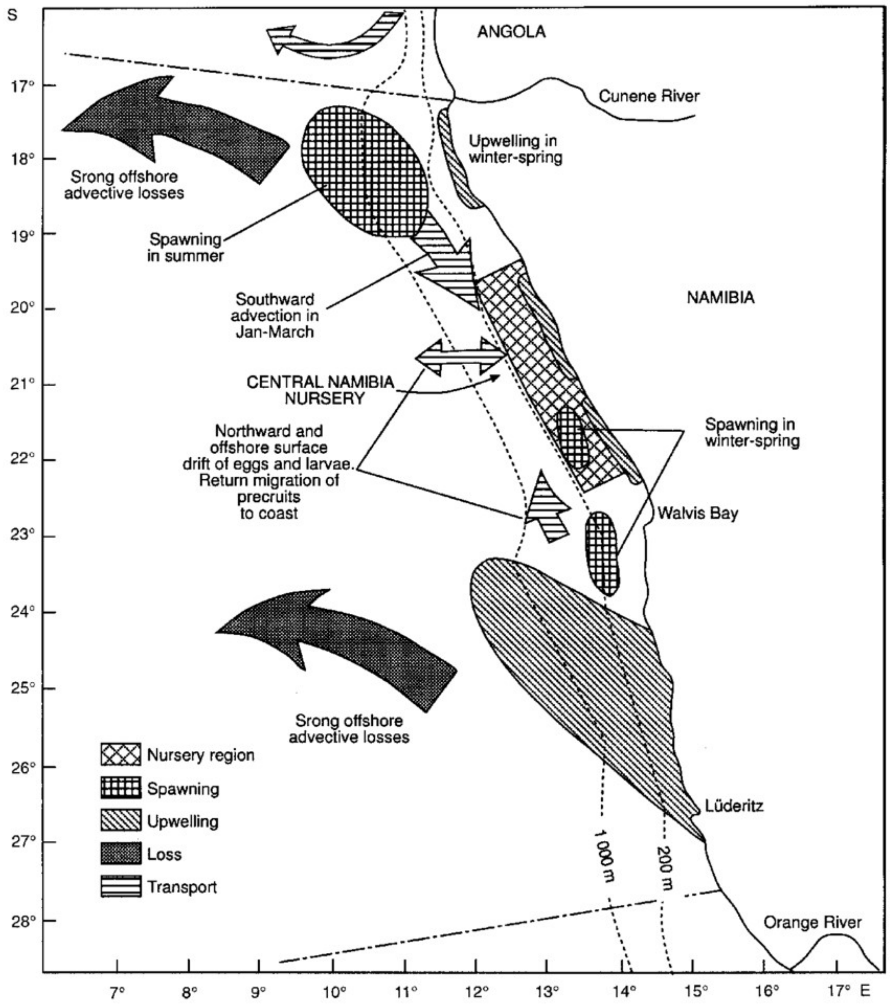


Figure 3.12 Central Namibian spawning/nursery ground, between the Lüderitz upwelling cell and the Angola-Benguela Front (Hutchings *et al.* 2002).

Other important linefish

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).

For breeding season and locality of prominent commercial, recreational and artisanal linefish species associated with the Western Cape please refer to the table below. Table 3.4 shows known spawning periods of key commercial species off the West Coast of South Africa.

Table 3.3 Summary breeding season and locality for important linefish species in Western Cape. Information adapted from Marine Linefish Species Profiles (Mann *et al.* 2013).

Common Name	*Scientific Name*	*Concerned Fishery*	*Breeding/spawning Season*	*Breeding/spawning Locality*
Blue Hottentot	*Pachymetopon blochii*	Artisanal line fishery, Recreational shore anglers and ski-boat fishers, bycatch of the gill-net fishery.	Throughout the year, with peaks in winter and summer (Pulfrich and Griffiths1988)	Throughout its distribution range (Pulfrich and Griffiths 1988)
Carpenter	*Argyrozona argyrozona*	Commercial line fishery, bycatch in demersal trawl (Attwood et al. 2011)	Summer and autumn (Brouwer and Griffiths 2005)	Throughout its distribution range (Brouwer and Griffiths 2005)
Dusky Kob	*Argyrosomus japonicus*	Mostly recreational shore, estuarine and ski boat anglers but also a component of commercial and artisanal line fishery.	October to January in the Eastern and Western Cape (Griffiths 1996)	Inshore reefs, pinnacles and wrecks (mainly at night) in KZN, Transkei and EC (Griffiths 1996, Connell 2012)
Geelbek	*Atractoscion aequidens*	Boat-based commercial and recreational line fishery. To a lesser extent, artisanal line fishery. Bycatch of the inshore demersal trawl.	Aug-Nov with a peak in Sep-Oct (Garratt 1988, Griffiths and Hecht 1995b, Connell 2012)	KZN offshore reefs 40-60m (Griffiths and Hecht 1995b, Connell 2012)
Red Roman	*Chrysoblephus laticeps*	Commercial and recreational line fishery.	Oct-Jan (Buxton 1990) observed Nov-Feb in the Goukamma area, WC (Götz 2005)	Eastern and Western Cape
Silver Kob	*Argyrosomus inodorus*	Recreational and commercial line fishery in SA and Namibia, bycatch of inshore trawl, taken by artisanal beach seine fishery.	Throughout the year, mainly from Aug-Dec with a peak between Sep-Nov (Griffiths 1997)	Inshore throughout distribution (Griffiths 1997)
White stumpnose	*Rhabdosargus globiceps*	Commercial and Recreational line fishery, occasional bycatch to artisanal net fisheries.	Summer, Sep-Mar (Griffiths et al. 2002).	Throughout the distribution range (Griffiths et al. 2002)
Yellowtail	*Seriola lalandi*	Large component of commercial line fishery, recreational fishery and artisanal beach seine fishers off Simonstown.	November to February.	Southern KZN to Cape Point.

Table 3.4: Summary table of known spawning periods for key commercial species off the West Coast of South Africa, which have been detailed in section 3.2.

Commercial Species	*Breeding/Spawning Season*	*Breeding/spawning Locality*	*Recruits*	*DWOB OVERLAP*
Horse Mackerel	June to August	Central / Eastern Agulhas bank	Inshore southern Cape	No
Anchovies	October to March, peaks November to December	Agulhas Bank and West Coast nursery grounds	Inshore West Coast	No
Sardine	August to February	West Coast and Agulhas nursery grounds, into KZN.	Migrate South East back to Agulhas bank	No
Hake spp	Throughout the year, peaks in March/April and October/November	Throughout SA distribution, concentrated mid-shelf Cape Columbine and W Agulhas bank	Inshore, migrate to depth as adults	No
Snoek	June to October	West Coast and Agulhas bank	Cape Columbine and Danger Point nursery	No
Squid	Throughout with peaks in November, and December.	Nearshore Eastern Agulhas Bank	Offshore and Westward	No

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 3.13 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, 46 research trawls were carried out within the licence block (average 5 trawls per survey), at a seafloor depth range of 345 m to 950 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.

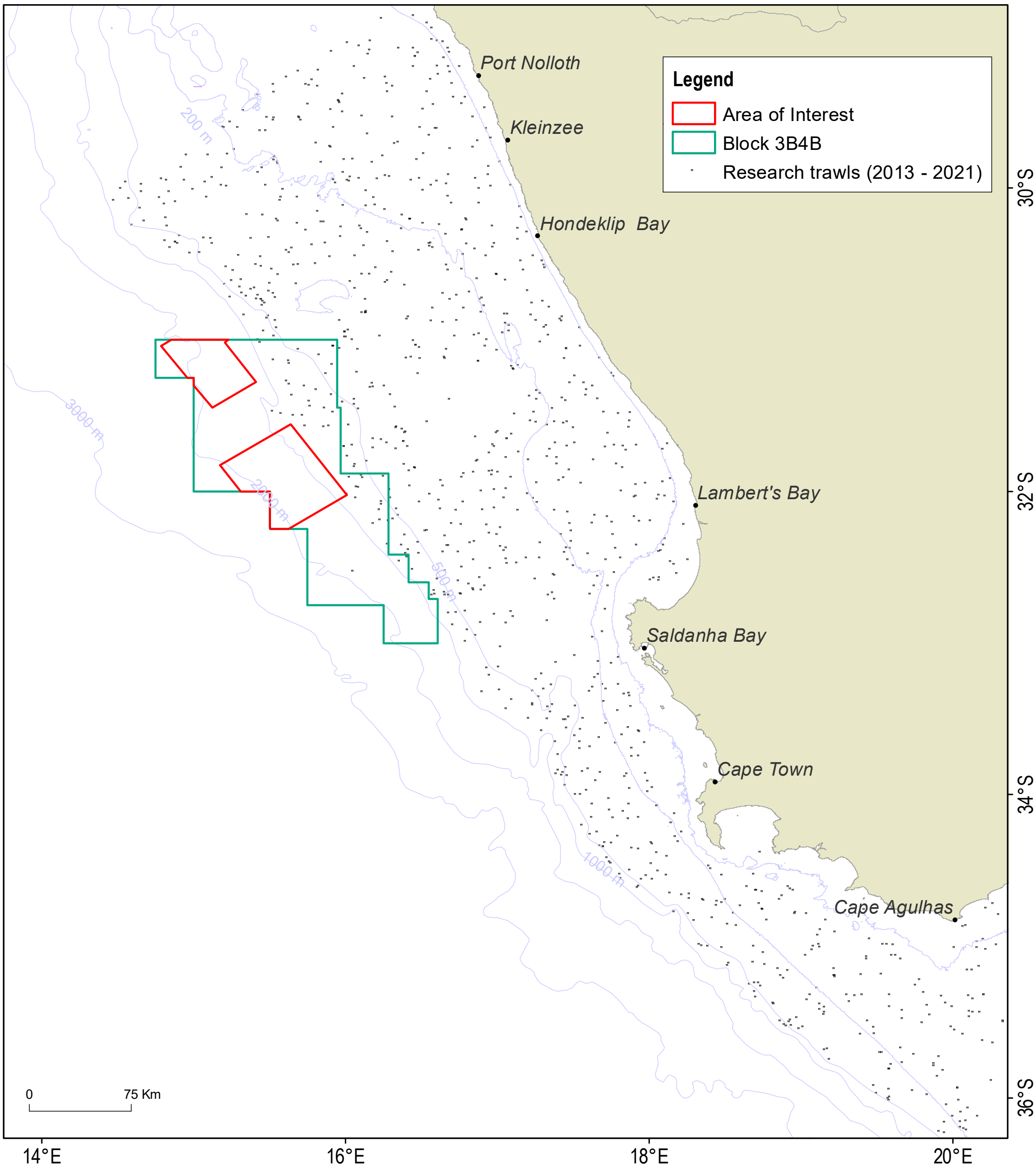


Figure 3.13: Spatial distribution of trawling effort expended by DFFE over the period 2013 to 2021 in assessing the biomass of demersal fish species.

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 1 000 m, 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 1 000 m. Figure 3.14 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. No transects coincided with the licence block or area of interest for well drilling.

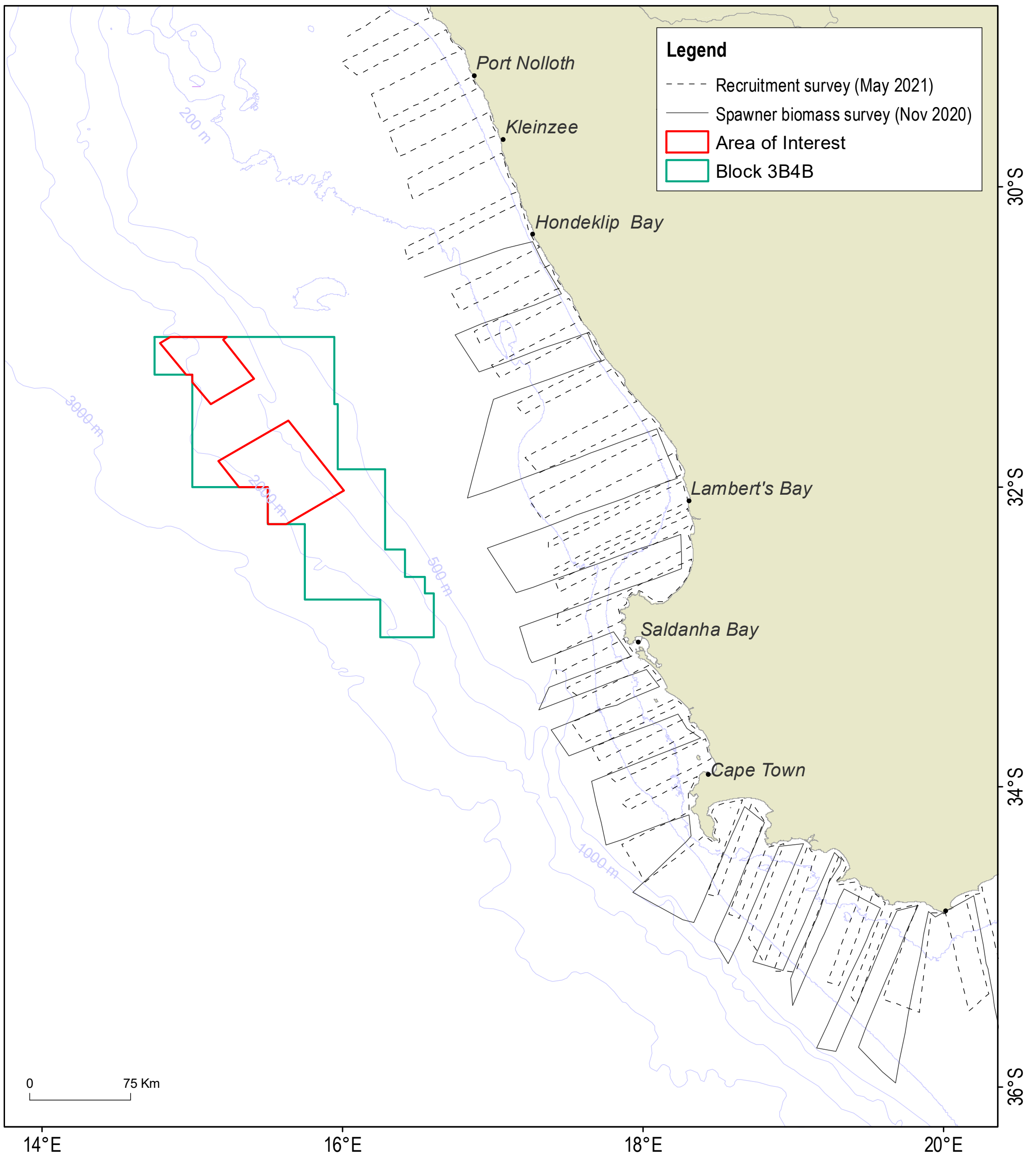


Figure 3.14: **Spatial distribution of survey transects undertaken by DFFE during November 2020 and May 2021 during the research surveys of recruitment and spawner biomass of small pelagic species, respectively.**

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 (see Figure 3.15). 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.

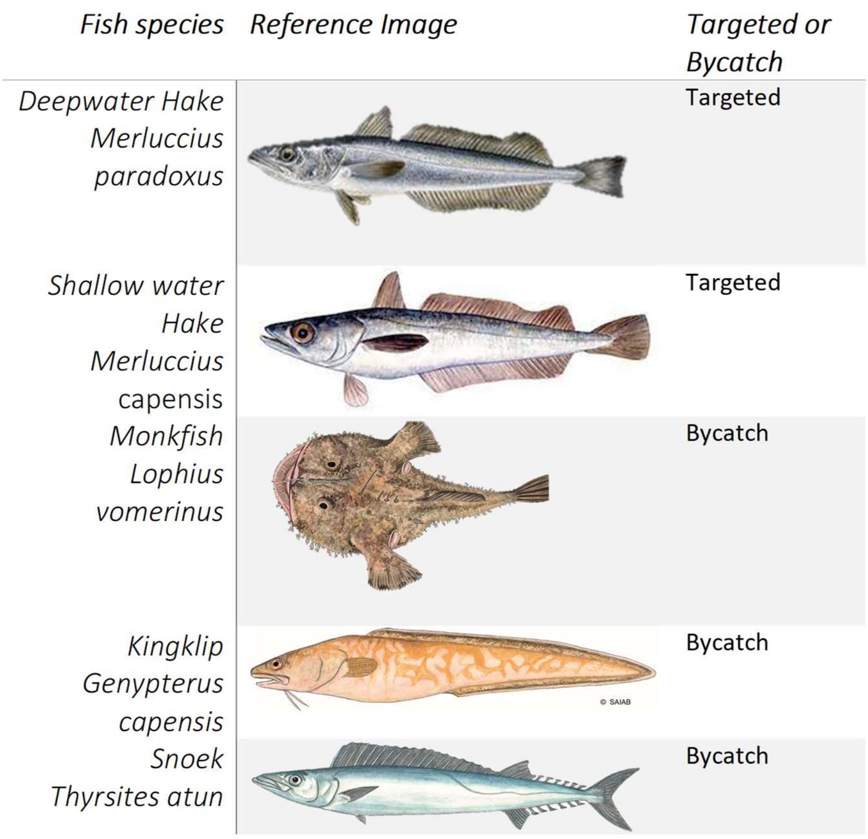


Figure 3.15 Commercially important target and bycatch species in the South African Demersal Trawl Fishery. Reference images courtesy of SAIAB.

Vessels operating in the fishery usually trawl throughout the traditional "inshore" area i.e., in waters shallower than the 110 m isobaths, but are not restricted from operating in deeper water. By contrast, vessels operating in the deep-sea trawl fishery may not operate in water depths of less than 110 m or within 20 nautical miles of the coast, whichever is the greater distance from the coast.

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. In 2020 the offshore trawl industry was values at R4.3 billion. The latest value estimates (Table 3.5) show a steady increase to R6 billion and R550 million for the offshore and inshore trawl fishery, respectively. The 2022 TAC for Cape hakes was set at 8 131 and 110 448 tonnes for the inshore and offshore trawl fisheries, respectively. Of the national TAC for Cape Hakes a further 10% is allocated to the hake demersal longline sector – refer to section 3.4.3.

Table 3.5: Estimates for the inshore and offshore demersal hake trawl fisheries. This includes financially value of the fishery (as of 2021) and TAC as of 2022.

VALUES	INSHORE	OFFSHORE
NUMBER OF RIGHTS HOLDERS	32	28
VALUE OF CATCH (2021, QUAYSIDE)	R550 million	R6 billion
TAC 2022	8 131 tonnes	110 448 tonnes
EMPLOYMENT CREATION	4 500	7 300
RIGHTS VALID UNTIL	31 December 2031	31 December 2037

The annual TAC limits and landings of hake (both species) by the trawl and longline sectors is listed in Table 3.6. A time-series of total hake catch as well as hake catch by sector is shown in Figure 3.16.

Table 3.6: Annual total allowable catch (TAC) limits and catches (tons) of the two species of hake by the hake-directed fisheries on the West (WC) and South (SC) coasts (Adapted from DEFF, 2020[3]).

		M. paradoxus					*M. capensis*						TOTAL both species
Year	TAC	Deep-sea		Longline		TOTAL	Deep-sea		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	5217	90	98777	12689	12863	3983	2615	481	32668	131370
2019	146431	70608	22201	5328	34	98171	14193	9454	4149	3623	299	31718	129898
2020	146400	97093	10061	5847	47	113048	18115	3500	4536	2348	321	28820	141872
2021	139109	102865	15597	5892	18	124372	15585	2937	4517	2932	194	26165	150537
2022	132154												

[3] FISHERIES/2022/OCT/SWG-DEM/35rev: Ross-Gillespie (2022). Update to the hake Reference Case Operating Model with corrected longline data, and 2021 commercial and 2022 survey data. Marine Resource Assessment and Management Group, University of Cape Town, Rondebosch, 7701

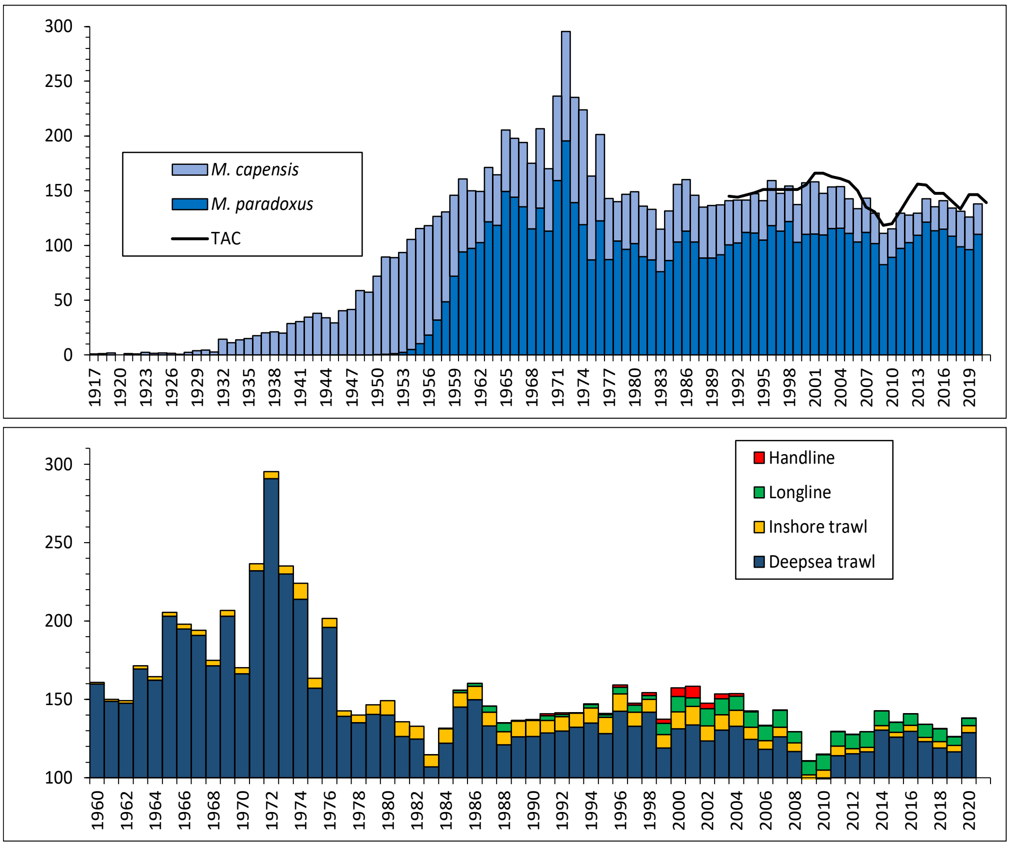


Figure 3.16: (Top panel) Total catches ('000 tonnes) of Cape hakes split by species over the period 1917–2020 and the TAC set each year since the 1991. (Bottom panel) Catches of Cape hakes per fishing sector for the period 1960–2020. Prior to 1960, all catches are attributed to the deep-sea trawl sector. Note that the vertical axis commences at 100 000 tonnes to better clarify the contributions by each sector (Source DFFE, 2022).

Offshore demersal trawl fishery

The offshore demersal trawl fleet consists of 53 trawlers. Twenty six fresh fish trawlers preserve hake on ice and return it to shore for processing, while 27 freezer vessels produce frozen headed and gutted (H&G) hake or sea-frozen fillets. Wetfish vessels range between 24 m and 56 m in length while freezer vessels are usually larger, ranging up to 90 m in length. See Figure 3.17 for a photograph of a wetfish trawler operating in South Africa's offshore demersal trawl fishery. 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. These vessels operate 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.

Between 2014 and 2019, a five-year benthic trawl experiment was conducted by the South African Deep Sea Trawling Industry Association (SADSTIA), in collaboration with the DFFE, the University of Cape Town, the South African Environmental Observation Network and the South African National Biodiversity Institute. The aim of the study was to assess the environmental impact of demersal trawling in South African waters. The offshore demersal trawl sector catches between 118 000 and 166 000 tonnes, with 90% of the catch being *M. paradoxus* and 10% *M. capensis*. The trawler owners and operators produce fresh and frozen products, which are sold in retail and food-service markets locally and internationally, with the main export markets being in Europe, Australia and the United States (Durholtz *et al.*, 2015).

The main bycatch species are kingklip and monk. Monkfish-directed trawlers tend to fish shallower waters than hake-directed vessels on mostly muddy substrates. 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).

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. As mentioned, the offshore sector is prohibited from operating in waters shallower than 110 m or within five nautical miles of the coastline. There are other measures in place to ease socio-economic concerns and environmental sustainability (see Figure 3.18).

Figure 3.17 Photograph of MFV *Harvest Mzansi*, a wetfish vessel operating in the South African offshore demersal trawl sector (source: www.sadstia.co.za).

Since South Africa declared its exclusive economic zone (EEZ) under the United Nations Law of the Sea in November 1977, the offshore demersal trawl fishery for hake has been closely managed and regulated. South Africa has implemented a range of regulatory and conservation measures to rehabilitate hake stocks that were previously overfished by international fishing fleets, working closely with the trawling industry (Durholtz et al., 2015). Today, the primary management measure for regulating hake fisheries is the setting of an annual total allowable catch (TAC). However, a comprehensive suite of additional measures has been developed over time to address socio-economic and ecosystem concerns, including spatial and temporal closures, gear restrictions, and bycatch limits (SADSTIA, 2021).

1. Restrictions on **vessel power and size** implemented in 2003 for inshore trawl fishery.
2. **Capacity management** measures introduced in 2008 to offshore demersal trawl fishery.
3. **Capacity-limitation** models developed to avoid fleet overcapacity.
4. Minimum **mesh size** regulations introduced in 1974 to minimize juvenile fish catch.
5. **Paired trawling** prohibited in 1977 to limit seabed impact of fishing.
6. **Limits** on bobbins and foot ropes size/weight introduced in 2003 to reduce seabed impact of fishing.
7. **Marine protected areas** introduced, some impacting deep-sea trawling, e.g., for protecting kingklip spawning grounds.
8. **Ring-fencing**, a voluntary measure adopted in 2008, to prevent further impact on benthic habitat.
9. **Mitigation** of seabird mortalities includes vessel-specific waste management measures, mandatory deployment of bird-scaring devices, and regulations on trawl warps.
10. **Bycatch** limitation measures introduced, including precautionary upper catch limits, "move-on" rules, and bycatch species proportion restrictions per landing.

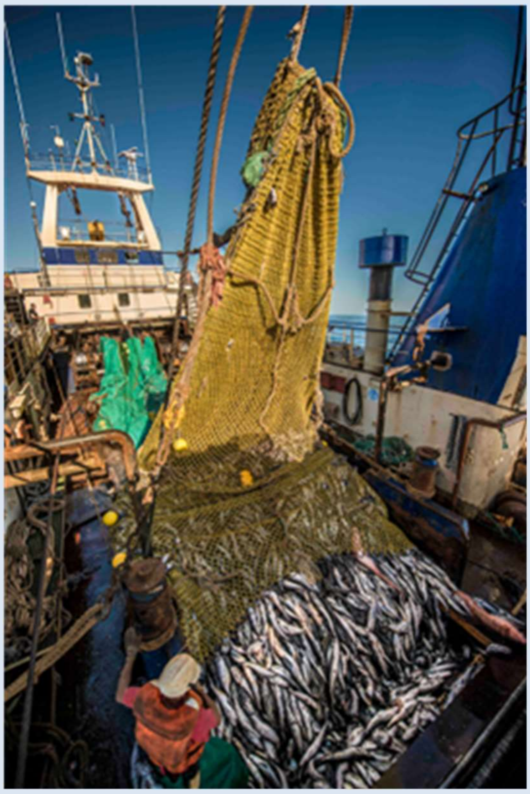


Figure 3.18 Additional management protocols for offshore demersal trawlers in South Africa (SADSTIA 2017).

Inshore 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 primarily target shallow water hake (*M. capensis*). The Agulhas sole (*Austroglossus pectoralis*) is the second most important catch close inshore between Struisbaai and Mossel Bay, between the 50 m and 80 m isobaths. Catches display a much higher species mix than those of the deep-sea trawl fishery. The vessels are smaller and less powerful than those used in the deep-sea trawl fishery; they range in length from 14 to 36 m and engine size is restricted to 1 000 hp. Modern stern trawlers, as well as much older side trawlers, form part of the fishing fleet. The inshore fishery also targets Hakes further offshore, where they can encounter both Hake species, in traditional grounds between 100 m and 200 m depth in fishing grounds known as *the Blues* located on the Agulhas Bank.

The activity of both the inshore and offshore 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.

Otter trawling

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 3.19).

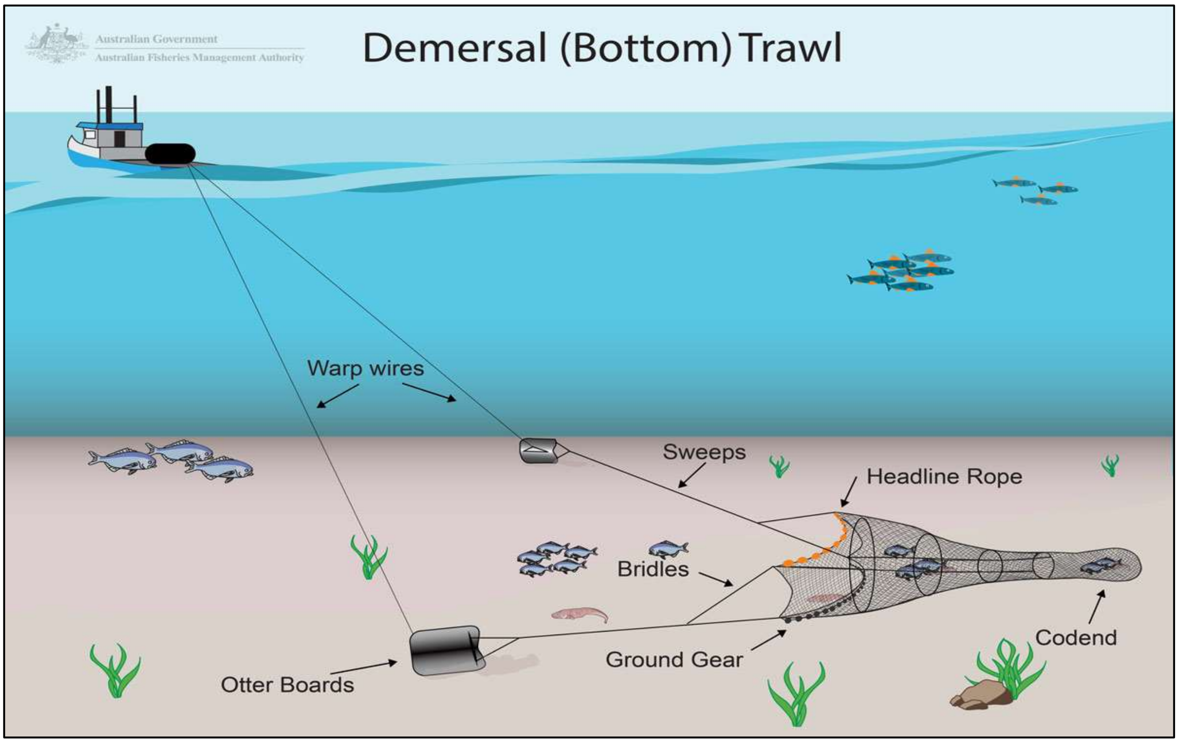


Figure 3.19: Gear configuration similar to that used by the offshore demersal trawlers targeting hake (Source: www.afma.gov.au/fisheries-management/methods-and-gear/trawling).

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

Licence Block 3B/4B does overlap the spatial extent of demersal trawling ground whereas the northern and central AOI are situated 25 km and 10 km, respectively, from the trawl footprint. A 500 m safety zone around the drilling unit would therefore not coincide with trawl ground nor present an exclusion to fishing operations or loss of access to fishing ground. Refer to Figure 3.20 which shows the location of demersal trawling grounds in relation to the area of interest for well drilling.

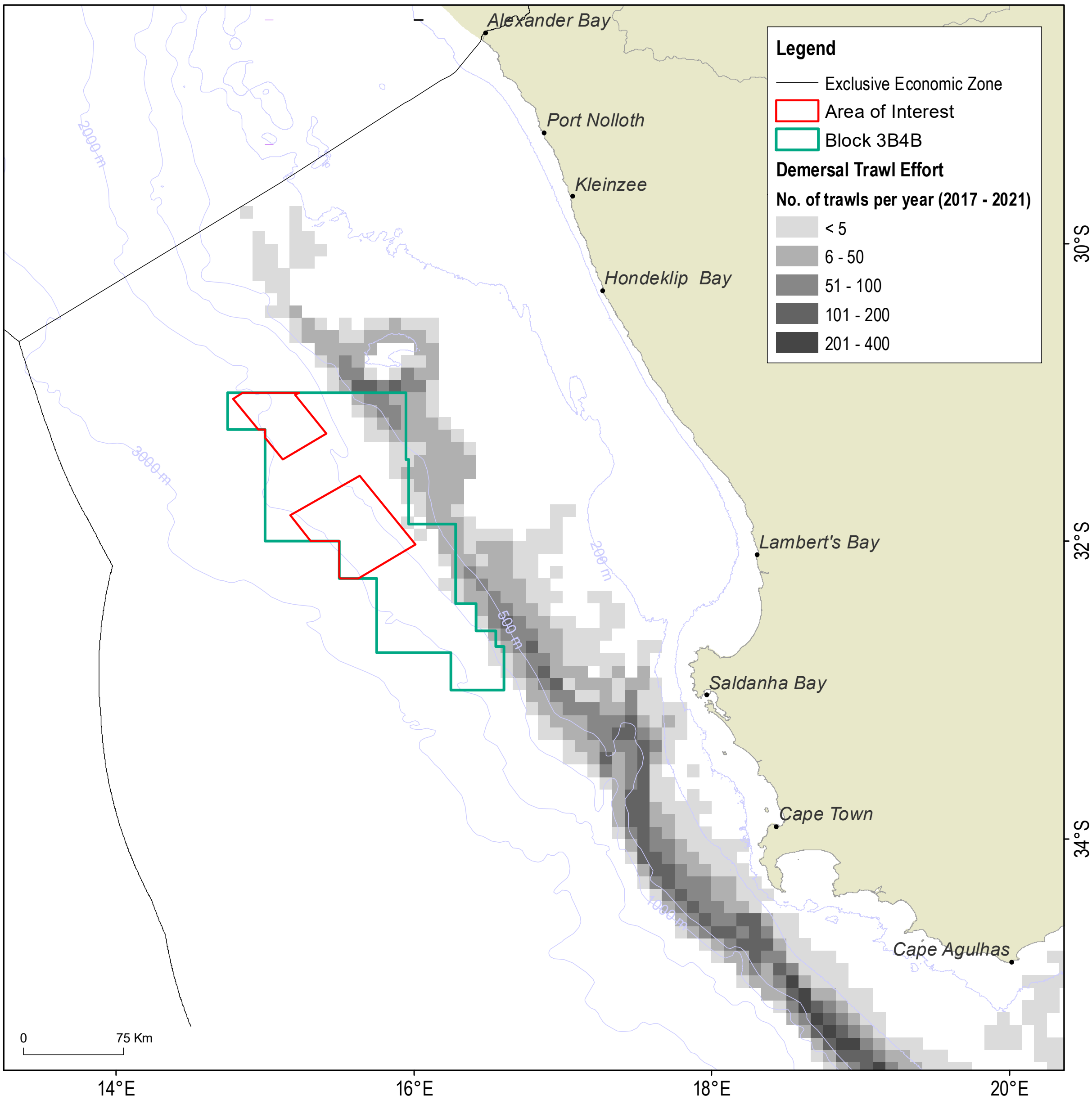


Figure 3.20: Overview of the spatial distribution of demersal trawl effort (2017 - 2021) in relation the licence block and area of interest for proposed drilling.

3.4.2 MIDWATER TRAWL

The midwater trawl fishery targets adult Cape horse mackerel (*Trachurus capensis*) (See Figure 3.21), 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).

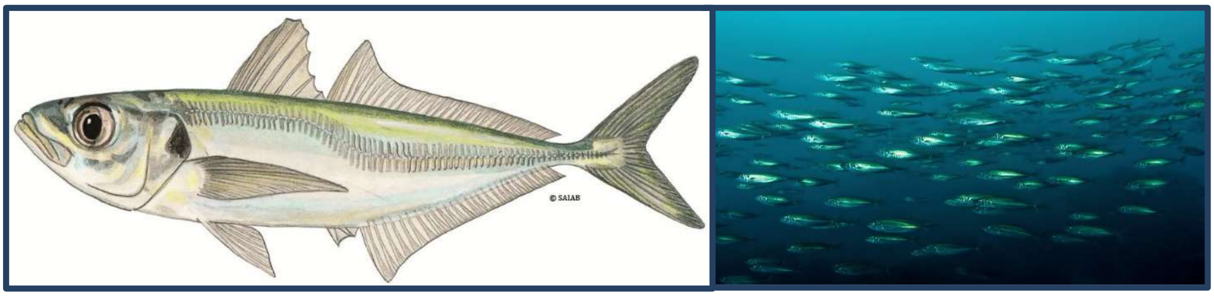


Figure 3.21 Cape horse mackerel (*Trachurus capensis*), primary target species of the Midwater Trawl Fishery in South Africa. Images courtesy of SAIAB (left) and Oceana (Right)

This sector comprises six vessels and 34 rights holders which landed a total catch of 19 555 in 2019. Refer to Figure 3.22 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 3.23). 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.

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 3.24 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.

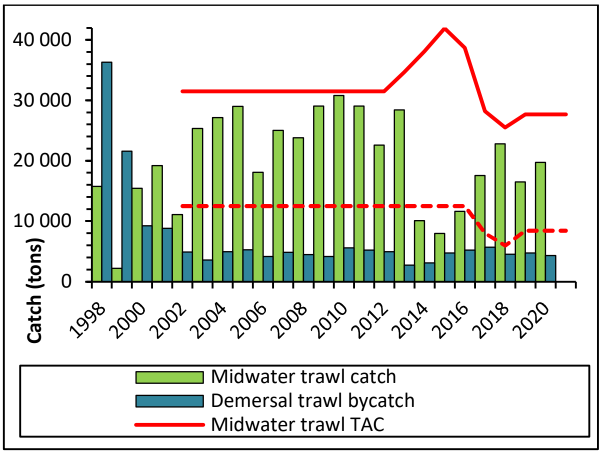


Figure 3.22: **Trawl catches (tons, 1998 – 2021) split into the demersal and midwater trawl components. The midwater trawl TAC (solid line) and demersal trawl bycatch reserve (dashed line) are also shown (Source: DFFE, 2022).**

Figure 3.23: Photograph of FMV *Desert Diamond* (midwater trawler).

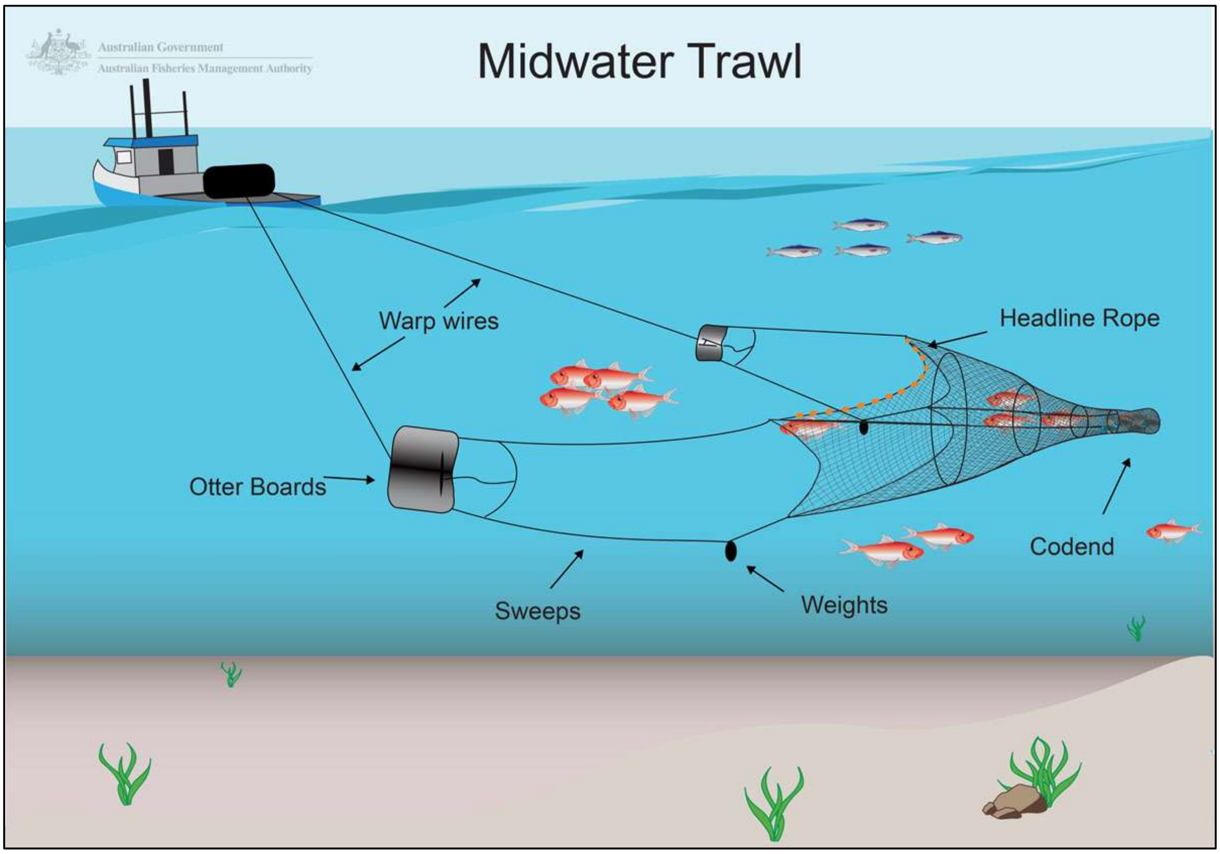


Figure 3.24: Schematic diagram showing the typical gear configuration of a midwater trawler. Source: www.afma.gov.au/fisheries-management/methods-and-gear/trawling

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 and horse mackerel is occasionally targeted around Child's Bank situated east of the licence block.

Figure 3.25 shows the spatial extent of grounds fished by mid-water trawlers in relation to the licence block and area of interest for drilling. There is no overlap of fishing grounds with either the licence block or the AOI.

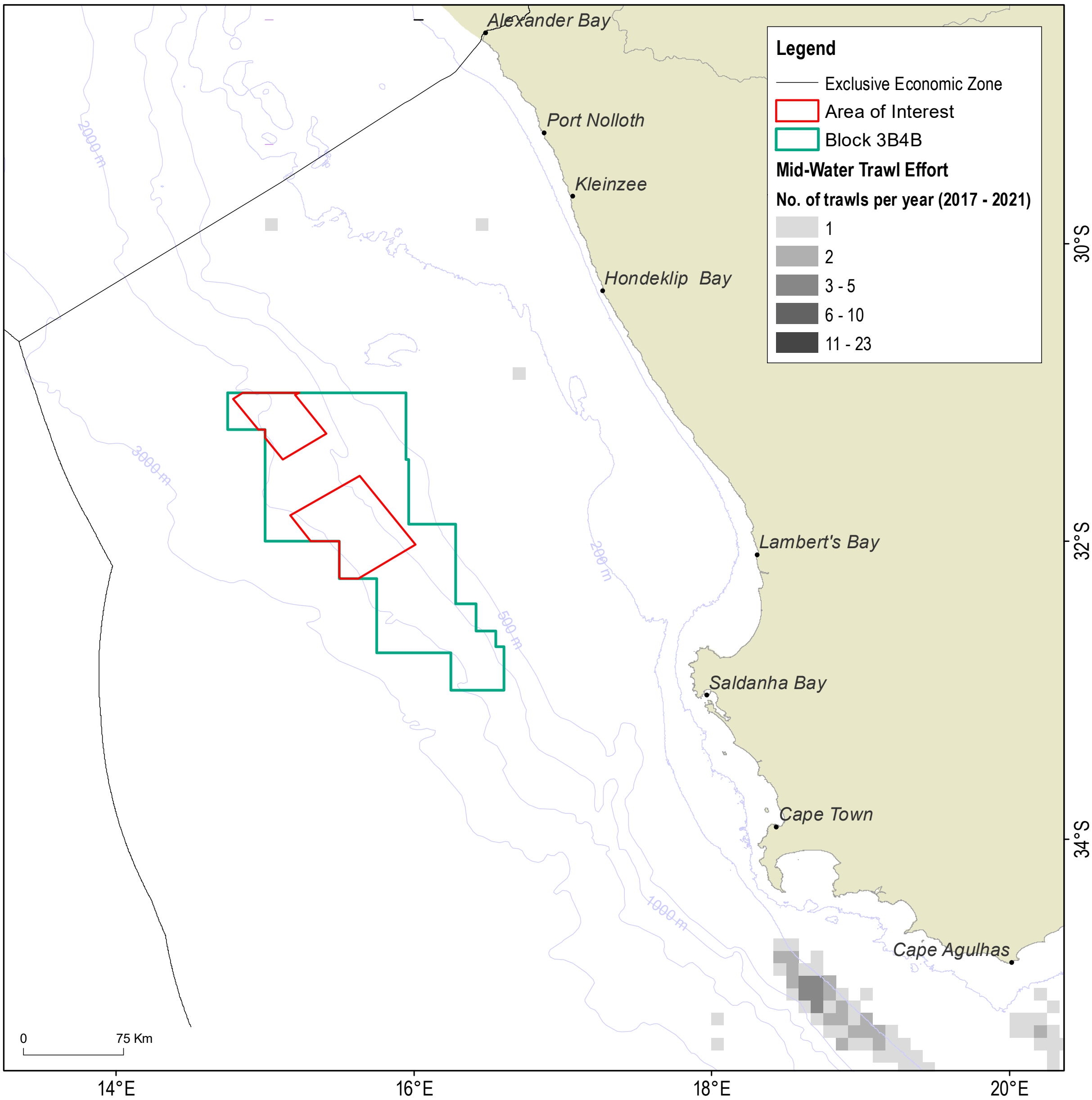


Figure 3.25: **Overview of the spatial distribution of fishing effort expended by the midwater trawl sector (2017-2019) targeting horse mackerel in relation to the area of interest for proposed drilling (red polygon) and block 3B/4B (green polygon).**

3.4.3 HAKE DEMERSAL LONGLINE

In 1983, a demersal longline fishery aimed at catching Kingklip *Genypterus capensis* was launched in the continental shelf waters of South Africa, but the fishery was closed in 1990 due to concerns over the sustainability of the Kingklip resource (Japp, 1993). In 1994, a new experimental longline fishery was started, targeting Cape hakes *Merluccius capensis* and *M. paradoxus* (Japp, 1993; Japp & Wissema, 1999). In 2017, 8 113 tons of catch was landed with a wholesale value of R319.2 million, or 3.2% of the total value of all fisheries combined. Landings of 8 230 tons were reported in 2018. Refer to Table 3.6 for the landings of hake by the demersal longline fishery over the period 2010 to 2020.

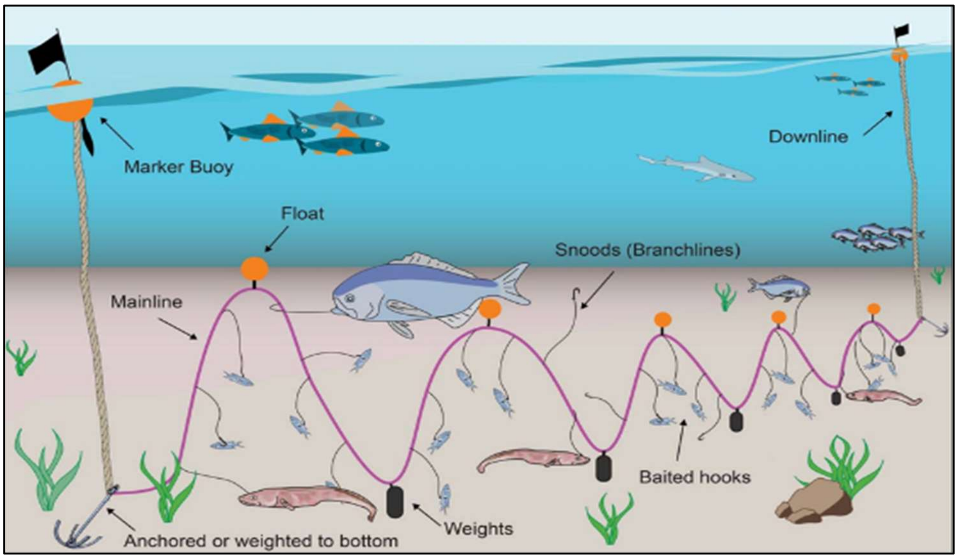
A demersal longline vessel may deploy either a double or single line which is weighted along its length to keep it close to the seafloor. Steel anchors, of 40 kg to 60 kg, are placed at the ends of each line to anchor it and are marked with an array of floats. If a double line system is used, top and 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 3.26.

Currently 64 hake-directed vessels are active (this can vary between 32 and 71 vessels Japp & Wissema 1999) 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 3.27 shows the spatial distribution of hake demersal longline fishing areas in relation to the licence block and proposed drilling area. The Area of Interest for proposed drilling area is situated offshore of the main fishing grounds which, in this area extend up to the 380 m bathymetric contour; the closest point of fishing effort to the boundary of the area of interest is 15 km. There is no overlap of fishing grounds with the AOI.

Figure 3.26: 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).



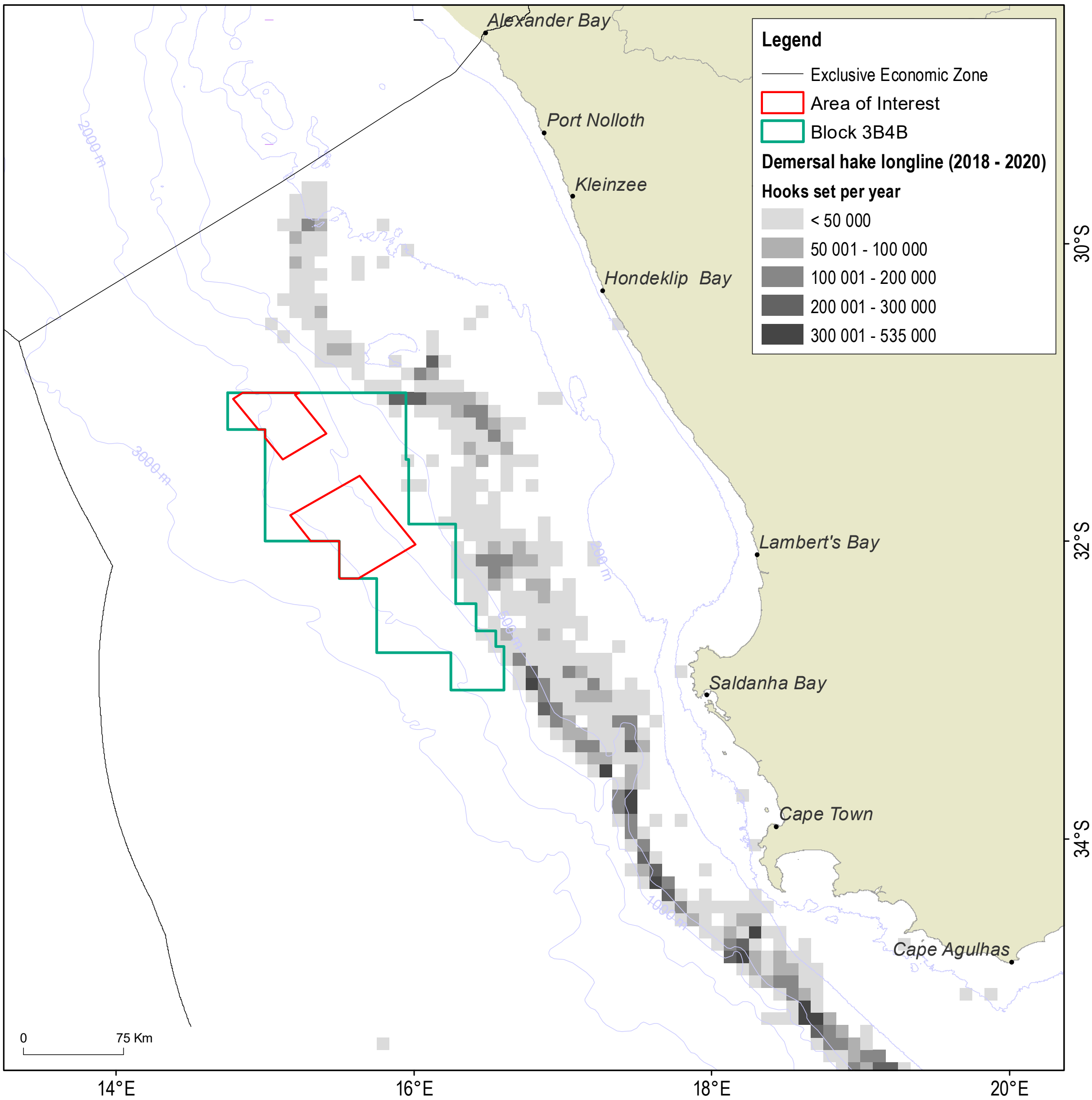


Figure 3.27: An overview of the spatial distribution of fishing effort expended by the hake demersal longline sector in relation to the licence block 3B/4B (green polygon) and area of interest for proposed drilling (red polygon).

3.4.4 SHARK DEMERSAL LONGLINE

After the tuna longline fishery declined in the mid-1960s, South African longline fishers shifted their focus to more profitable stocks. In 1991, permits were granted for the demersal shark longline fishery, which initially arose from exploiting regulatory loopholes to catch hake with longline gear, an activity that had been discontinued in 1990. Fishers targeted hake and kingklip under the guise of shark permits, but when bycatch limits for these species were lowered in the shark fishery, fishing effort decreased significantly. The number of permits issued was reduced from over 30 to just 6 by 2006, due to poor performance in the fishery. In the past decade, only 4 vessels have been active at any given time, despite 6 rights being allocated during the previous allocation process, with 2 of those vessels remaining inactive. 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 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 (See Figure 3.28). 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.

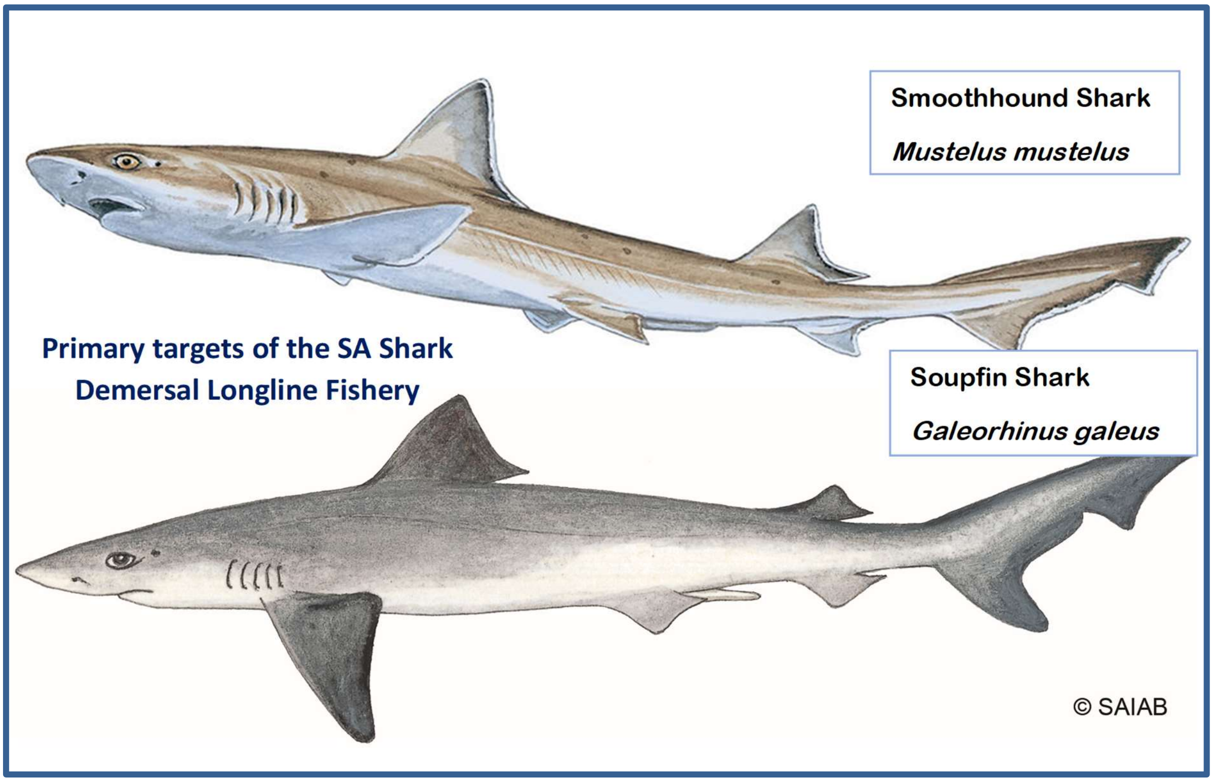


Figure 3.28 Primary target species of the Shark Demersal Longline fishery in South Africa, the Smoothhound and Soupfin shark. Images courtesy of Shark Research Institute and SAIAB.

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. Refer to Figure 3.29 for the concerning stock status of Soupfin sharks based on stock status estimates. 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. With the traditional linefishery being the largest participant in shark catches. It was only in the mid 2000s when participation in shark landing was seen in other fisheries (See Soupfin estimated landings example in Figure 3.30). Species targeted include soupfin sharks, smoothhound sharks, dusky sharks *Carcharhinus obscurus*, bronze whaler sharks *C. brachyurus*, and various skate species.

Table 3.7 lists 2018 landings of the main demersal shark and skate species caught by line and Figure 3.31 shows the spatial distribution of catch between 2017 and 2019. Fishing effort is coastal and directed inshore of the 100 m depth contour. The proposed drilling area is situated approximately 350 km from the closest expected fishing activity and there is no overlap of fishing grounds with the Area of Interest for proposed drilling.

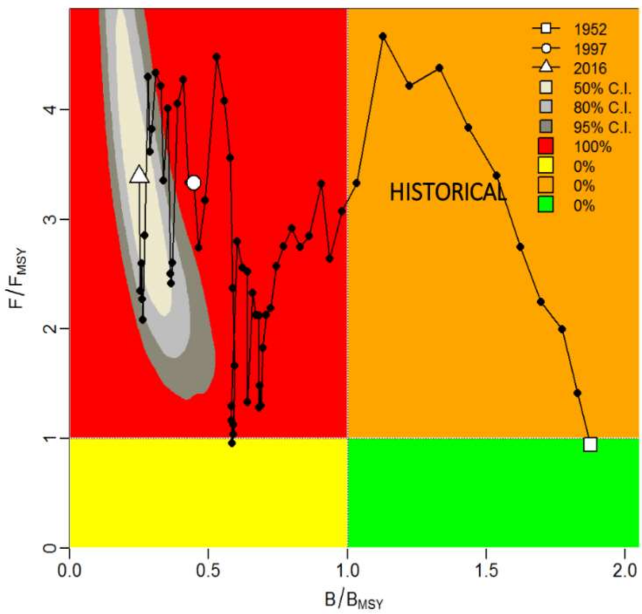


Figure 3.29 Kobe plot the stock status estimates of fishing mortality relative to FMSY and biomass relative to BMSY for soupfin sharks Galeorhinus galeus (A century of shark fishing in SA, DFFE).

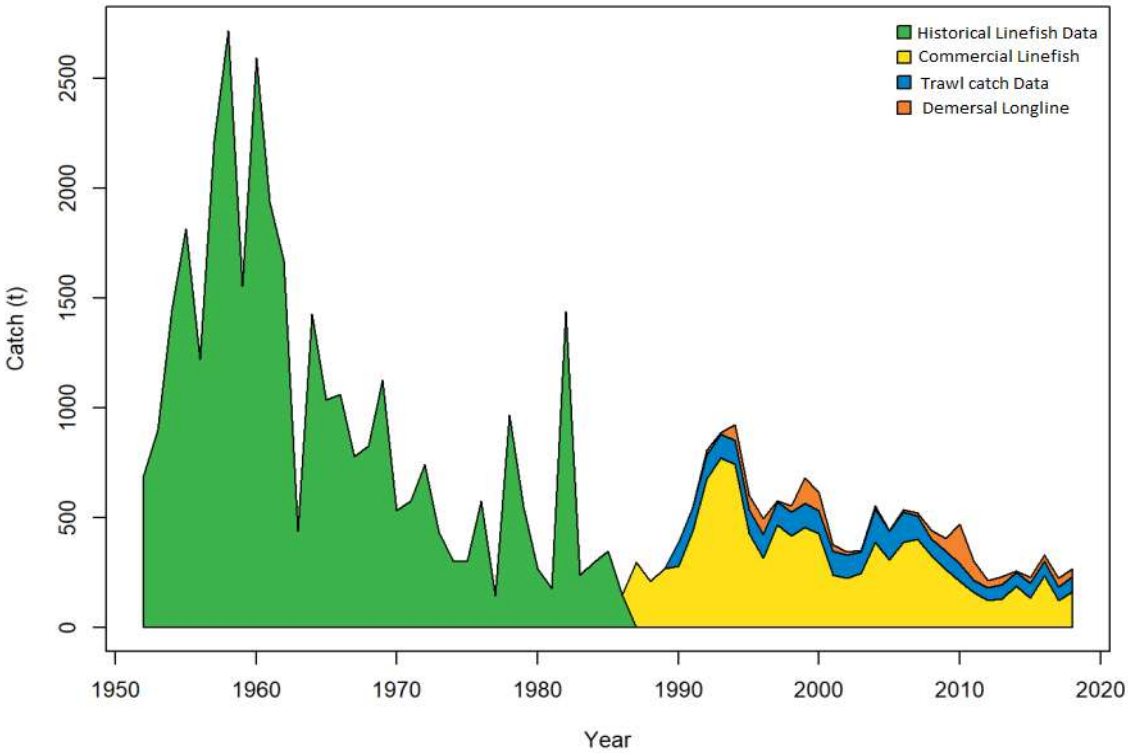


Figure 3.30: Time-series of estimated catch in metric tons (t) for soupfin sharks *Galeorhinus galeus* (1952-2018) showing the linefish historical data (green), commercial linefish data (yellow), trawl catch data (blue) and demersal shark longline catch data (orange; A century of shark fishing in SA, DFFE).

Table 3.7: 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

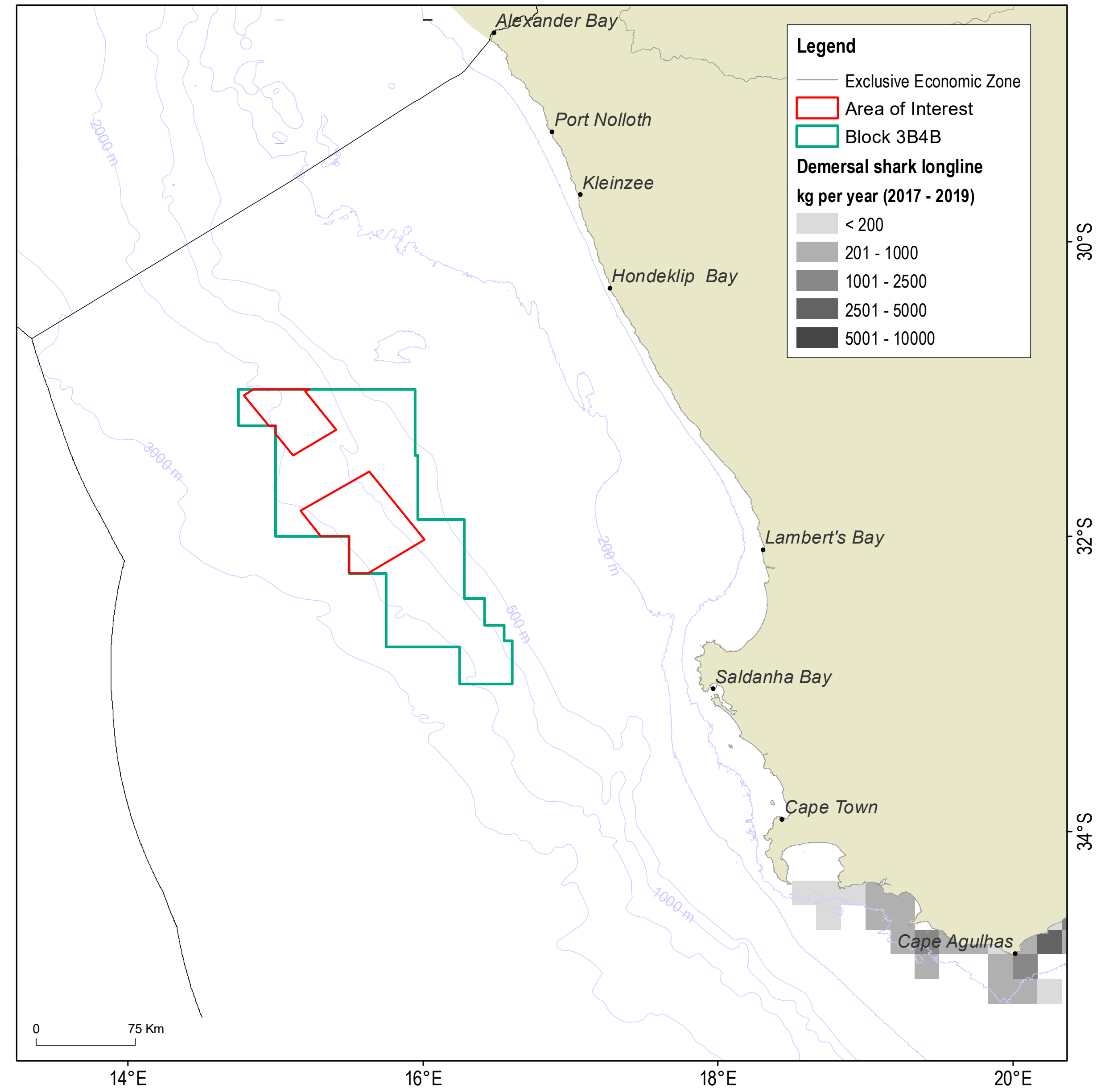


Figure 3.31: Spatial distribution of catch taken by the demersal shark longline fishery (2017 – 2019) in relation to the licence block 3B/4B (green polygon) and the area of interest for proposed drilling (red polygon).

3.4.5 SMALL PELAGIC PURSE-SEINE

The South African small pelagics fishery developed in the 1940s primarily targeting adult sardine (*Sardinops sagax*) along the West Coast. However, the sardine catch collapsed in the early 1960s, possibly due to overfishing. The industry then switched to smaller meshed nets and targeted anchovy (*Engraulis encrasicolus*) instead, which dominated catches from about 1964 to the mid-1990s. Recovery of the sardine stock was achieved under a stock rebuilding management strategy, and catches of both species have been at similar levels (around 250 000 tons) as biomass increased from the mid-1990s. The fishery also targets round herring (*Etrumeus whiteheadi*) to a lesser degree, which, along with anchovy, is processed into fishmeal and fish oil (93% of processed mass in the small pelagic fishery is fish oil and fish meal, SAPFIA). Bycatch species are mainly juvenile sardine, horse mackerel, and chub mackerel. The industry precautionary upper catch limits (PUCLs) are currently set at 60 000 t for round herring (Red Eye) and 25 000 t for Lantern and Lightfish (combined). The TACs and PUCLs have been repeatedly reduced to allow for stock stabilisation. Anchovy and Sardine directed fishing have been further decreased by 10% for 2023 (See Figure 3.32 for 2023 TAC and PUCLs).

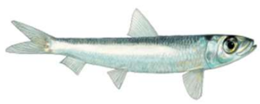
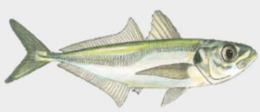
	2023 TAC Small Pelagic Fishery		
	Directed Anchovy	Has been decreased by 10%	222 750t
	Juvenile Sardine	Has been decreased by 10%, associated with anchovy directed catches	4 500t
	Directed Sardine	Has been decreased by 10%, not to exceed 70% West of Cape Agulhas and 30% East of Cape Agulhas	18 000t
	2023 Pools and Precautionary Upper Limits		
	Anchovy, Sardine-only permit holders	Not to be actively targeted	100t
	Red Eye	Associated with Sardine and Anchovy permit holders	60 000t
	Adult Sardine	Associated with directed Red Eye and Anchovy fishing, not to be targeted	2 000t
	Juvenile Sardine	Associated with directed Red Eye and Sardine fishing, not to be targeted	500t
	Horse Mackerel	Not to be targeted	6 200t
 	Lantern and Lightfish (combined)	Associated with Sardine and Anchovy permit holders	25 000t

Figure 3.32: Small pelagic anchovy and sardine TACs, PUCL's, and Pools for the 2023 season (DFFE notice, 20 Dec 2022)

The pelagic-directed purse-seine fishery is the largest South African fishery by volume and the second most important in terms of economic value. The wholesale value of catch landed by the sector during 2018 was R3.2 billion, or more than 22% of the total value of all fisheries combined. However, 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. This is below both long-term (338 000 t) and short-term (294 000 t) averages (See Figure 3.33).

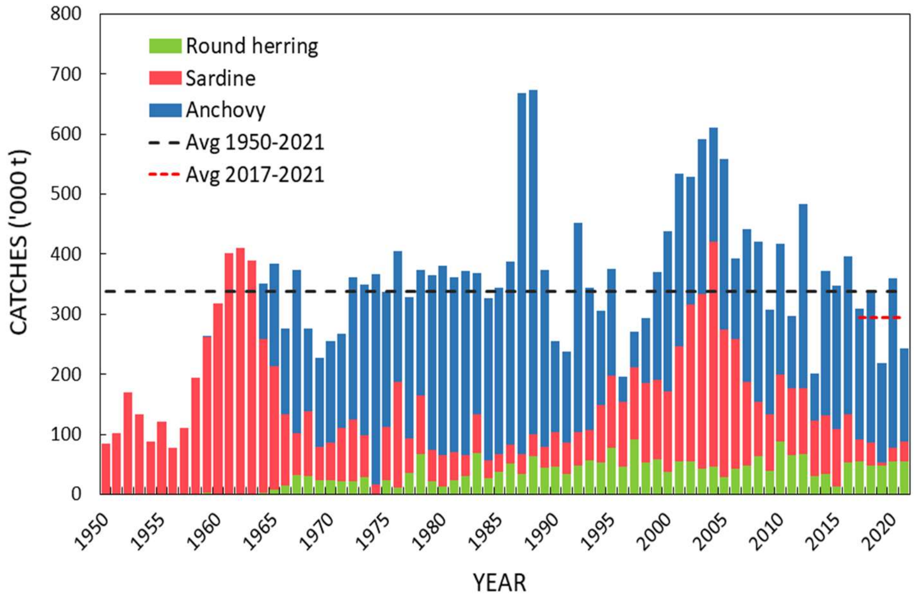


Figure 3.33: The annual combined catch of anchovy, sardine and round herring. Also shown is the average combined catch since the start of the fishery (1950-2021; black dashed line) and for the past five years (red solid line). Source DFFE, 2022.

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 vessels ranging in length from 11 m to 48 m (see Figure 3.34). Once a shoal of the targeted species is located, the vessel encircles it with a large net extending to a depth of 60 m to 90 m. Netting walls surround the 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 onboard into the hold of the vessel. It is important to note that after the net is deployed, the vessel has no ability to manoeuver until the net has been fully recovered on board, which 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 operates 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. The ports of deployment correspond to the location of canning factories and fish reduction plants along the coast. Approximately 80% of the sardine catch in South Africa is processed by six canneries located in St Helena Bay (4), Gans Bay (1) and Mossel Bay (1), with the remaining catch packed by a decreasing number of pack-and-freeze processors, down from around 26 in 2004 to 12 in 2013. In addition to canning sardines, five of the canneries located west of Cape Agulhas produce fishmeal and fish oil from reduction processing of anchovy, round herring, small quantities of mesopelagic species (e.g. lanternfish and light fish) and sardine offal. However, the canning of round herring has been discontinued due to limited seasonal availability and issues with fish quality.

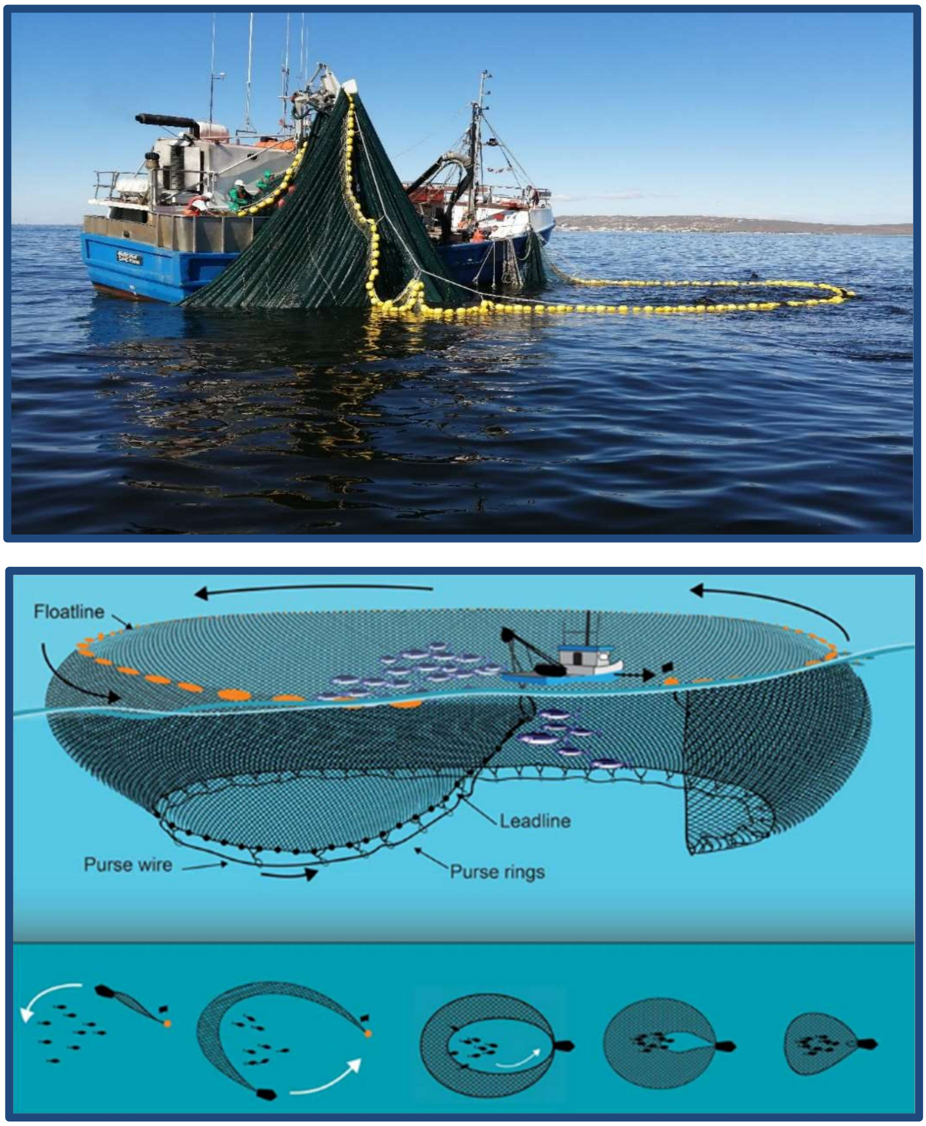


Figure 3.34: (Above) Photograph of a purse-seine vessel registered to fish for small pelagic species (credit C. Heinecken, CapMarine). (Below) Typical configuration and deployment of a small pelagic purse seine for targeting anchovy, sardine and round herring as used in South African waters. Source: http://www.afma.gov.au/portfolio-item/purse-seine.

Between 2005 and 2008, in response to the decline in sardine biomass west of Cape Agulhas, the directed sardine catch was mostly made east of Cape Point, with over 50% of the catch taken east of Cape Agulhas. This shift had socio-economic impacts for the industry due to the mismatch between processing capacity (which was mostly located in St Helena Bay) and the area of sardine availability. As a result, sardines were caught using smaller vessels in the Mossel Bay area and transported at additional cost to the west coast processors. This shift also led to the development of canning capacity in Mossel Bay and resulted in some restructuring of vessel use and operational procedures (FAO, 2016). As of the 2023 TAC and PUCL updates, it is specified that a maximum of 70% of directed sardine catches must be made West of Cape Agulhas with no more than 30% maximum East of Cape Agulhas.

The geographical distribution and intensity of the fishery are largely dependent on the seasonal fluctuation and distribution of the targeted species. The sardine-directed fleet concentrates its 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 is most active in the period from March to September. Round herring is targeted when available, 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. The fishery operates throughout the year with a short seasonal break from mid-December to mid-January. Seasonality of catches is shown in Figure 3.35 with an increase in fishing effort and landings evident during the winter months.

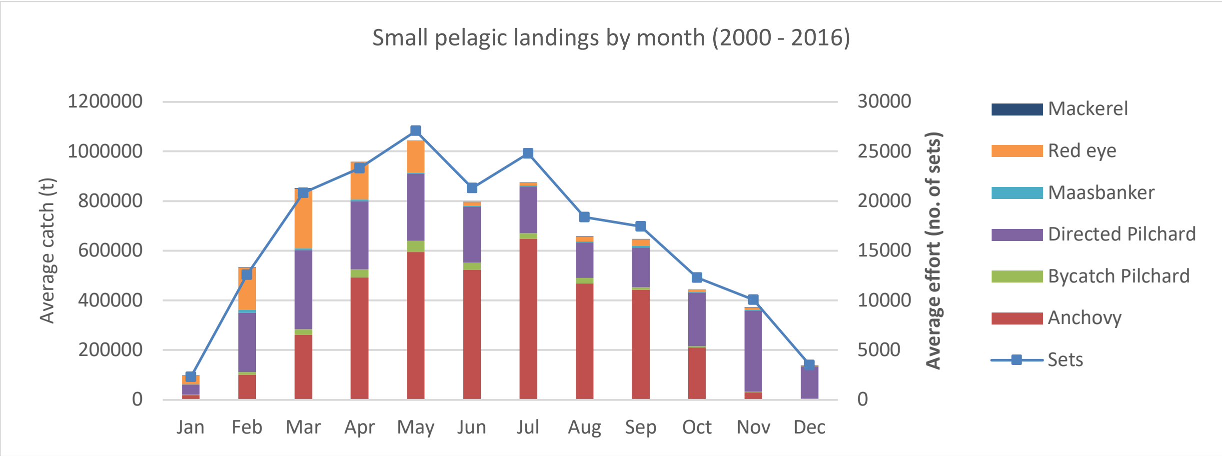


Figure 3.35: Graph showing monthly catch (tons) and effort (number of sets) reported for the small pelagic purse-seine fleet over the period 2000 to 2016 (cumulative). Source: DFFE.

Figure 3.36 shows the spatial extent of fishing grounds in relation to the license block and Area of Interest for proposed drilling. There is no direct overlap and the AOI which is situated at least 100 km from fishing grounds.

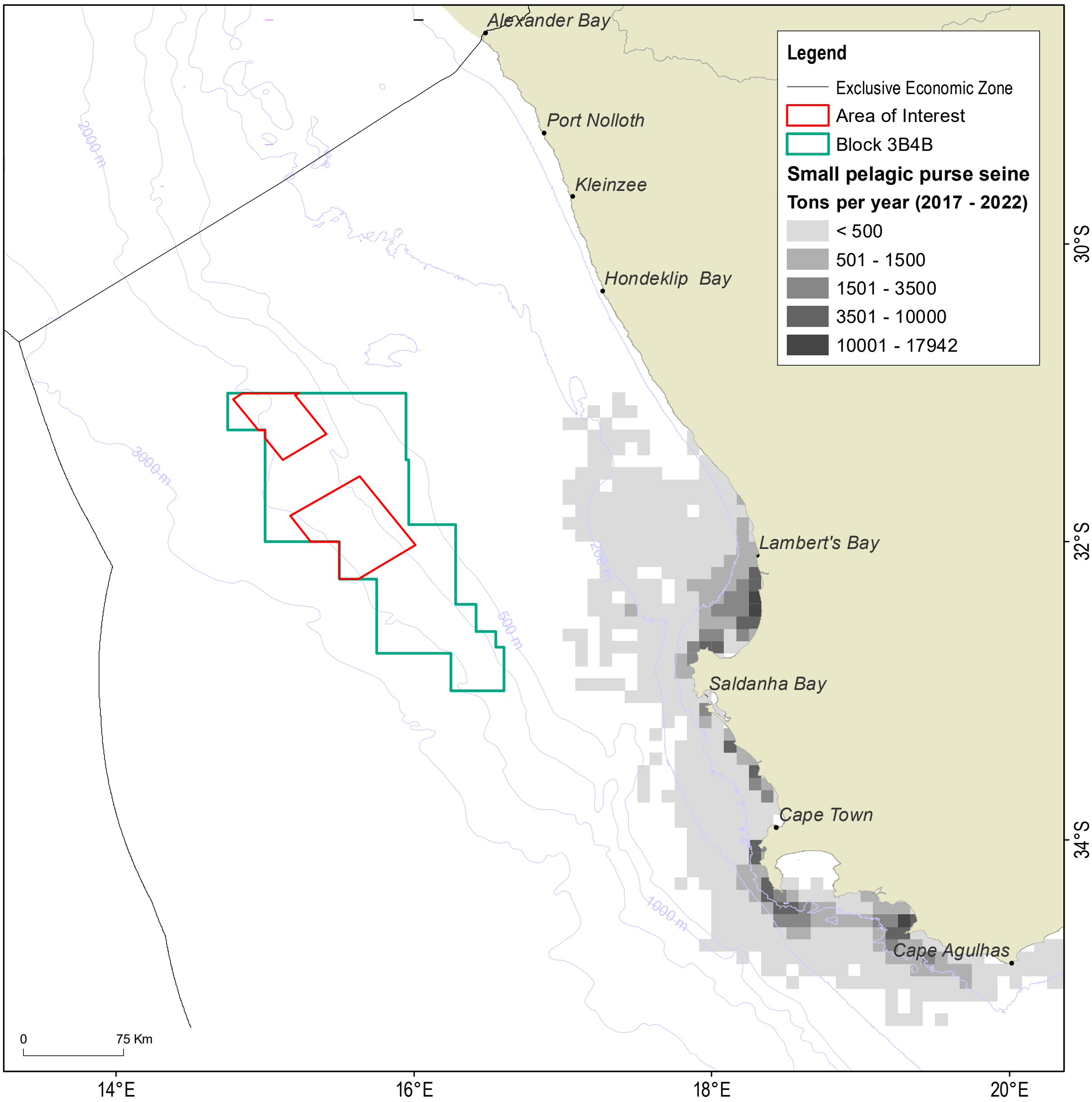


Figure 3.36: An overview of the spatial distribution of effort expended by the purse-seine sector targeting small pelagic species in in relation to the licence block 3B/4B (Green polygon) and the proposed area of interest for drilling (Red Polygon).

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 (See Figure 3.37). 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 2 541 tons (2017) and 2 815 tons (2018). Catch by species and number of active vessels for each year from 2005 to 2018 are given in Table 3.8.

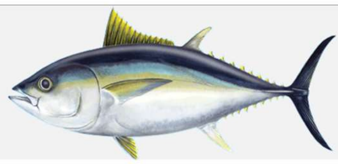
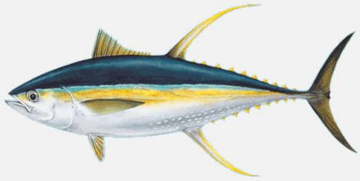
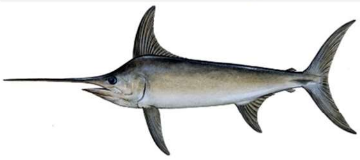
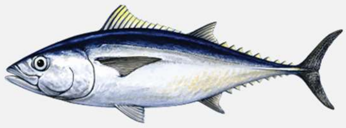
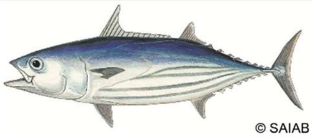
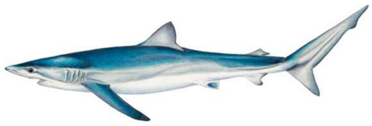
SPECIES NAME	REFERENCE IMAGE	LARGE PELAGIC LONGLINE (LPL) / TUNA POLE (TP)
BIGEYE TUNA (THUNNUS *OBESUS*)		LPL & TP
ALBACORE (*THUNNUS ALALUNGA*)		LPL & TP
YELLOWFIN TUNA (*THUNNUS ALBACARES*)		LPL & TP
SWORDFISH (*XIPHIAS GLADIUS*)		LPL
SOUTHERN BLUEFIN (*THUNNUS MACCOYII*)		LPL
SKIPJACK TUNA (*KATSUWONUS PELAMIS*)		TP
SHORTFIN MAKO (*ISURUS OXYRINCHUS*)		LPL
BLUE SHARK (*PRIONACE GLAUCA*)		LPL

Figure 3.37 Primary species targets for the Large Pelagic Longline Fishery (LPL) and Tuna Pole Fishery (TP; Refer to Section 3.4.7) in South Africa. Images courtesy of WWF-SASSI and SAIAB.

Table 3.8: 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 3.38. 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 3.39.

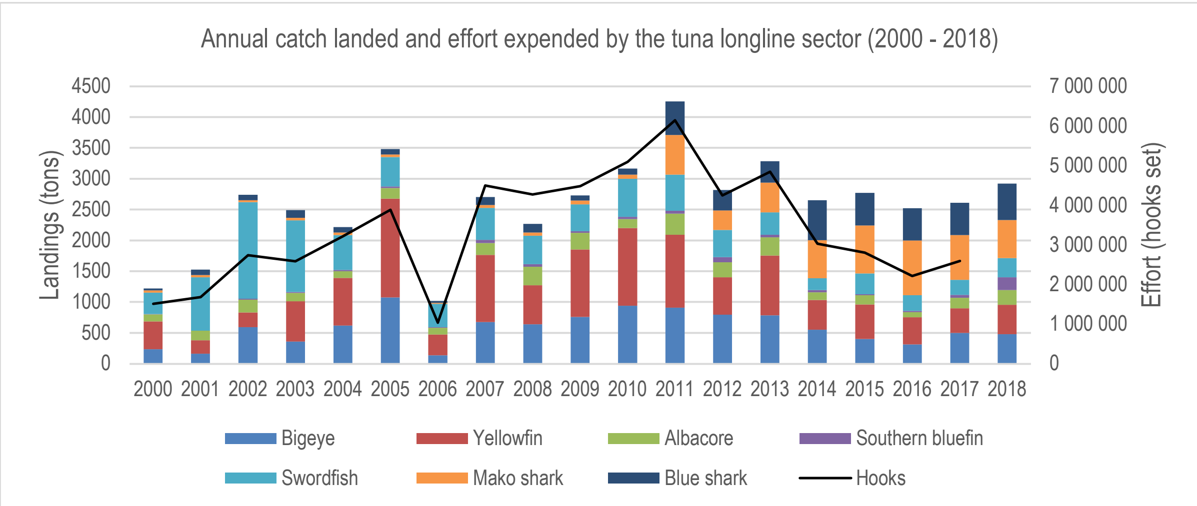


Figure 3.38: Inter-annual variation of catch landed and effort expended by the large pelagic longline sector in South African waters as reported to the two regional management organisations, ICCAT and IOTC (2000 – 2018; Source: DEFF, 2019).

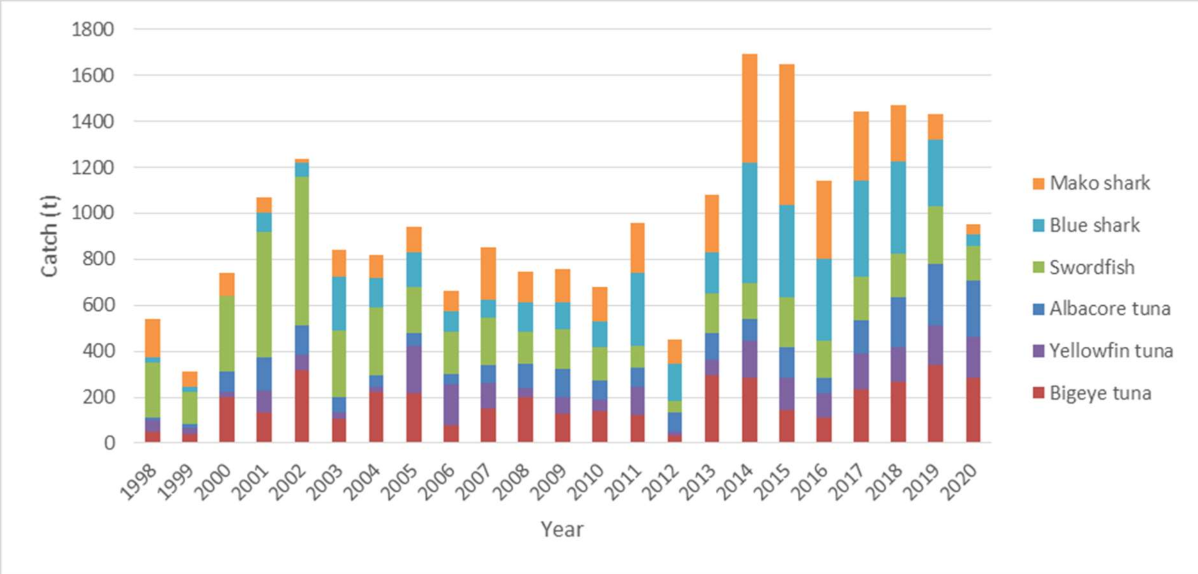


Figure 3.39: Inter-annual variation of catch landed by the large pelagic longline sector operating in the ICCAT region of South African waters (i.e. West of 20°E from 1998 – 2020).

Tuna and billfish are migratory stocks and are managed as a "shared resource" among various countries under the jurisdiction of the International Commission for the Conservation of Atlantic Tunas (ICCAT) and the Indian Ocean Tuna Commission (IOTC). South Africa has a long history of commercial longlining for tuna, which began in the 1960s and initially focused on southern bluefin tuna and albacore. The fishery declined after the mid-1960s due to a poor market for low-quality bluefin and albacore. Interest in longline fishing for tuna and swordfish in South African waters was revived in 1995, and 30 experimental longline permits were issued in 1997. The primary objective of the fishery was to develop a large pelagic catch performance for South Africa so that it could receive equitable quotas from RFMOs (Regional Fisheries Management Organisations) such as ICCAT and IOTC.

During the experimental phase of the fishery, catches peaked at over 2,500 t, but swordfish comprised the bulk of the catch in each year. Targeting of swordfish led to sharp declines in swordfish abundance in South Africa's EEZ. In 2005, long-term rights were made available, with 17 rights issued to the swordfish-directed fishery and 26 to the tuna-directed fishery. The primary objectives of this allocation were to develop a tuna catch performance for South Africa and to South Africanize the fishery. Catches improved to over 3,500 t in 2005 with the assistance of foreign-flagged charters. However, none of the Asian-flagged vessels reflagged South African, and no further provision was made for the use of foreign-flagged charters in 2006. Consequently, catches declined to less than 500 t.

In 2007, foreign-flagged vessels were once again allowed to fish in South Africa to improve its catch performance, transfer skills to South African crew, and eventually reflag South African. To date, an average of 10-15 foreign-flagged vessels takes out permits to fish in South Africa each year. In March 2011, the Department consolidated the tuna/swordfish longline fishery and the pelagic shark fishery, absorbing the 6 pelagic shark vessels into the tuna/swordfish longline fishery. The decision to terminate the targeting of pelagic sharks was due to several reasons, including concerns over substantial pelagic shark bycatch in the tuna/swordfish fisheries, the slow-growing, late-maturing, and low fecundity nature of sharks, and the threats to the survival of blue and mako shark populations.

In 2017, 60 fishing rights were allocated for a period of 15 years, with the total number of active longline vessels within South African waters being 22. Of these, 18 fished exclusively in the Atlantic (West of 20°E) and were domestic vessels, while three Japanese vessels fished exclusively in the Indian Ocean (East of 20°E) in joint ventures with South African companies.

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 3 500 baited hooks are attached to the mainline via 20 m long trace lines, targeting fish at a depth of 40 m below the surface. Various types of buoys are used in combinations to keep the mainline near the surface and locate it should the line be cut or break for any reason. Each end of the line is marked by a Dahn Buoy and radar reflector, which marks the line position for later retrieval. Typical configuration of set gear is shown in Figure 3.40 and photographs of monofilament fishing line and marker buoys are included in Figure 3.41 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.

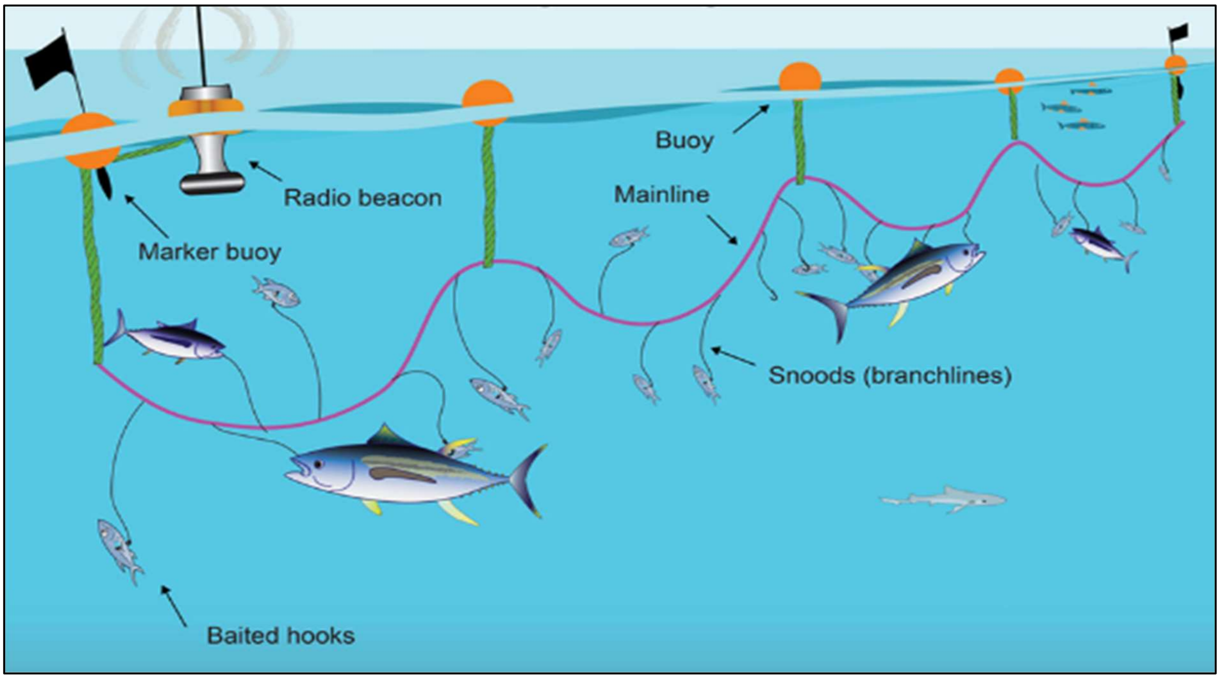


Figure 3.40: Typical large pelagic longline gear (Source: http://www.afma.gov.au/portfolio-item/longlining).

Figure 3.41: 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 3.43b). 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).

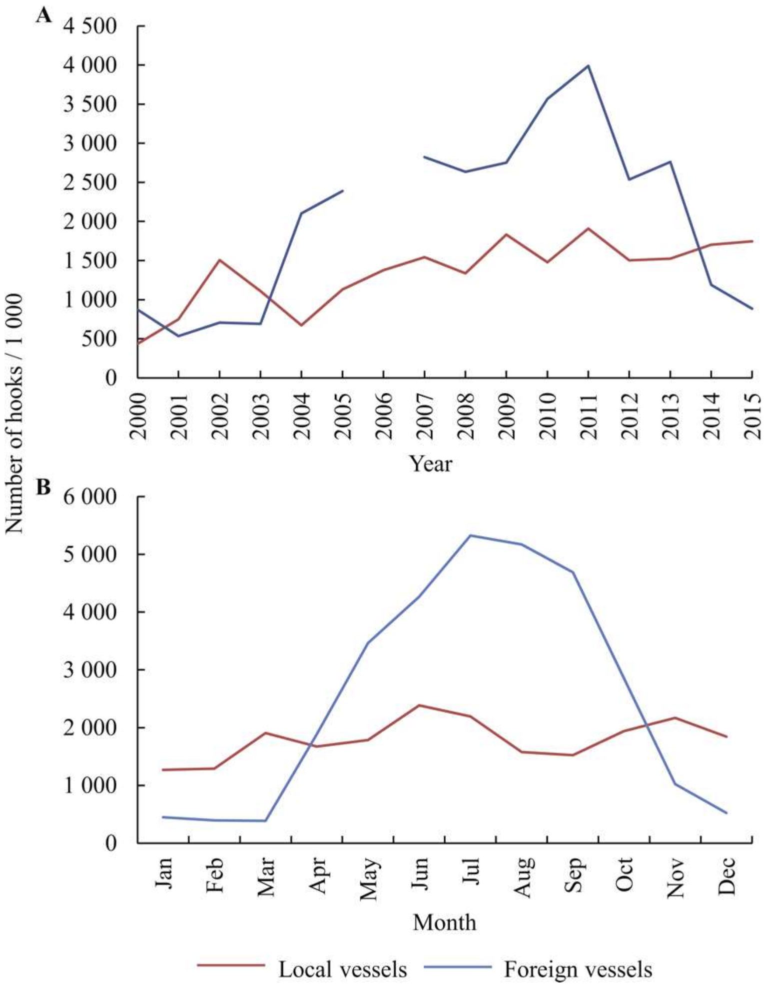


Figure 3.42: Numbers of hooks set per (A) year (2000–2015) and (B) per calendar month, as reported by local and foreign pelagic longliners (Jordaan *et al*., 2018).

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 3.43. 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 3.42b). Foreign vessels venture further southwards than local vessels, which tend to remain within the EEZ (Figure 3.43; 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.

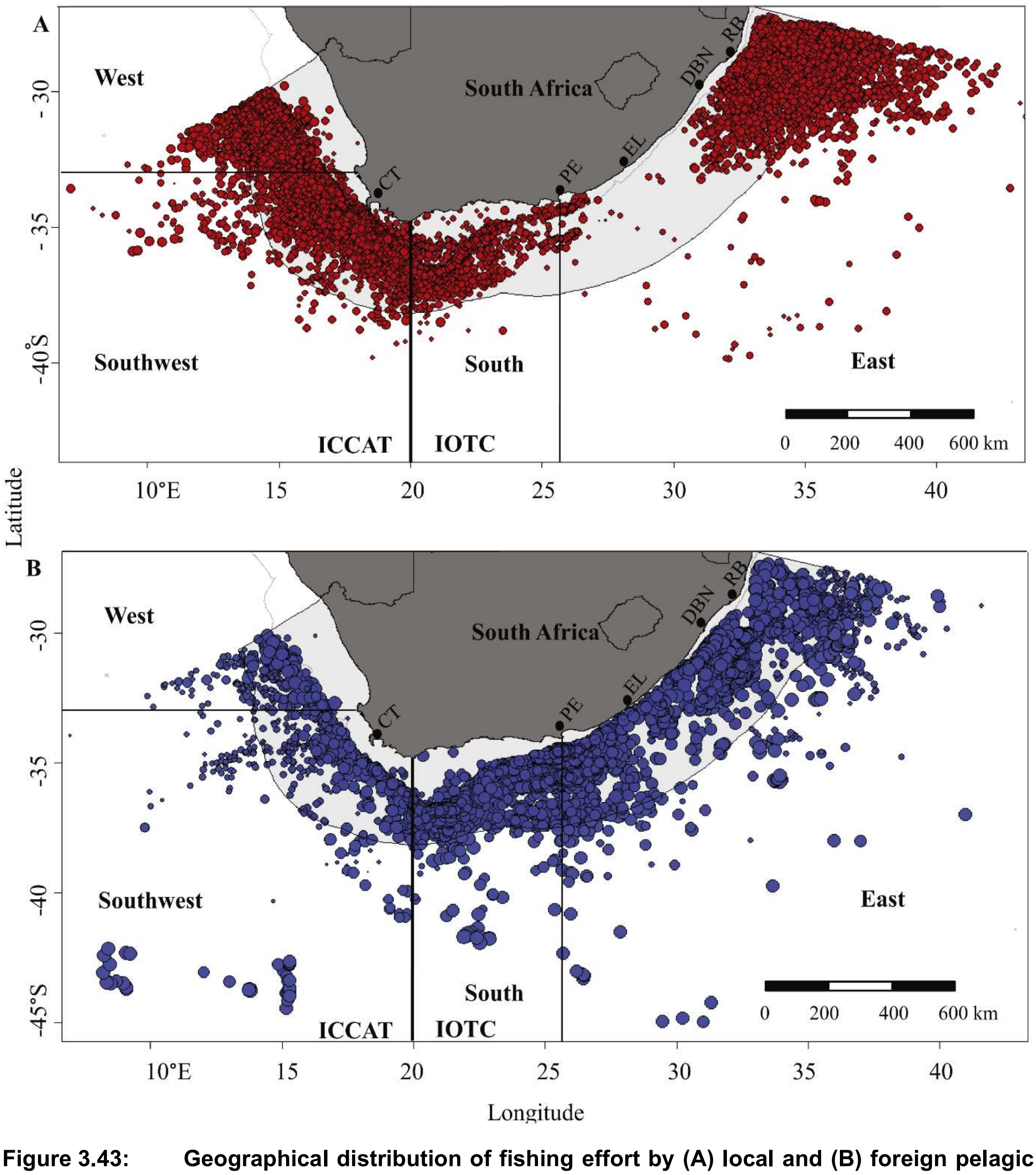


Figure 3.43: Geographical distribution of fishing effort by (A) local and (B) foreign pelagic longliners between 2000 and 2015, based on logbook data provided by vessel skippers (Jordaan *et al*., 2018).

The fishery operates extensively within the South African EEZ, primarily along the continental shelf break and further offshore. Figure 3.44 shows the spatial extent of pelagic longline fishing grounds in relation to the licence block and Area of Interest for proposed drilling.

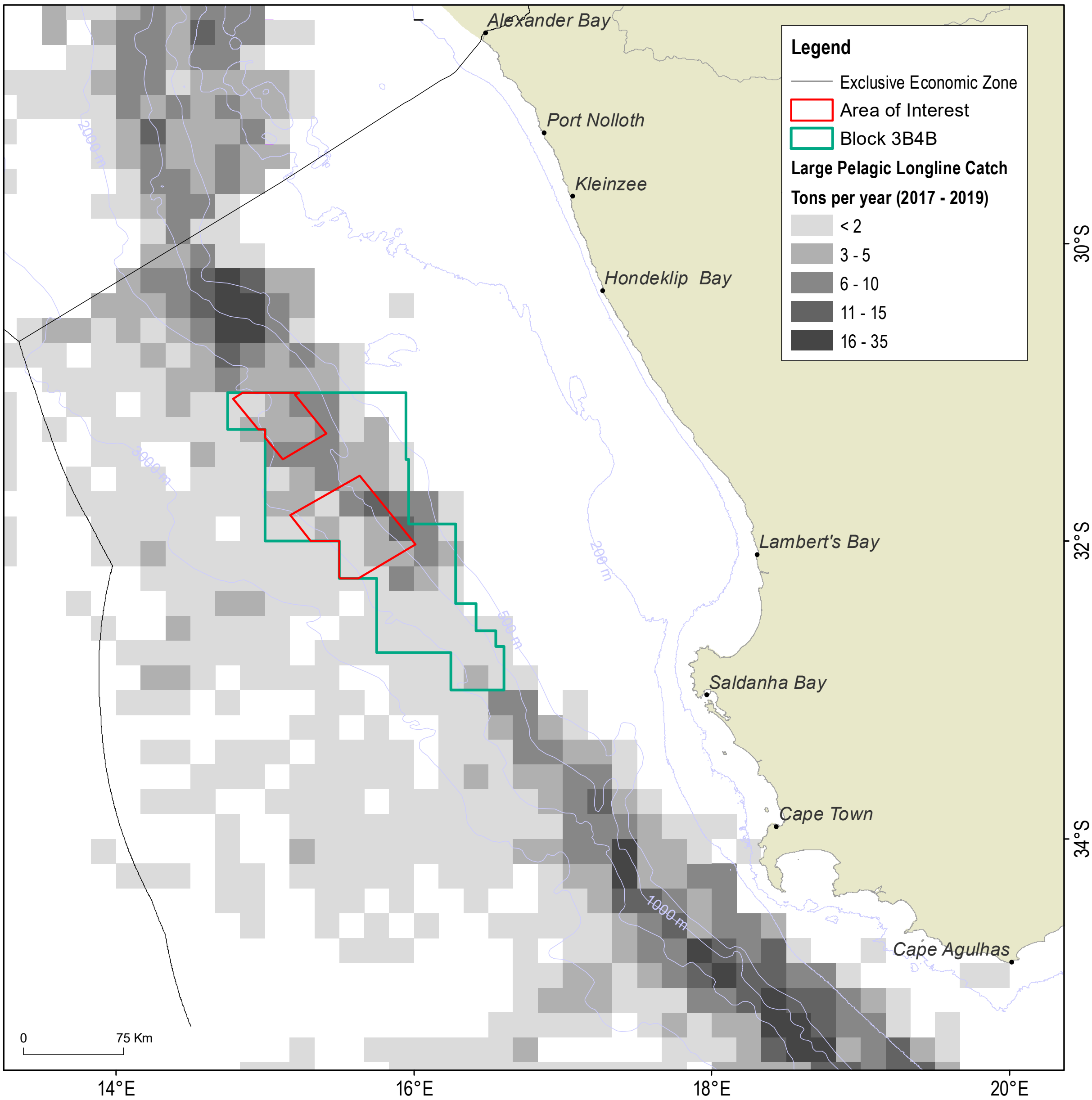


Figure 3.44: An overview of the spatial distribution of fishing effort expended by the longline sector targeting large pelagic fish species in relation to licence block 3B/4B (Green polygon) and area of interest for proposed drilling (Red polygon).

Over the period 2017 to 2019 an average of 95 lines per year were set within the AOI yielding 127 tonnes of catch (4.5% of total national catch). Fishing activity takes place over the entire Area of Interest for proposed exploration drilling but is concentrated towards the shelf break. Fishing effort within the AOI is highest during the period May, June and July. 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.

3.4.7 TUNA POLE-LINE

The tuna pole fishery in South Africa has been operating since 1980, and traditionally targets high volume, low-value albacore (*Thunnus alalunga*) for canning along the west coast of the country. In recent years, some vessels have also begun targeting low volume, high-value yellowfin tuna (*T. albacares*) for sashimi markets. The fishery has faced challenges due to the seasonality of tuna in South African waters, with catches of albacore fluctuating around 3 000 tonnes per year, largely dependent on the availability of the species in near-shore waters between October and May.

To reduce conflict with the traditional linefish sector, access to additional species, including snoek (*Thyrsites atun*) and yellowtail (*Seriola lalandi*), has been granted to the tuna pole fishery. However, some operators have exacerbated the situation by targeting these species without also targeting tuna. As a result, the South African government has instituted bag limits for yellowtail of 10 per person per trip, and a minimum vessel size of 10 m, unless the vessel can demonstrate good performance on tuna. Access to snoek is still under deliberation.

The fishery is managed by a total allowable effort (TAE) of 200 vessels, with 200 rights made available in a long-term allocation process in 2005. The four major contracting parties actively fishing for albacore in the South Atlantic are Chinese-Taipei, South Africa, Brazil, and Namibia. The International Commission for the Conservation of Atlantic Tunas (ICCAT) is responsible for conducting stock assessments, devising control measures, and issuing country allocations. In 2011, the stock assessment for southern Atlantic longfin tuna (albacore) determined a total allowable catch (TAC) of 24 000 MT for the region, with South Africa and Namibia allocated a combined total of 104 000 tonnes. This allocation is currently being managed on an Olympic-type system.

Fishing for tuna occurs along the entire west coast of South Africa beyond the 200 m bathymetric contour, along the shelf break with favoured fishing grounds between 60 km and 120 km offshore of Saldanha Bay and north of Cape Columbine. Fishing activity for snoek is seasonal and takes place inshore of the 100 m depth contour along the coast between March and July, with a peak in activity during April and May.

Overall, the South African tuna pole fishery has faced challenges due to the seasonality of the target species and competition with the traditional linefish sector. The government has implemented bag limits and vessel size restrictions to reduce conflict, and the fishery is managed through an allocation system overseen by ICCAT. 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 3 941 tons. A historical time series of catch and effort reported by the South African sector operating within the Atlantic region is shown in Table 3.9 and Figure 3.45. The total effort of 4 131 catch days within the ICCAT convention area in 2019 represents an increase in effort of 9% compared to 2018.

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 3.46).

Table 3.9: 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

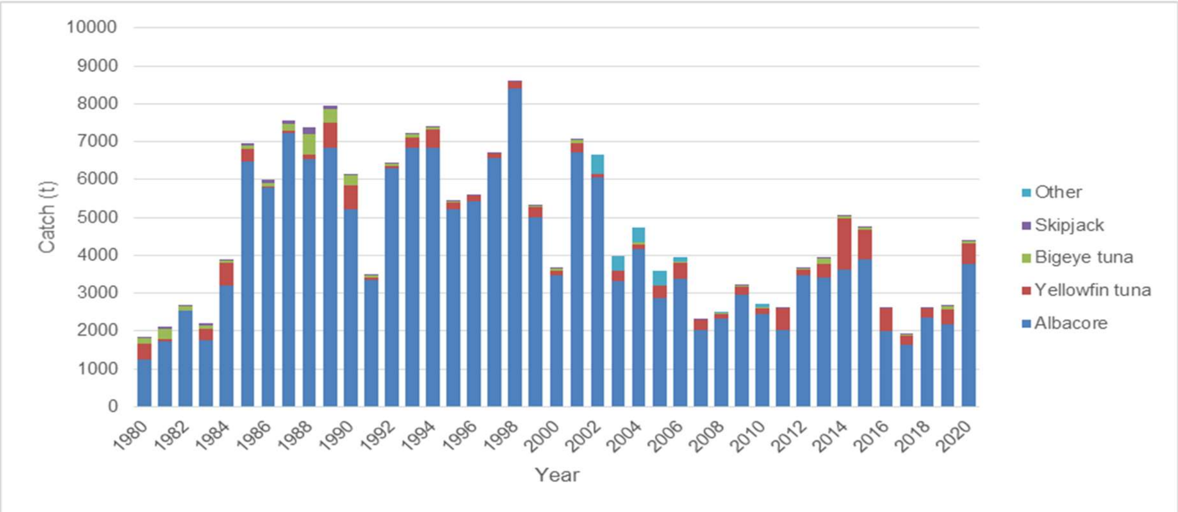


Figure 3.45: Catches (tons) of pelagic species by the South Africa pole-line (“Baitboat”) fleet between 1980 and 2020 (ICCAT, 2022).

Figure 3.46: Schematic diagram of pole and line operation (Source: http://www.afma.gov.au/portfolio-item/minor-lines).

The nature of the fishery and communication between vessels often results in a large number of vessels operating in close proximity to each other at a time. The vessels fish predominantly during daylight hours and are highly manoeuvrable. However, at night in fair weather conditions the fleet of vessels may drift or deploy drogues to remain within an area and would be less responsive during these periods.

Figure 3.47 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 fishing within the licence block but no activity within the AOI.

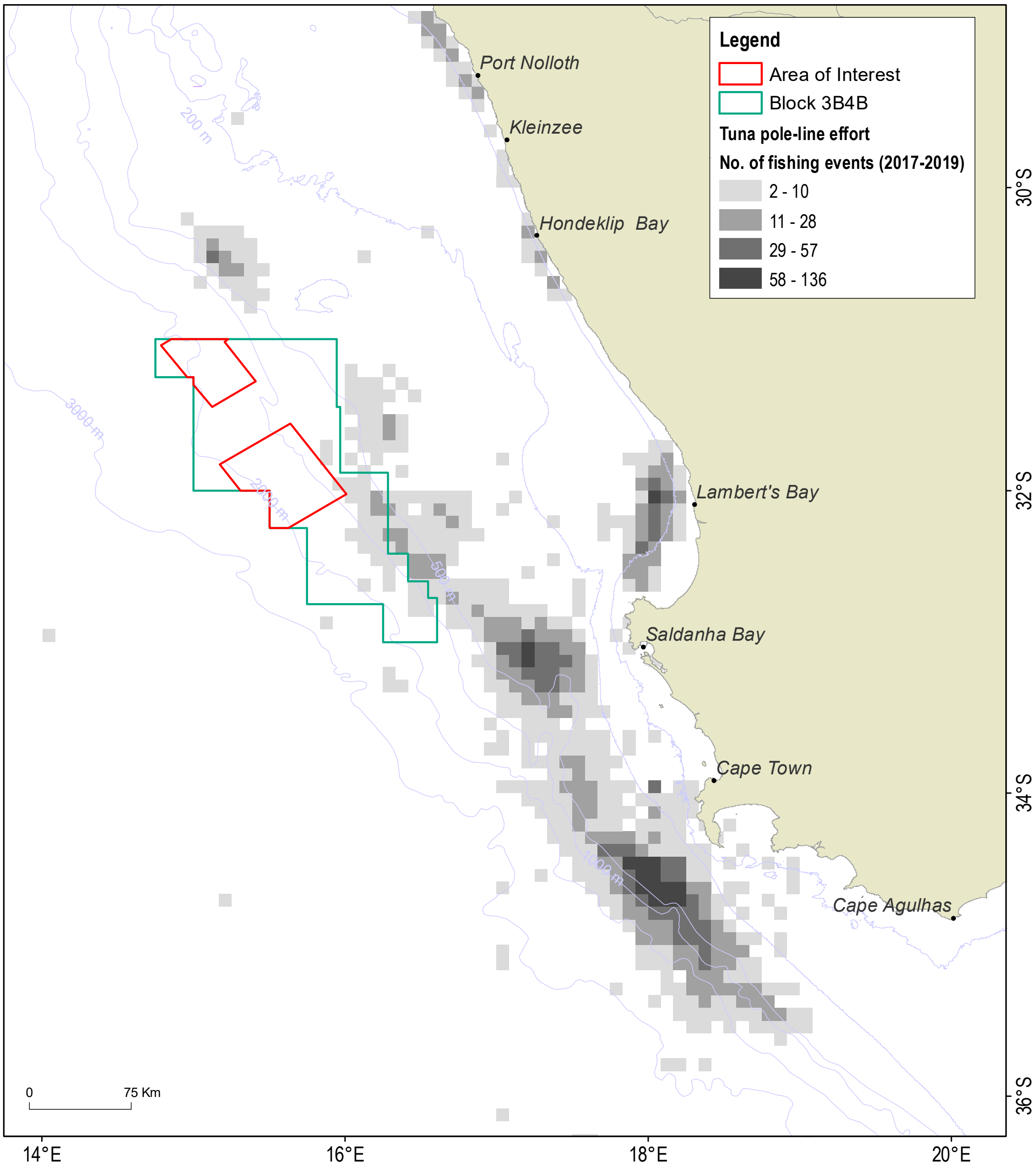


Figure 3.47: An overview of the spatial distribution of fishing effort expended by the pole- line sector targeting pelagic tuna (offshore areas) and snoek (inshore areas) in relation to the licence block 3B/4B (Green polygon) and area of interest for proposed drilling (Red polygon).

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 resources 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 3.10 lists the catch of important linefish species for the years 2010 to 2022. Figure 3.48 shows the variability in catches of the eight most importance species by the linefishery over the period 1985 to 2021.

Table 3.10: 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*

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[4]

[4] 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

is currently 425. For the 2021/2022 fishing season, 325 vessels were apportioned to commercial fishing, whilst 122 vessels apportioned to small-scale fishing[5] (refer to Section 3.5).

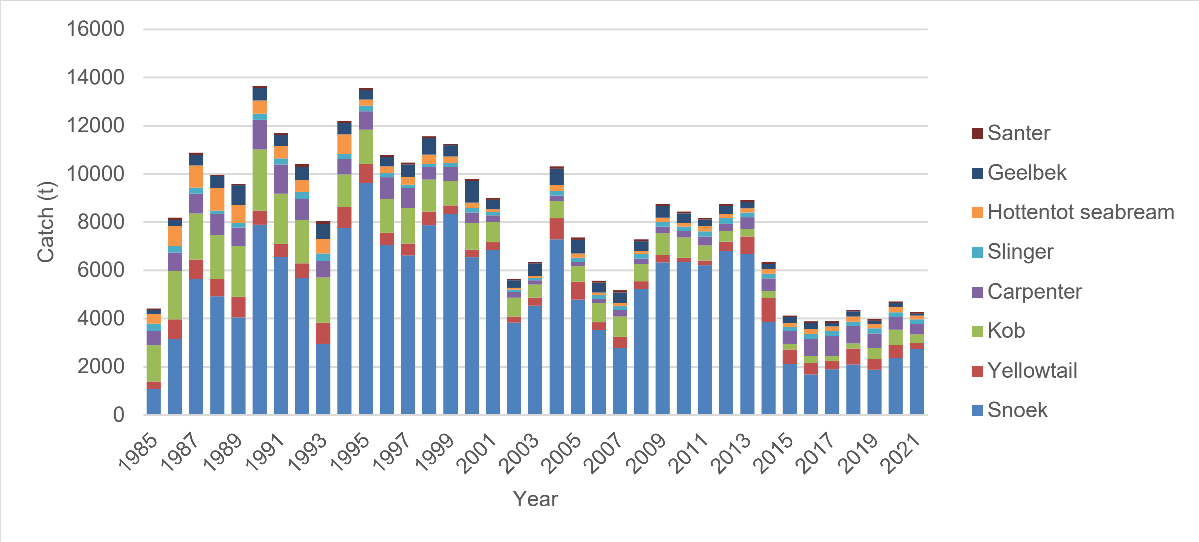


Figure 3.48: Annual catch (t) of the eight most important linefish species for the period 1985-2021 (DFFE, 2022).

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.

Table 3.11 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 3.11: Annual total allowable effort (TAE) and activated commercial line fish effort per management zone from 2007 to 2019 (DEFF, 2020).

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.

[5] 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.

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 3.49). 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 3.49: 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 3.50 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. There is no overlap with the licence block or the AOI.

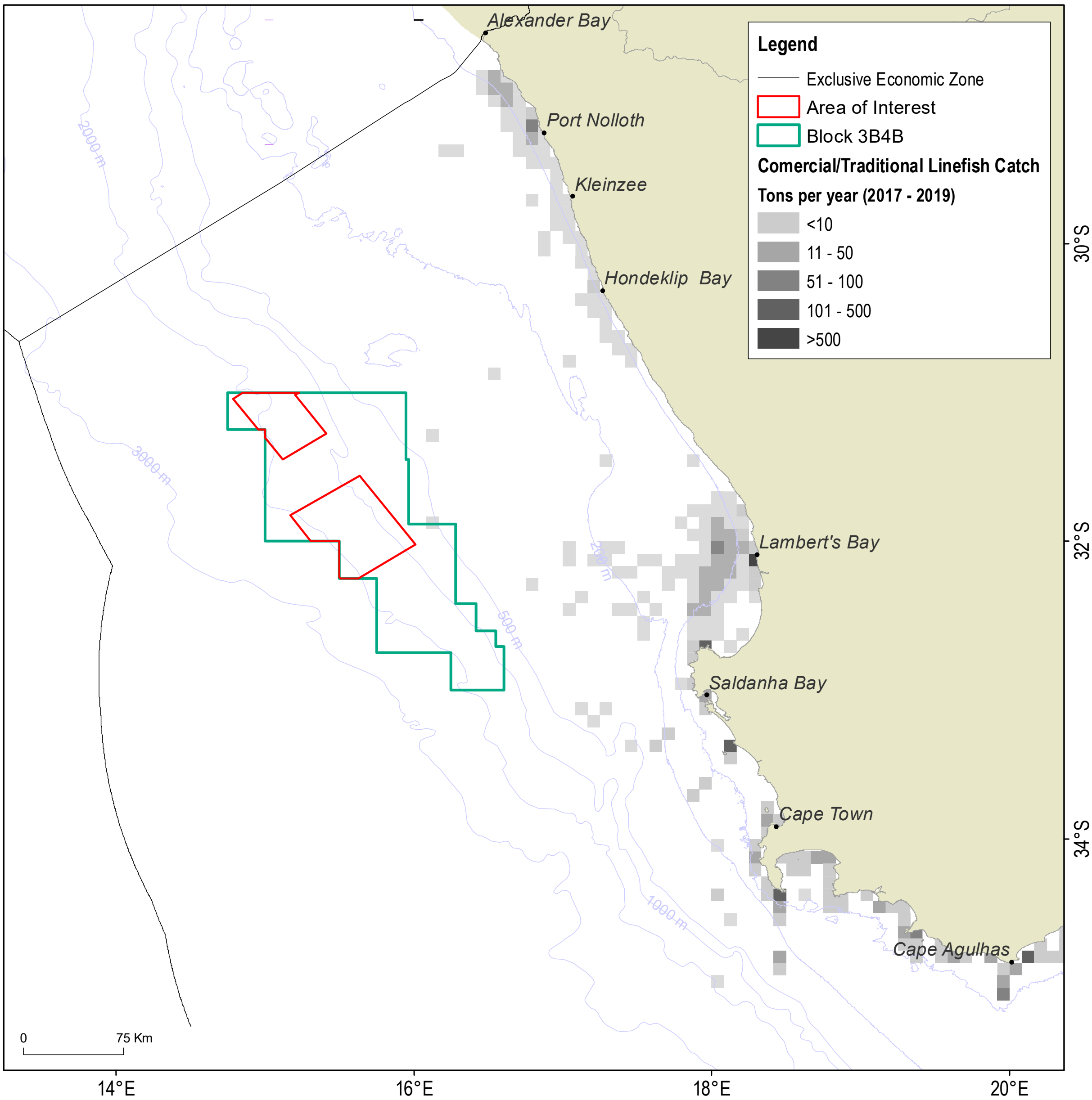


Figure 3.50: An overview of the spatial distribution of catch taken by the line fish sector in relation to licence block 3B/4B (Green polygon) and area of interest for proposed drilling (Red polygon).

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 3.12. The TAC for the 2021/2022 fishing season was reduced by 28% from the previous fishing season (2020/2021). The updated stock assessment for the resource has indicated that it is further depleted than was thought to be the case two years ago, and poaching[6] is one of the major contributors to the recently exacerbated depleted status of the resource. The resource has over recent decades been at about 2.5% of the pristine level, but that over the last few years this had dropped to about 1.5%.

Average monthly landings over the period 2006 to 2020 are shown in Figure 3.51 and a historical time-series of TACs and landings is listed in Table 3.13.

Table 3.12: 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 3.13: 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

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

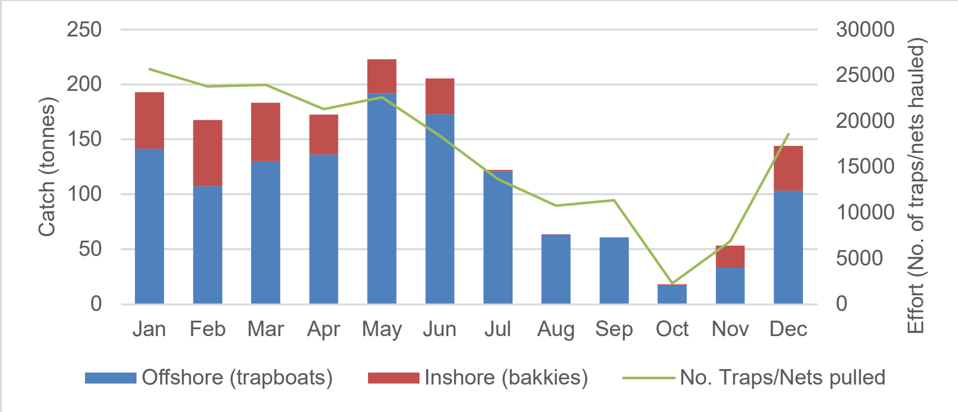


Figure 3.51: Graph showing the average monthly catch (tonnes) and effort (number of traps hauled) reported by the offshore (trapboat) and inshore (bakkie) rock lobster sectors over the period 2006 to 2020.

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 3.14.

Table 3.14: 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 3.52. 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 3.53 shows rock lobster catch by area for the commercial offshore and nearshore sub-sectors over the period 2005 to 2016.

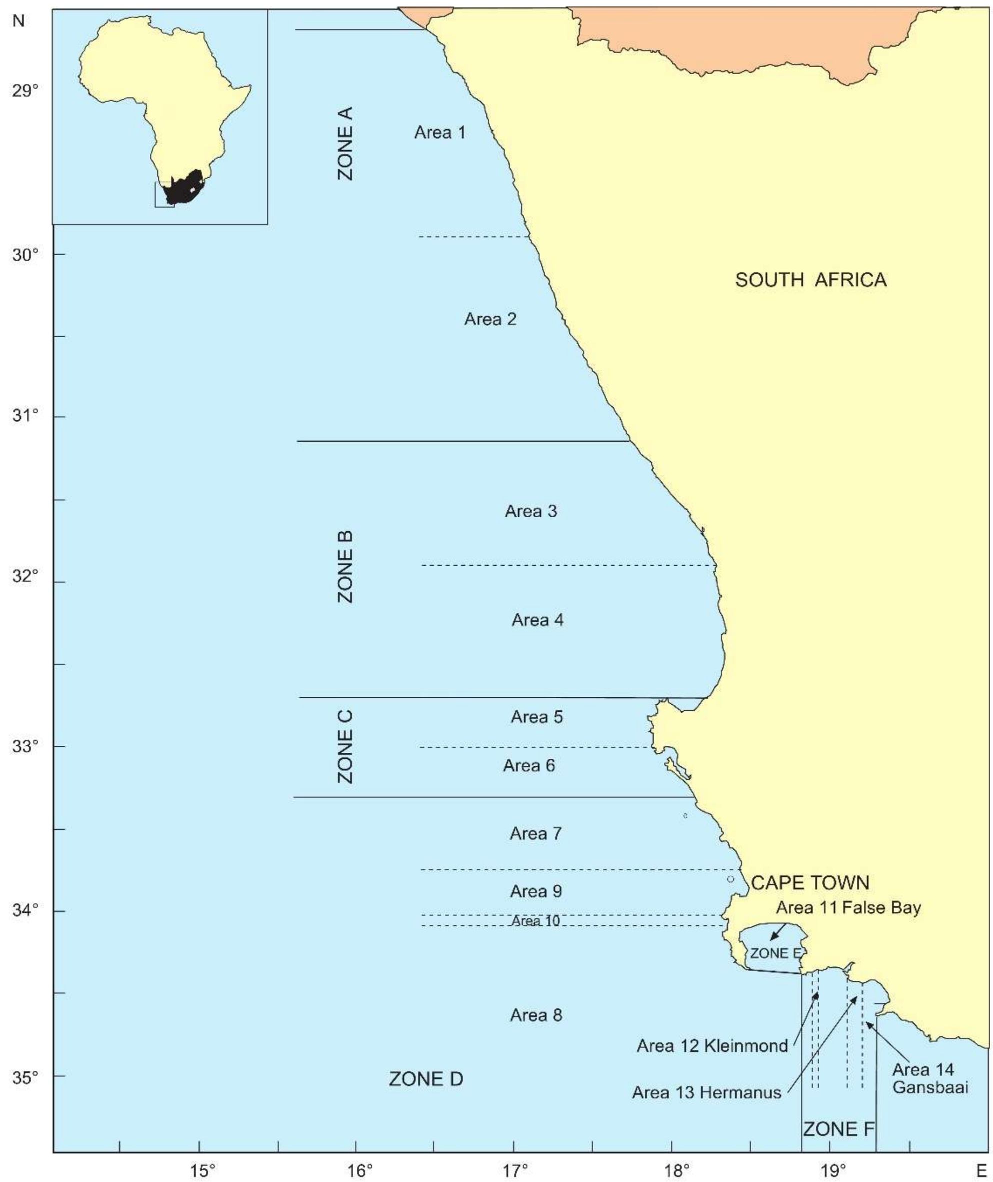


Figure 3.52: West Coast rock lobster fishing zones and areas. The five super-areas are: areas 1–2, corresponding to zone A; areas 3–4, to zone B; areas 5–6, to zone C; area 7, being the northernmost area within zone D; and area 8+, comprising area 8 of zone D as well as zones E and F.

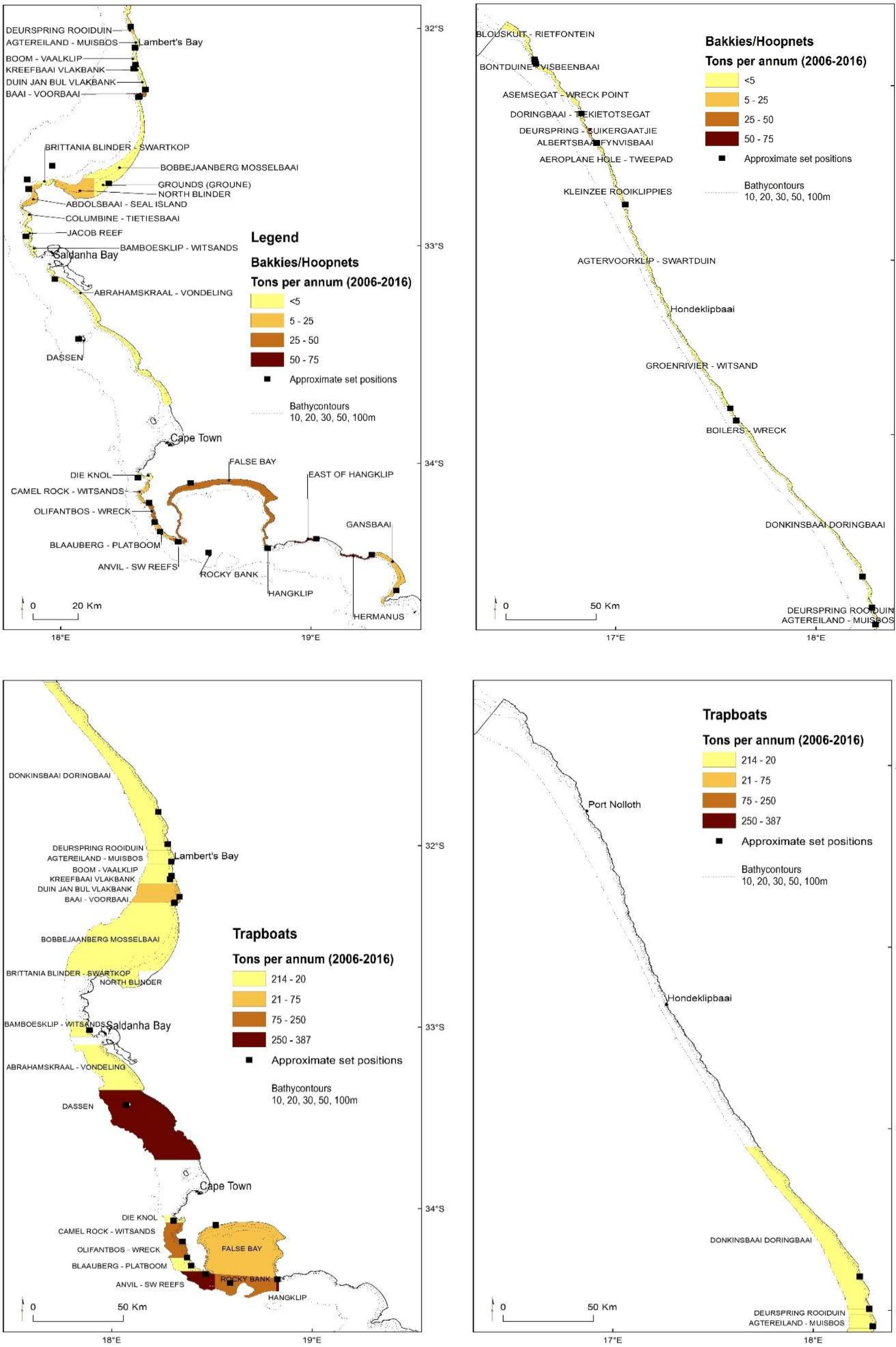


Figure 3.53: An overview of the spatial distribution of fishing effort expended by the west coast rock lobster nearshore (above) and offshore (below) sub-sectors within demarcated lobster management zones.

The licence area is situated offshore of rock lobster management zones B and A; 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 3.54).

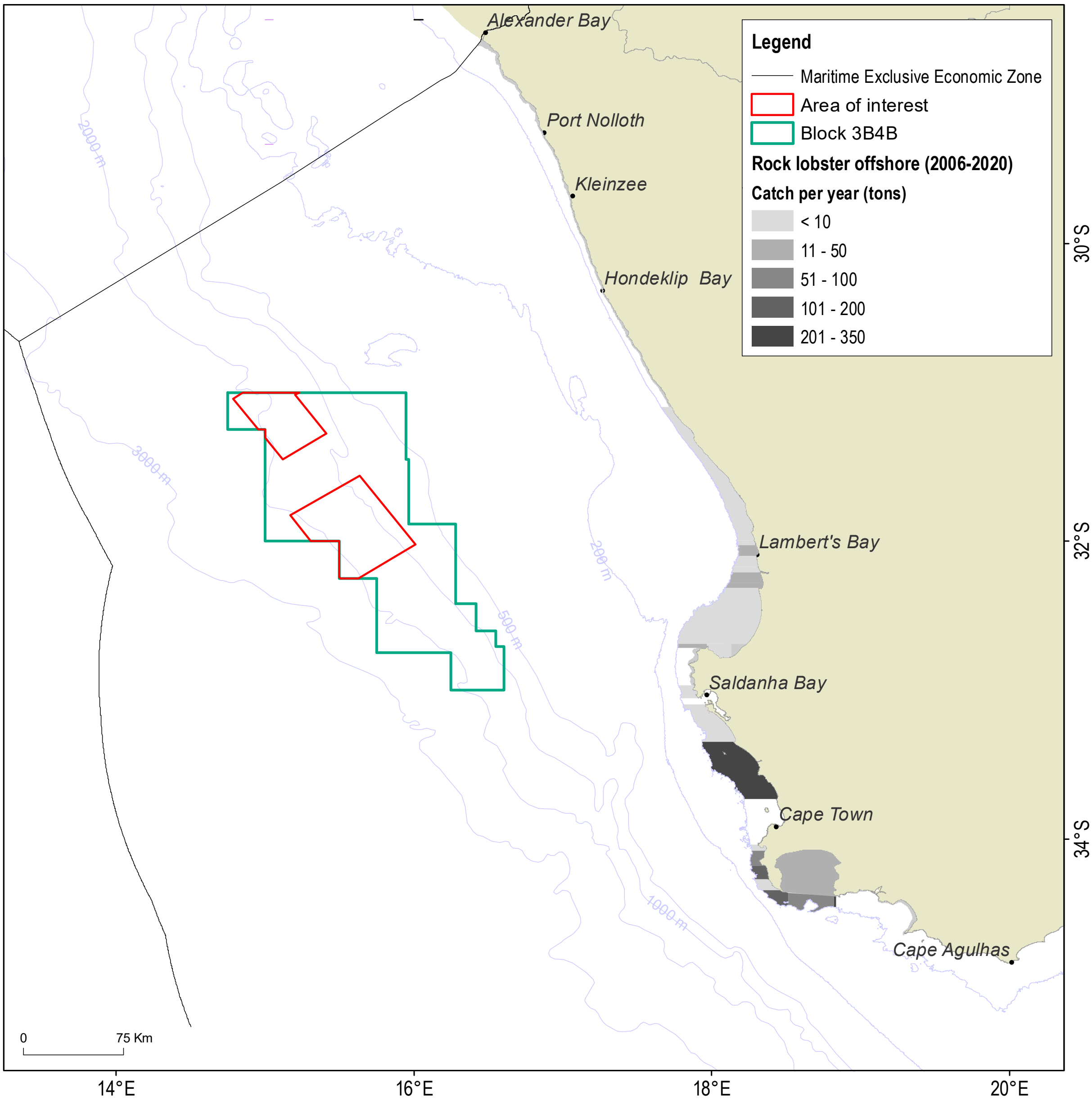


Figure 3.54: Spatial distribution of lobster catch by management sub-area over the period 2006 to 2020 (offshore/trapboat sub-sector) in relation to licence block 3B/4B (Green polygon) and area of interest for proposed drilling (Red polygon). Depth contours range from 100 m to 1000 m.

3.4.10 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 3.55), the closest of which (between Doring Bay and Lambert's Bay) is located between 280 km and 380 km to the south-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[7] 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 3.56). 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 3.57).

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 3.17 for recent (2018) monthly harvest of white mussels by area.

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

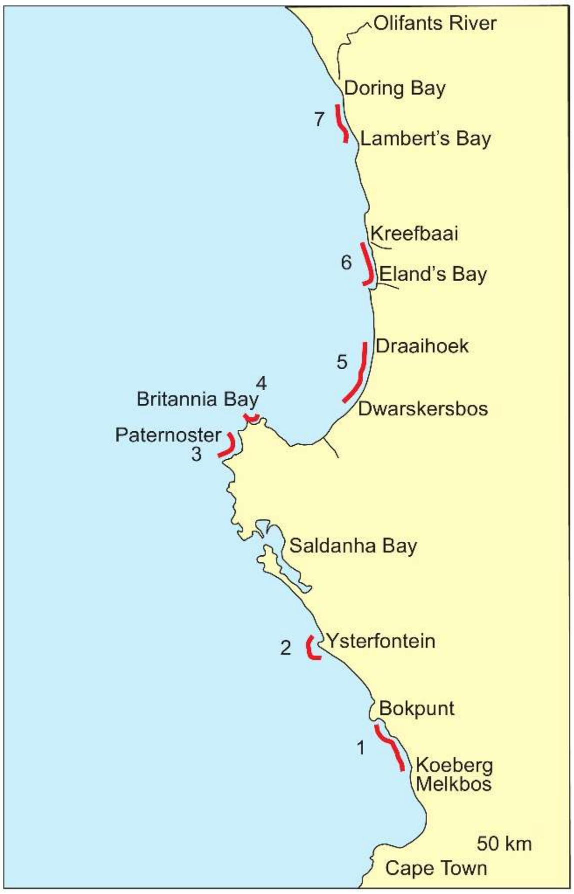


Figure 3.55: Areas allocated for commercial harvesting of white mussel, *D. serra*, along the West Coast of South Africa (DEFF, 2020).

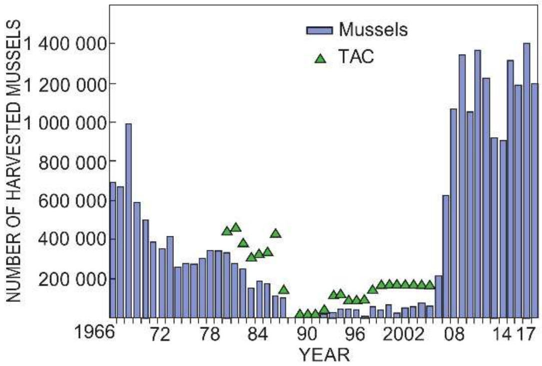


Figure 3.56: TAC and yield (total number) of white mussels harvested commercially per annum, 1966 – 2018.

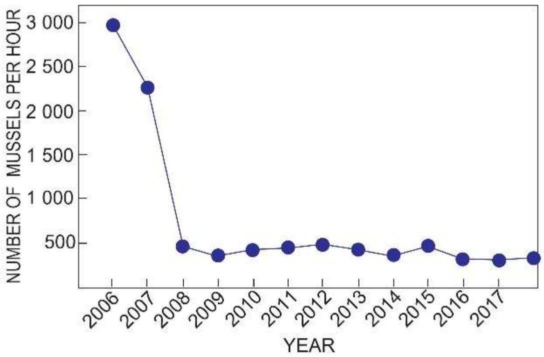


Figure 3.57: CPUE data for mussels harvested commercially from 2006 to 2018.

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

3.4.11 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 3.58 and recent landings (2013 – 2018) are listed in Table 3.18. The coastal locations of boundaries between management zones for the Southern Cape area are shown in Figure 3.59.

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.

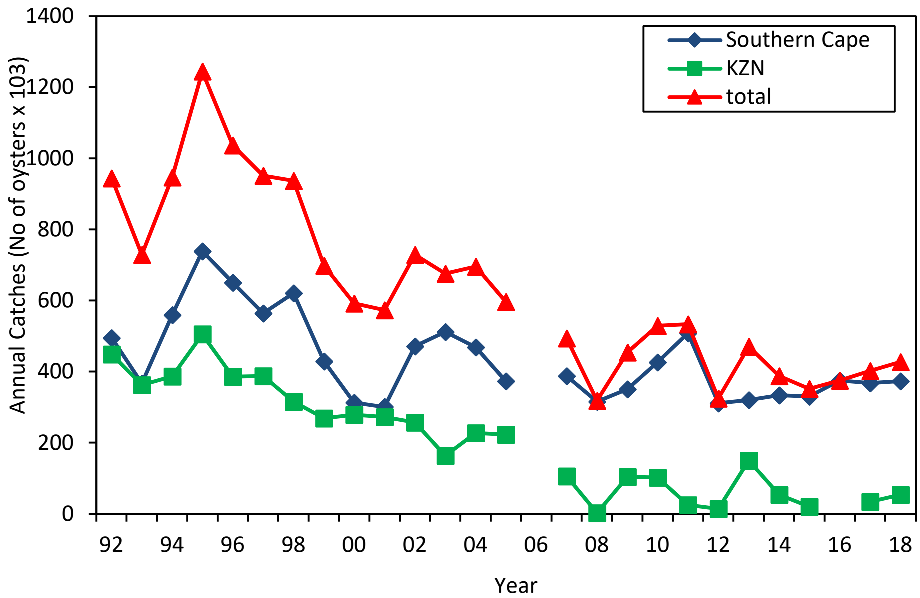


Figure 3.58: Total number of oysters (*Striostrea margaritacea; Crassostrea gigas*) harvested from the Southern Cape and KwaZulu-Natal coasts from 1992 to 2018 (DEFF, 2020).

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

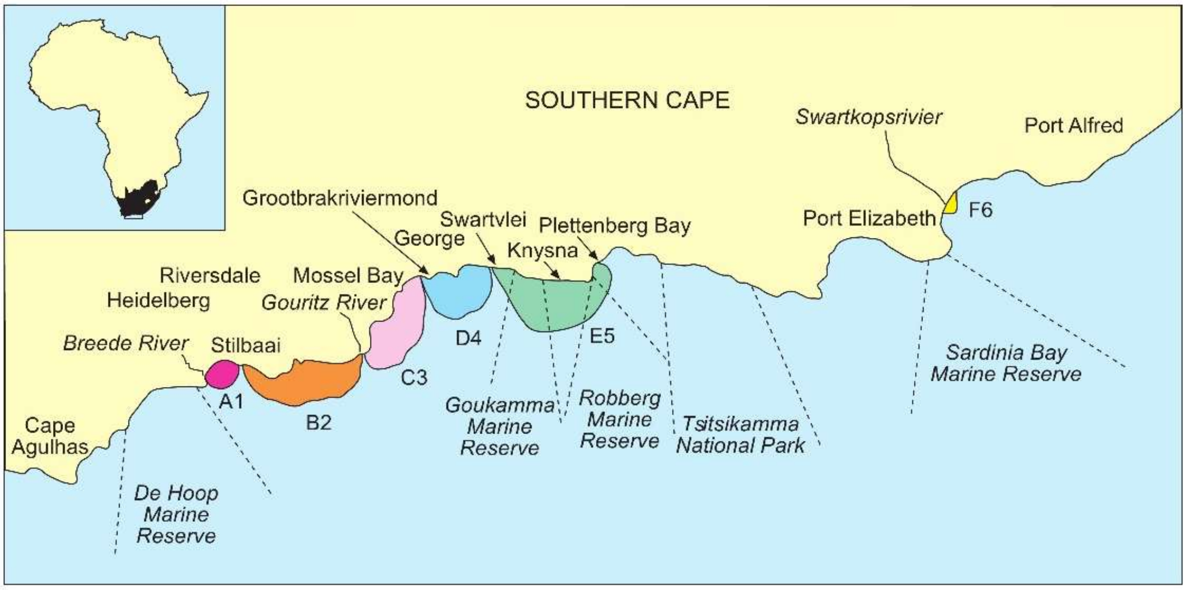


Figure 3.59: Oyster fishery in Gqeberha and the Southern Cape. Colour areas denote dedicated oyster collection zones (DEFF, 2020)

3.4.12 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[8] and continued declines in the abundance[9] 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 3.19 and Figure 3.60). Estimated weight and number of illegally-harvested abalone for the years 2000–2020 is shown in Figure 3.61.

[8] The bulk of illegally harvested abalone is transported to Asia, through channels in Hong Kong.
[9] 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.

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 3.62). Refer to Table 3.20 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 3.4.17). However, ocean-based abalone farming is also done in four designated areas in the Northern Cape. This is called ‘ranching’ (refer to section 3.4.13). 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.

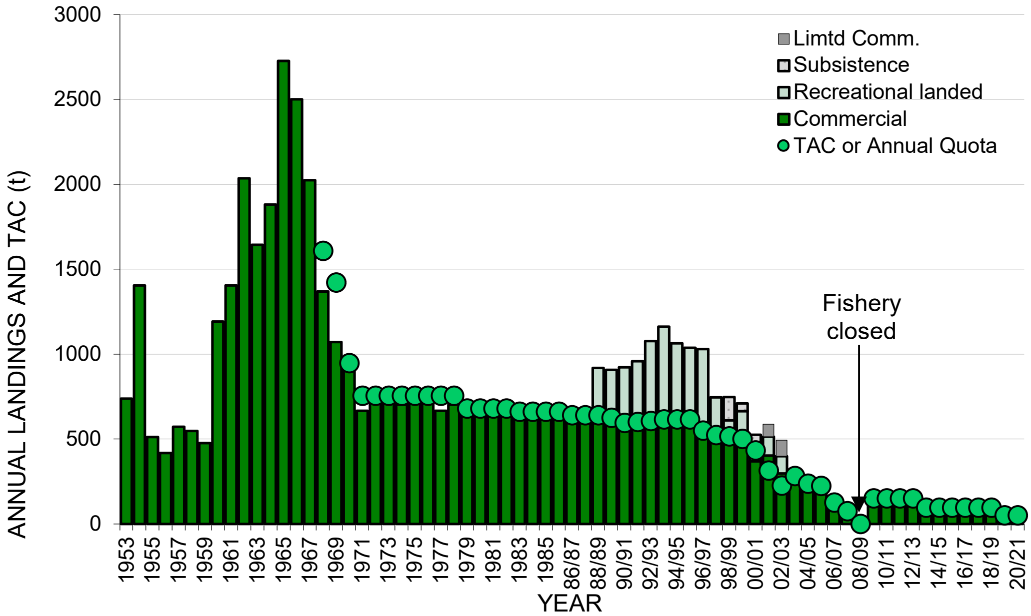


Figure 3.60: TAC and recorded (legal) annual landings for the abalone fishery from 1953 to 2020/21. Landings for the recreational sector are only available since 1988/89. Note that the substantial illegal catches are not shown.

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

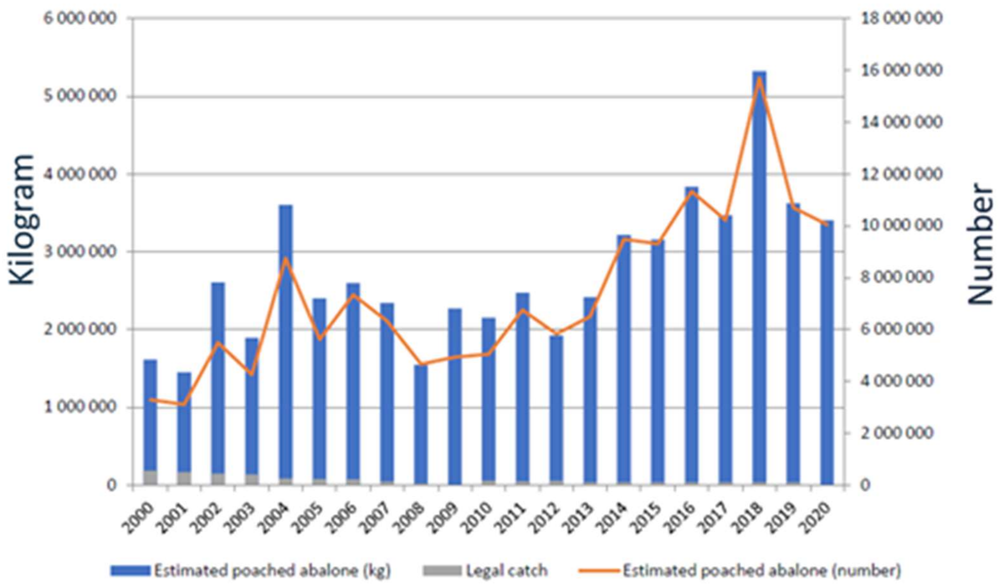


Figure 3.61: Estimated weight and number of illegally-harvested abalone based on international trade data, and recorded legal abalone catch (weight) for the years 2000–2020.

Figure 3.62: 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

3.4.13 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 AOI is situated 185 km offshore of the ranching zones (refer to Figure 3.63). The maximum depth of seeding is considered to be approximately 10 m within each of the zones.

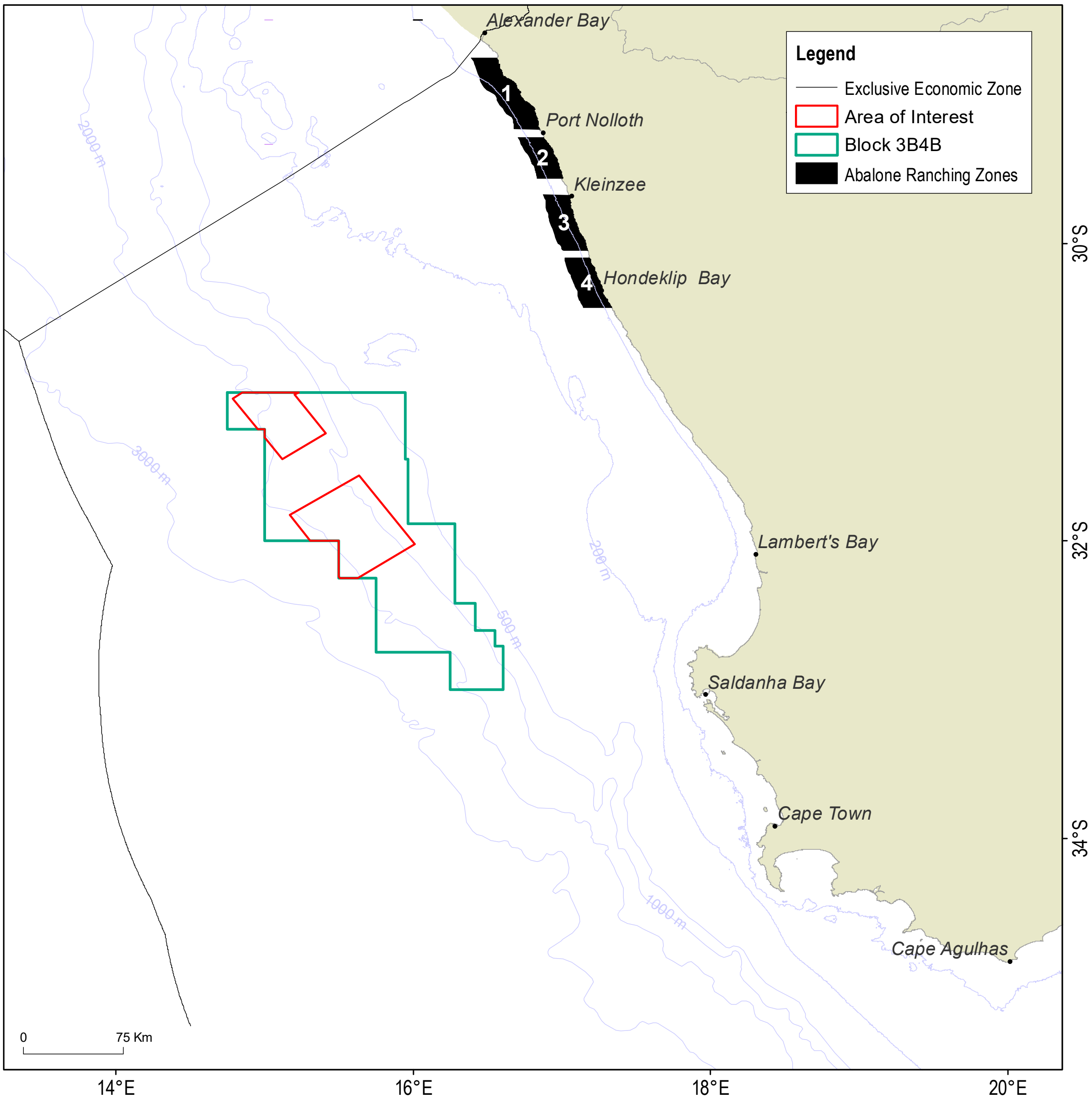


Figure 3.63: An overview of the spatial distribution of abalone ranching concession areas 1 – 4 in relation to licence block 3B/4B (Green polygon) and area of interest for proposed drilling (Red polygon).

3.4.15 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 3.21 for the number of rights issued and Figure 3.64 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

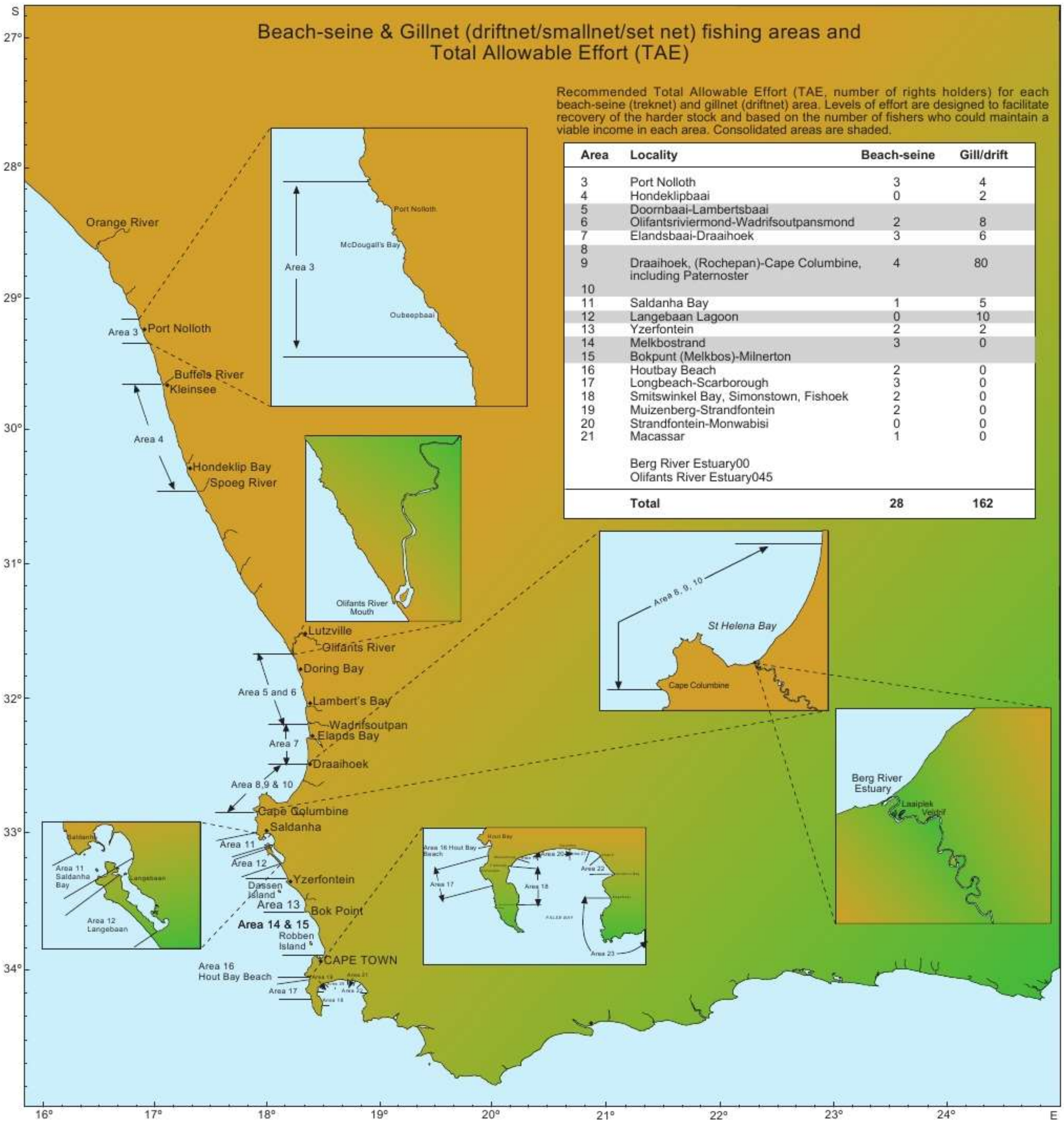


Figure 3.64: Beach-seine and gillnet fishing management areas and TAE (DAFF, 2014)

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 3.65 shows the expected range of gillnet fishing activity off the west coast of South Africa.

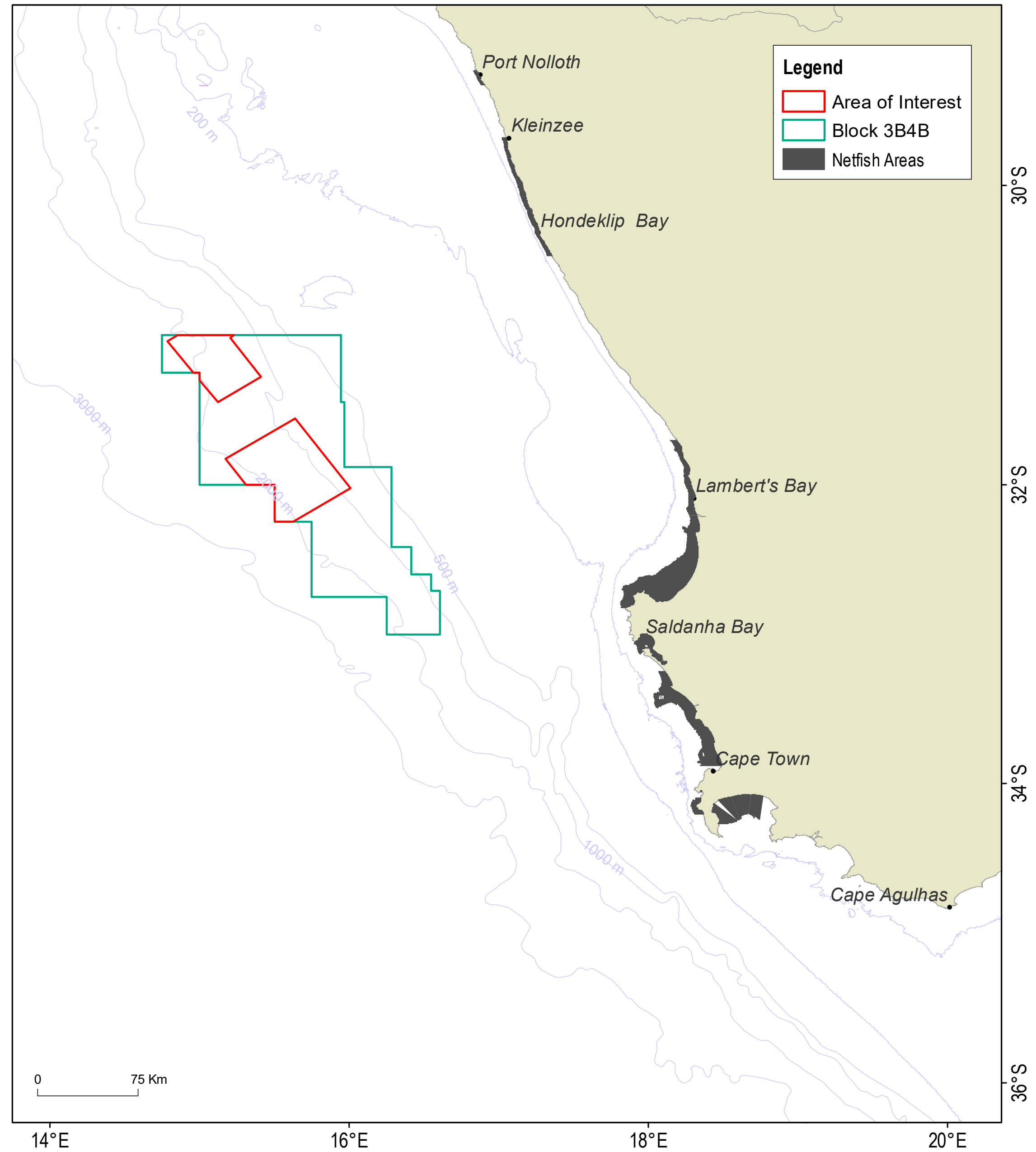


Figure 3.65: Netfish (gillnet and beach-seine) management areas (DAFF, 2016/17) in relation to licence block 3B/4B (Green polygon) and area of interest for proposed drilling (Red polygon).

3.4.16 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 3.66). Annual yields of commercial seaweeds in South Africa from 2001 to 2018 are listed in Table 3.22. Table 3.23 lists the yield of kelp by area for the 2018 season).

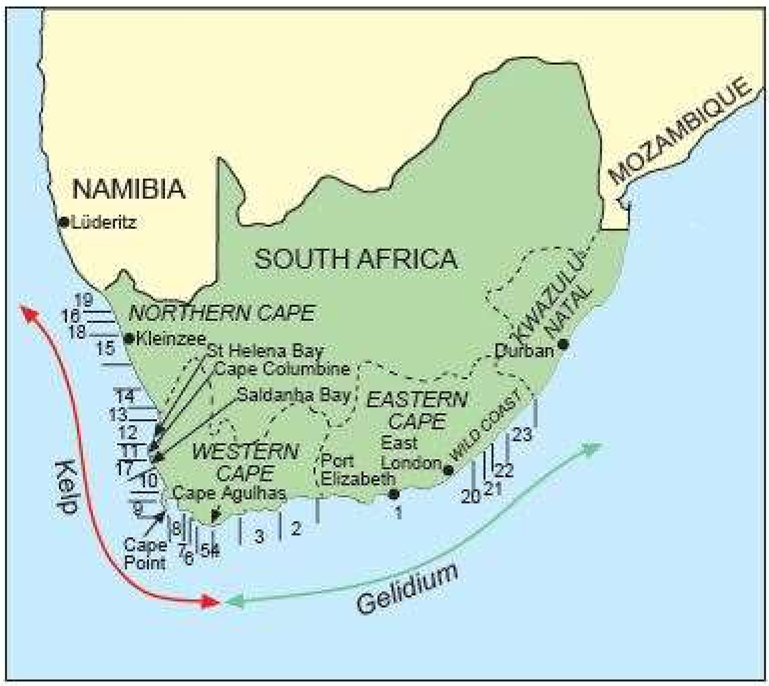


Figure 3.66: Map of seaweed rights areas in South Africa (DEFF, 2020).

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 3.67). 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 therefore do not coincide with the licence area, which lies far beyond the safe depth range at which divers could harvest kelp.

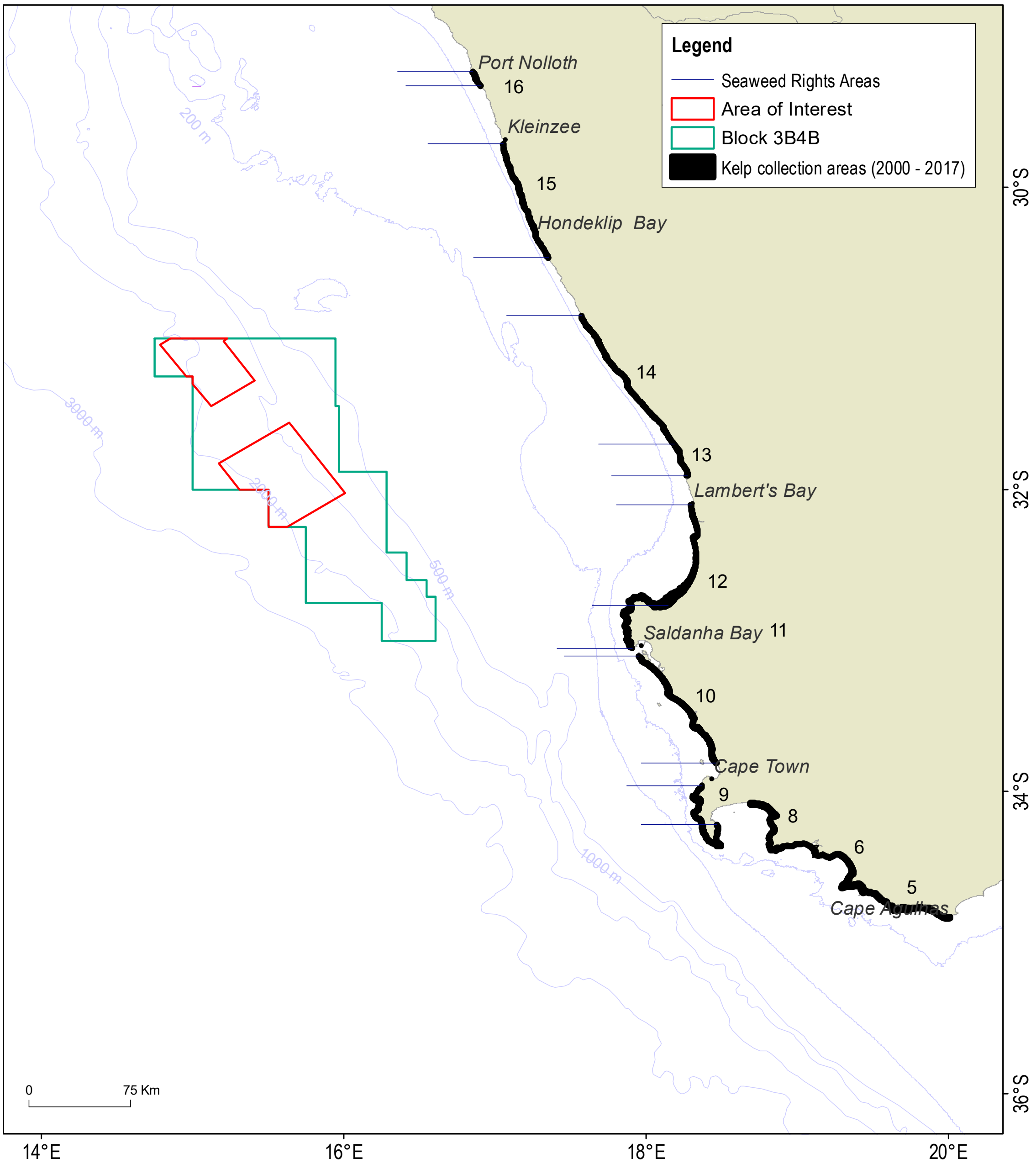


Figure 3.67: Location of seaweed rights areas (numbered) and kelp collection areas in relation to licence block 3B/4B (Green polygon) and area of interest for proposed drilling (Red polygon).

3.4.17 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 3.68). The Orange-Hondeklip Bay and Strandfontein-Lamberts Bay are the closest ADZs to the licence block.

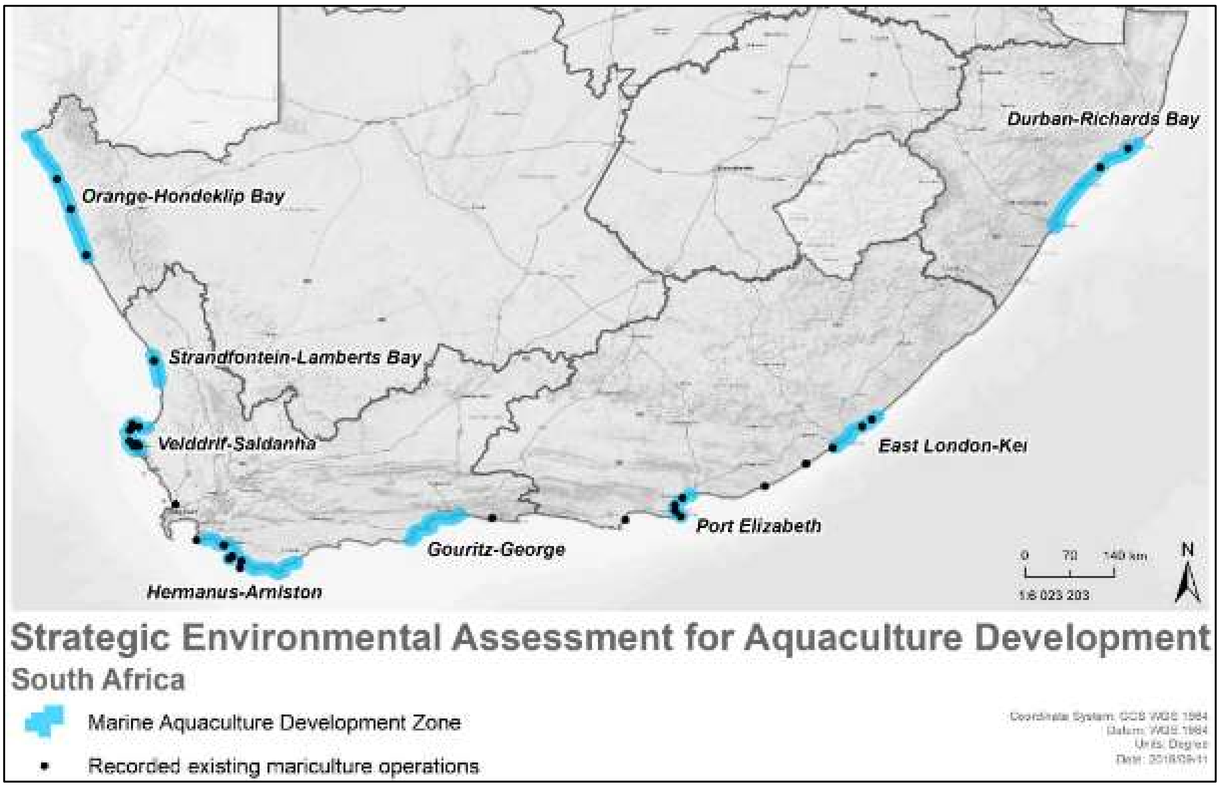


Figure 3.68: Proposed Marine Aquaculture Development Zones and existing mariculture operations.

Currently, 39 marine aquaculture farms operate in South Africa, most of them are experimental or of a small-scale commercial nature. The Western Cape is the highest provincial contributor with 71.7% of the national marine aquaculture production. 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).– Northern Cape Province contributed 4.1% (175.6 tons) to the national marine aquaculture prodection. In 2018, there were five marine farms in the province comprising four abalone and one oyster facility. Refer to Figure 3.69 for mariculture methods and Figure 3.70 for locations in South Africa.

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).

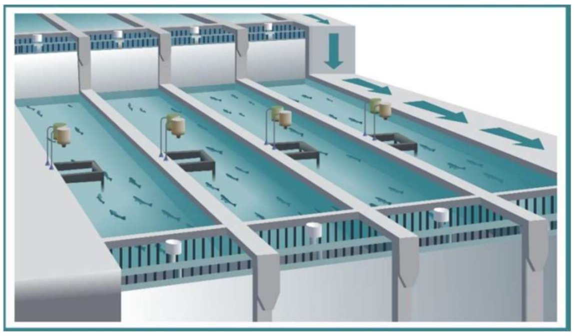
The mussel sub-sector is the highest biomass contributor to aquaculture in South Africa. The sub-sector is entirely represented by the Western Cape Province with eight longline culture operations and three raft culture operations. The species cultured in South Africa are the exotic Mediterranean mussel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

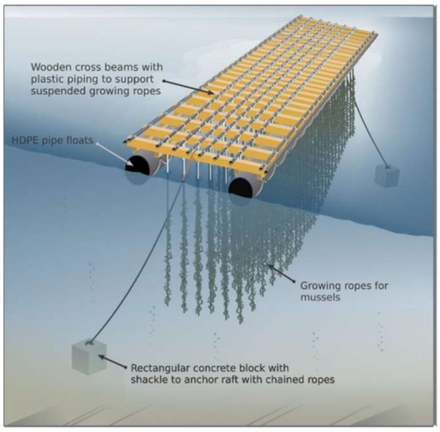
There were four Oyster farms recorded in the Western Cape, which are represented by three longline systems and one raft system. The species cultivated in South Africa is the exotic Pacific oyster (*Crassostrea gigas*) (DFFE, 2019).

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).

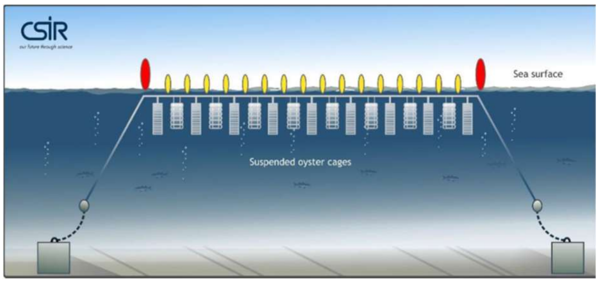
Cage culture involves the placing of cages in oceans to contain and protect the fish until they can be harvested. Finfish cage culture types include nearshore gravity net cages or pens, and open water floating, submersible and/or semi-submersible cages.



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

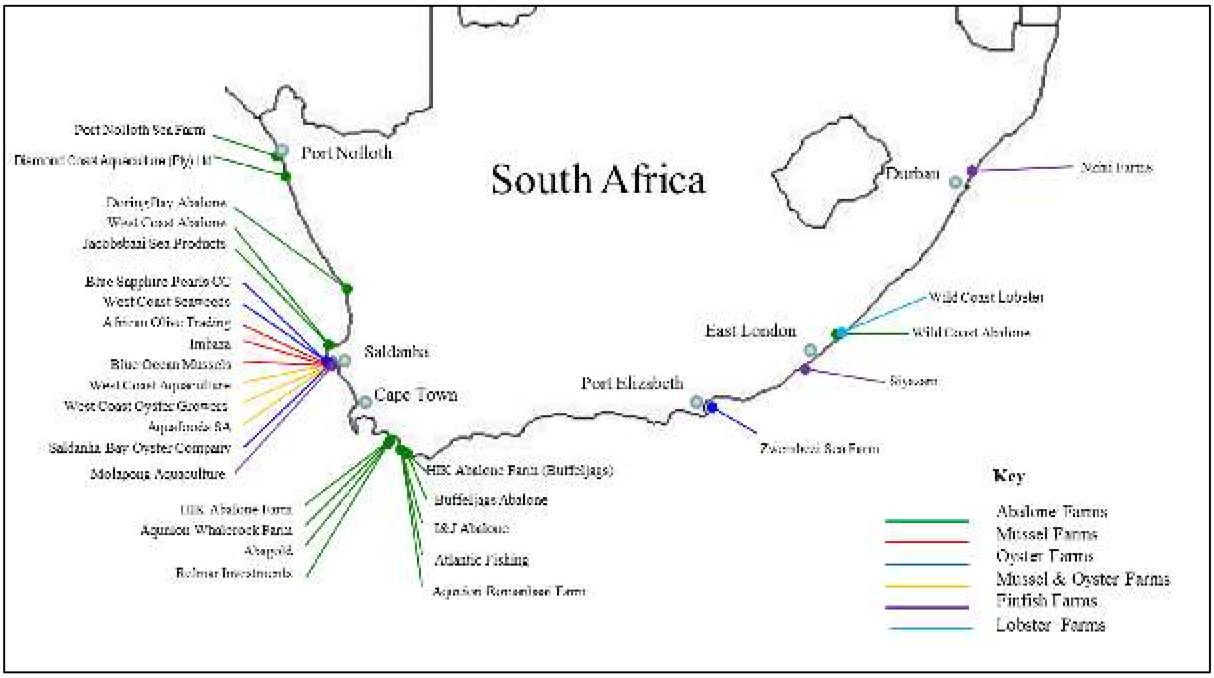


Figure 3.70: Distribution of aquaculture farms along the South African coast.

3.5 SMALL-SCALE FISHERY SECTOR

Small Scale Fishers are defined as "…persons that fish to meet food and basic livelihood needs, or are directly involved in harvesting/ processing or marketing of fish, traditionally operate on or near shore fishing grounds, predominantly employ traditional low technology or passive fishing gear, usually undertake single day fishing trips, and are engaged in the sale or barter or are involved in commercial activity" (Small-Scale Fisheries Policy, 2012).

Small scale fishers in South Africa can apply for a subsistence and small-scale fishing exemption if they reside in a coastal community and wish to utilize marine living resources. To qualify for the exemption, fishers must meet all verification criteria and apply through locally established local co-management committees. It is illegal to engage in subsistence and small-scale fishing without a permit, and currently, subsistence and small-scale fishers are managed by fishing exemptions until the finalization of the small-scale fisheries policy. The exemption is renewable annually, and before issuing exemptions, departmental staff explain exemption conditions and bag limits. Fishers should register and apply at their local co-management committee, indicate the sector or fishery they want to engage in, and sign the list to acknowledge receipt of their exemptions. The application process can take a month or longer, depending on the volume of applications. Failure to adhere to exemption conditions may result in legal proceedings, including the suspension, cancellation, or revocation of the exemption.

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 (See Figure 3.71). 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).

Figure 3.71 The University of Western Cape's PLAAS and Masifundise Development Trust organized a round table discussion on the status of small-scale fisheries in South Africa on 19 April 2018. More than 60 people, including civil society members, academics, community representatives, students, and legal practitioners, attended the event and presented their views. Image: Fishing Industry News SA

In 2013 the SSFP Implementation Plan (IP) was finalised. The IP estimated a five-year process and a total budget of R424 million. Accordingly, the Marine Living Resources Act (MLRA) had to be amended to accommodate the small-scale fishing sector. Since the Act was amended to accommodate the small-scale fishing sector, much progress has been made in rolling out the small-scale fishing sector.

Looking at the SSF sector in more detail, the majority of applicants are male, averaging 44 years in age and the majority are classified as previously disadvantaged ethnic groups. The majority of respondents in each province are mainly dependent on fishing for more than 50% of their income. Additionally, there is a large dependency on government grants (32-45%) and limited involvement in other forms of economic activity. Approximately 80% of respondents are living with an income that is under or close to the poverty line of R1 558 pm.

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[10]. 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[11].

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[12].

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

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[10] 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).

[11] 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.

[12] 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.

fishing rights[13]. 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 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. These permits are still outstanding and for now SSF operate under "exemptions".

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 3.72. 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. These fishers form part of 2 Co-Operatives.
- 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 2 741 fishers registered in the province. The number of Co-Operatives are still under review.
- 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 5 335 fishers registered in the province. These fishers form part of 72 Co-Operatives.
- KwaZulu-Natal has 2 184 registered small-scale fishers divided by district into 1) Ugu, 2) Ethekwini Metropolitan, 3) Ilembe, 4) King Shwetshayo/Uthungula, and 5) Umkhanyakude. These fishers form part of 35 Co-Operatives.

Approximately 10 000 small-scale fishers have been identified around the coast. The licence block is situated offshore of the Namakwa and West Coast municipal districts. Between Port Nolloth and Saldanha Bay, 19 communities have been registered for small-scale fishing rights, comprising a total of 842 fishers.

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[14]. 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.

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

[14] 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.

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[15], abalone, KZN beach seine, netfish (gillnet and beach-seine) (See Figure 3.80), seaweed and white mussel. An apportionment of TAE/TACs for these species will be transferred from existing commercial rights to SSF[16], whereas white mussels will become the exclusive domain of SSF. Species nominated for commercial use will be subject to TAE and/or TAC allocation. Species nominated for own use will be available to all members of a particular co-operative, but subject to output controls.

The small-scale fishery rights cover the nearshore area (defined in section 19 of the MLRA as being within close proximity of shoreline). Small-scale fishermen along the Northern Cape and Western Cape coastlines are typically involved in the traditional line, west coast rock lobster and abalone fisheries, whereas communities on the South Coast would be involved in traditional line, squid jig and oyster harvesting. The small-scale communities on the West Coast, with long family histories of subsistence fishing, prioritise the harvest of nearshore resources (using boats) over the intertidal and subtidal resources. An example of such boats is shown in Figure 3.80.

Figure 3.72: 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).

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[15] 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".

[16] 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).

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[17]. Snoek availability coincides with peaks in the availability of other small pelagic species, notably anchovy and sardine. As shown by Crawford *et al.* (1987) [18][19] snoek stay inshore on their southward migration (see Figure 3.10) (i.e. April through to June) and then move offshore into deeper waters to spawn[20] 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 (See Figure 3.80). 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 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 tuna as it is not listed in the basket of species for SSF exploitation, although they are allowed to catch up to 10 tuna per day. Based on the distance from key SSF harbours to the area of interest and on vessel clarification (with Class C to E vessels not being allowed to travel beyond 28 km from the coast[21]), tuna is caught closer to the coast by the SFF (and traditional line fish and recreational fishers) when warmer waters move closer inshore during the summer months.

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[17] 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.

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

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

[20] 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).

[21] Only Class A and B vessels can travel beyond 28 km from the coast. These are larger vessels that must be certified by the South African Maritime Safety Authority). SSF vessels are more likely to be Class C to E.

Figure 3.73 Top: West Coast Rock Lobster Fishers row out to sea in their small wooden boat, Paternoster, Western Cape, South Africa. Bottom: Trek-net fishers launching their small wooden rowing boat into the sea, Strandfontein beach, False Bay. Images Peter Chadwick, African Conservation Photographer.

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[22] 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 vessels up to 40 nm offshore and are longer than 9 m) are likely limited to "C" class being mainly vessels of <9 m[23] permitted to only operate < 15 nm offshore. It should also be noted that the area of interest does not overlap with the traditional line fish (which also targets snoek and tuna) and small pelagic purse-seine (which targets sardine and anchovy) fishing grounds. Based on the above, there is no anticipated overlap with the SSF.

[22] 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.

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

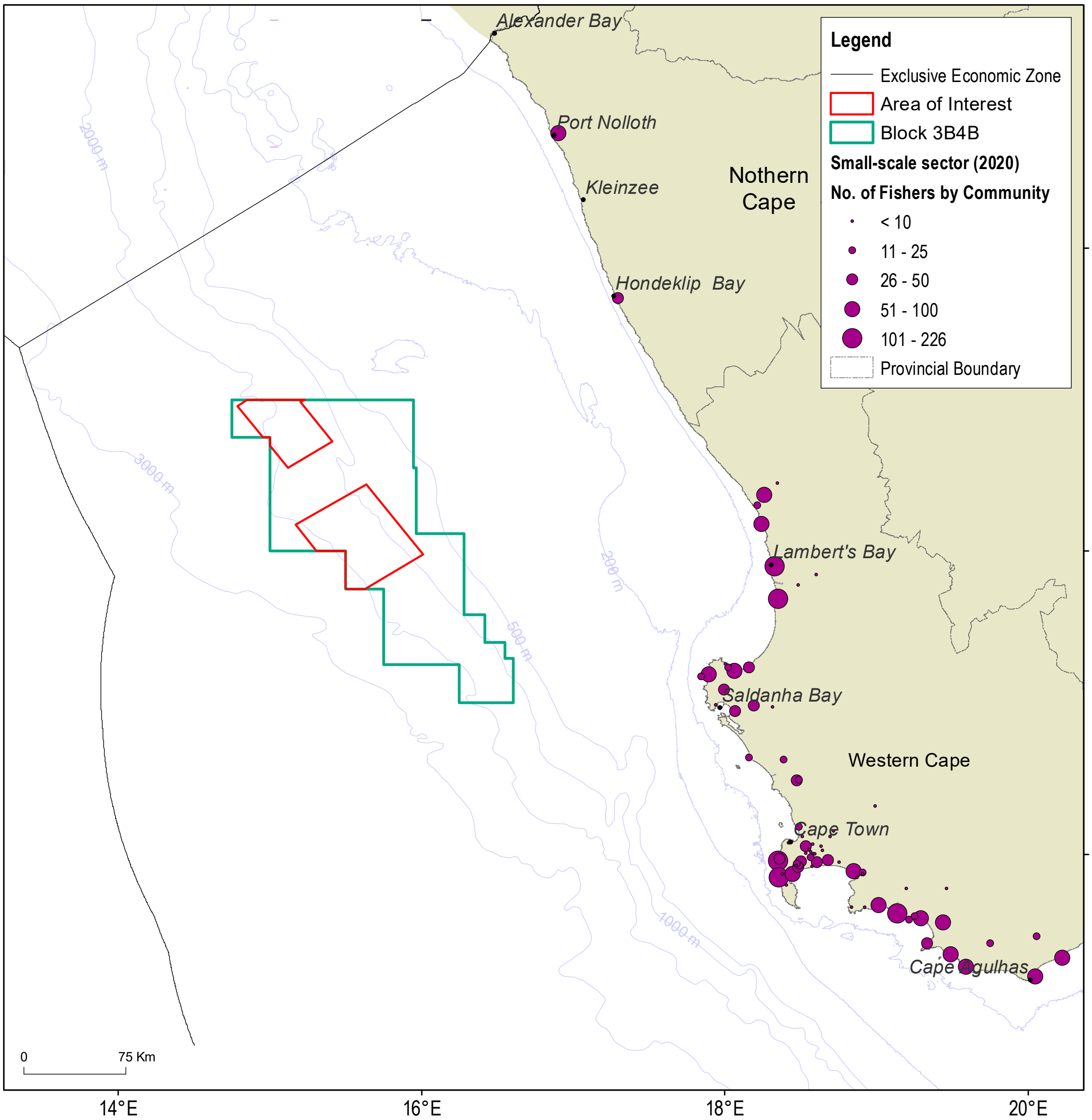

Figure 3.74: Licence block 3B/4B (Green polygon) and area of interest for proposed drilling (Red polygon) in relation to the spatial distribution of small-scale fishing communities and number of participants per community along the west coast of South Africa.

3.6 RECREATIONAL FISHING

Recreational fishing is a non-commercial fishery in South Africa that is regulated by individual permits obtained by the public. It is estimated to have the largest number of participants of all fishery sectors in South Africa, with over 450,000 participants (DFFE, 2020). In 1996, it was estimated that there were 500,000 recreational fishers in the country (McGrath et al., 1997), but a more recent study by Leibold and van Zyl (2008) estimated that there were 900 000 participants in 2007.

Recreational fishing is a valuable industry in South Africa, with the tourism infrastructure, boats, vehicles, tackle, and bait making it an important economic contributor, estimated to be more than R9 billion per annum (DFFE, 2020). 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 their own use only and not for the purpose of selling or trading fish. The fishery is managed by several output restrictions, such as size and bag limits, closed areas, and seasons. These restrictions are in place to ensure the sustainability of fish stocks and to minimize the impact on the marine ecosystem. Less than 6% of anglers are affiliated to angling clubs and organizations (Mann et al., 2013; See Figure 3.75), which suggests that the majority of recreational fishers operate independently. This could pose a challenge for monitoring and regulating the recreational fishery, as it may be difficult to ensure compliance with regulations and to collect accurate data on catches and effort.

Figure 3.75 Recreational anglers affiliated with South African Shore Angling Association (SASSA) competing in the Senior A Nationals (Photograph courtesy of Vivienne Dames).

Overall, recreational fishing is an important and valuable industry in South Africa, with a large number of participants and significant economic impact. However, effective management and regulation are crucial to ensure the sustainability of fish stocks and the marine ecosystem, as well as to maintain the economic benefits of recreational fishing in the long term.

Landings and operational effort from this open-access recreational fishery are not reported nor recorded throughout the region. Recreational fishing is extensive around the coast of South Africa and comprises 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 5 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 to the area of interest for proposed exploration drilling.

Category A and B certified recreational vessels as well as fishing charter operation vessels[24] targeting offshore pelagic species (tuna, dorado, marlin, etc.) with rod-and-reel are known to focus their effort on the North-eastern boundary between Cape Canyon offshore of Saldanha Bay and Hope Canyon due South of Cape Point. These anglers are unlikely to fish in the area of interest for proposed drilling as they seldom fish offshore of the 1 000 m depth contour. These vessels fish seasonally in the above-mentioned areas with the majority of their effort taking place between October and May.

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 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.

Considering that the Licence Block is situated offshore of the continental shelf in water depths exceeding 500 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 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.

[24] There are currently no regulations or permits for charter operators in the recreational fishing sector. Vessels used for charter operations have to operate under a SAMSA commercial call sign and complete annual Local General Safety Certificates through SAMSA. Anglers running these commercial charter operations do so under the recreational angling permit (MLRA).

Table 3.22: Summary table showing seasonal variation in fishing effort expended by fisheries sectors operating in the South African EEZ West of 20° 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	Improbable	0	0	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	Improbable	0	0	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	~4%	~4%	M	M	M	M	H	H	H	H	H	H	H	M
Tuna Pole-Line	Albacore, snoek	Improbable	0	0	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
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	Improbable	0	0	M	M	N	N	M	M	N	N	M	M	N	N
Pelagic Research Survey	Small pelagic species	Improbable	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

AOSAC proposes to drill up to five exploration wells within the Area of Interest. Drilling is expected to take up to three to four months to complete the physical drilling and testing of each well. Well plugging and abandonment is expected to take up to 15 days, and demobilisation a further 10 days. 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 remove the wellheads from the seafloor on non-productive wells. On productive wells, it may be decided to abandon the wellheads on the seafloor after installation of over trawlable protective equipment[25]. The risk assessment criteria will consider factors such as the water depth and use of the area by other sectors e.g. fishing. Monitoring gauges to monitor pressure and temperature through wireless communication may be installed on wells where AOSAC will return in the future for appraisal / production purposes. Monitoring gauges will not be installed on exploration wells which are earmarked for abandonment. A final clearance survey check will be undertaken using an ROV, after which the drilling unit and supply vessels will demobilise from the offshore licence area.

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[26].

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

[25] The dimensions of the cap are estimated to measure approximately 5.2 m x 5.2 m, with a height of 4.4 m.
[26] The location of abandoned and suspended wellheads is listed by SANHO in the annual summary of South African Notices to Mariners.

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).

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 **large pelagic longline sector is the only fishery that operates 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**[27].

Impact Magnitude (or Consequence)

The duration of the impact is considered to be short-term (up to **3-4 months for drilling**). A safety zone of 500 m would be enforced around the drilling unit, resulting in an exclusion area of 0.79 km^2 (**site**). 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[28]. 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 2.75% (74 tons) and 2.74% (49 lines), respectively, of the total catch and effort reported by the sector on a national scale. The **intensity** of the impact, based on the catch and effort within the area of impact is considered to be **low**.

[27] 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.

[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.

Thus, the impact **magnitude** (or consequence) is considered to be **very low**. The proposed area of interest for drilling does not overlap with the fishing grounds of the demersal trawl, midwater trawl, hake- and shark-demersal longline, small pelagic purse-seine, tuna pole-line, linefish, west coast rock lobster, south coast rock lobster, squid jig or small-scale fisheries. Thus the presence of the drilling unit will not result in an impact on these sectors.

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**.

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. The residual impact significance will remain **LOW** for the large pelagic longline sector (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	**HIGH** Large pelagic longline
Magnitude (or Consequence)	**VERY LOW**	**VERY LOW**
Intensity	**LOW**	**VERY LOW**
Extent	**Site**	**Site**
Duration	**Short Term**	**Short Term**
Significance	**LOW** Large pelagic longline	**LOW** Large pelagic longline
Probability	**Probable** Large pelagic longline	**Probable** Large pelagic longline
Confidence	**High**	**High**
Reversibility	**Fully Reversible**	**Fully Reversible**
Loss of Resources	**Low**	**Low**
Mitigation Potential	**Very Low**	**Very 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 would pose an obstruction to any sector that drags a net along the seabed or anchors at the seabed. Thus, the demersal trawl fishery could be affected if the 500 m safety exclusion zone around a wellhead coincides with trawl ground as this could result in a potential loss of catch (direct negative impact). Note that the demersal long-line sector, which also sets its gear on the seafloor, would not be affected by well abandonment as this sector is permitted to set lines over an abandoned wellhead. This sector is not considered further here.

Project Controls

Surveys will be conducted to accurately chart wellheads with the South African Navy Hydrographic Office (SANHO).

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. The demersal trawl sector would lift nets to avoid 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)

Since the abandoned wellheads would present a permanent obstruction to the demersal trawl sector, the impact would persist beyond the temporary drilling operation (**permanent**). Figure 3.20 shows the demersal trawling effort in relation to Block 3B/4B and Area of Interest (AOI) for proposed exploration drilling area. The AOI does not overlap the spatial extend of demersal trawling ground. At its closest location, the trawl footprint is situated 5 km from the AOI and a 500 m safety zone around the drilling unit would therefore not coincide with trawl ground nor present an exclusion to fishing operations or loss of access to fishing ground. There is no impact expected on the sector.

Impact Significance

The presence of the abandoned wellhead(s) within the area of interest for well-drilling does not coincide with demersal trawling ground and there is therefore **NO IMPACT** expected on the sector. The alternative of removing the wellhead(s) after decommissioning is considered unnecessary (**NO IMPACT**).

Mitigation

Table 4.3 lists the proposed mitigation measures to mitigate the impact of permanent exclusion around decommissioned wellheads.

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

Mitigation measure		
1	Abandoned wellhead locations must be surveyed and accurately charted with the South African Navy Hydrographer (SANHO).	Abate

Residual Impact

There is no impact expected on the fishing industry (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
Significance	**NO IMPACT**	**NO IMPACT**

4.2 DISCHARGE OF DRILL CUTTINGS

Source of Impact

The project activities that will result in impacts to benthic biota as a consequence of sediment disturbance and smothering by accumulation of cement, drill cuttings and drilling fluids are listed below.

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

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, as per Table 1.3. In addition to the cuttings, WBM will be discharged onto the seafloor over a period of 2.5 days (60 hrs in 2 batches plus lagtime between operations), as per Table 1.3. 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 would occur over a period of a few hours.
- 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 (50 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 NADF) are lifted up the marine riser to the drilling unit and 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. Cuttings released from the drilling unit would be dispersed more widely around the drill site by prevailing currents. Cuttings and mud released during the risered stage would be discharged over a period of ~45 days (1 080 hrs in 3 batches plus lagtime between operations).
- 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.

Potential Impact Description

The cuttings discharged at the seabed during the riserless drilling stage typically create a cone close to the wellbore, thinning outwards. The spatial extent of the cuttings pile depends on the volume of cuttings discharged and the local hydrodynamic regime: in areas with strong currents, the cuttings piles often have an elliptical footprint with the long axis of the ellipse aligned with the predominant current direction (Breuer *et al.* 2004).

The discharge of cuttings and WBM onto the seabed from the top-hole section of the well and the discharge of treated cuttings with NADF from the drill rig during the risered drilling stage would have both direct and indirect effects on benthic communities in the vicinity of the wellhead and within the fall-out footprint of the cuttings plume discharged from the drill rig. These impacts on marine fauna have been assessed in the marine ecology specialist assessment (Pisces 2023). Ecological impacts in response to cuttings disposal are typically characterised by reduced species diversity, enrichment of opportunistic and/or pollution-tolerant fauna and a loss of more sensitive species (Ellis et al. 2012; Paine et al. 2014).

The cuttings and WBMs from the top-hole sections of the well are discharged onto the seafloor at the wellbore where they would accumulate in a conical cuttings pile around the wellbore thereby smothering or crushing invertebrate benthic communities living on the seabed or within the sediments. Cuttings and associated NADF drilling muds discharged from the drill rig would disperse and settle over a wider area around the wellhead resulting in changes in sediment structure and community composition within the fall-out footprint of the cuttings plume.

The discharge of residual cement during cementing of the first string (surface casing) and plugging of the well on demobilisation would result in accumulation of cement on the seabed and on the cuttings pile, respectively. Any benthic biota present on the seabed may potentially be smothered by the residual cement or suffer indirect toxicity and bioaccumulation effects due to leaching of potentially toxic cement additives.

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 survey(s), the well(s) will specifically be sited to avoid sensitive or potentially vulnerable hardground habitats 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 <6.9% 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 188 km offshore where the Southeast Atlantic Unclassified Slopes habitat has been rated as of ‘Least

Threatened' due to the expansive areas they occupy. The overall sensitivity of these receptors is considered LOW. In contrast, the benthos of deep-water hard substrata are typically vulnerable to disturbance due to their long generation times. No canyons, valleys or hard grounds have been reported for the Area of Interest for drilling, with the closest being Child's Bank located ~75 km east of the eastern point of the Area of Interest for drilling (refer to Pulfrich, 2023). 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.

<u>Impact Magnitude (or Consequence)</u>

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 2023a). The modelling considered five potential locations within the area of interest for well-drilling. The locations were selected to cover the area of interest based on distance to coast, proximity to marine protected areas and critical biodiversity areas that might be impacted by drilling discharges, as well as metocean conditions with the intention that the selected location represented the worst-case scenario (i.e. presented the worst risk to the environment). One location (Discharge Point "D") was retained as the worst-case location and this location was modelled across four alternative seasons. Discharge Point "D" was situated at 32°07´33.38"S; 15°42´19.51"E, approximately 215 km from the coastline at a water depth of 1499 m.

<u>Cuttings Dispersion Modelling:</u>

The results of the cuttings dispersion modelling studies undertaken as part of this project (HES Expertise Services 2023) largely confirm the reports of international studies that predicted that the effects of discharged cuttings are localised (see Perry 2005). Two scenarios were modelled namely 1) using WMBs only at release point D and 2) using NADFs for the deeper well sections for release point A and D. For the current project and assuming drilling using high performance WBMs only, 278 m^3 of cuttings would be generated, of which 116 m^3 would be discharged directly at the seafloor (42% of the total volume of cuttings generated), with the remaining 162 m^3 discharged off the drill unit into the water column, after treatment to reduce oil content to <6.9% Oil on Cutting (OOC). In addition, approximately 374 tons of WBM (riserless: 344 m^3; displacement: 30 m^3) will be discharged onto the seafloor at the wellbore with an additional 444 tons of high-performance KCl/glycol mud discharged from the drilling unit. These discharges are pulsed throughout the drilling campaign (Base case: 60 days), reflecting the five periods corresponding to the different wellbore diameters. A single worst case scenario discharge location (Discharge point D) was modelled across four quarters; Q1: January – March; Q2: April – June; Q3: July – September and Q4: October – December.

For scenario 2 using NADFs during the risered sections at release point A, 1 876 tons of cuttings would be generated, of which 1 039 tons would be discharged directly at the seafloor (55% of the total volume of cuttings generated), with the remaining 837 tons discharged off the drill unit, after treatment to reduce oil content to <6.9% Oil On Cutting, into the water column. In addition, approximately 879 tons of WBM will be discharged onto the seafloor at the wellbore during riserless drilling with an additional 116 tons of NADFs discharged from the drilling unit. These discharges are pulsed throughout the drilling campaign (Base case: 60 days), reflecting the five periods corresponding to the different wellbore diameters. Four quarters were modelled for a single discharge location (Discharge point A).

The cuttings discharged at the seabed during the riserless drilling stage typically create a cone close to the wellbore, thinning outwards. The spatial extent of the cuttings pile depends on the volume of cuttings discharged and the local hydrodynamic regime: in areas with strong currents, the cuttings piles often have an elliptical footprint with the long axis of the ellipse aligned with the predominant current direction (Breuer *et al.* 2004).

<u>Environmental Risk due to Physical Smothering:</u>

Thickness Deposits

- For the current project the cuttings mound at the end of drilling operations modelled at discharge Point D (i.e. at the end of both the riserless and risered drilling stages) will result in a depositional area around the wellbore progressively thinning out in a NW to SE direction. The distance reached varies from 160 m (Q1, Q4) to 165 m (Q3) to a maximum of 175 m (Q2) – see Figure 4.1 and Figure 4.2. The maximum thickness deposit located at the discharge point, shows a slight decrease one year after the operations, becoming insignificant (< 6.5mm) 5 years after the operations for all the Quarters. For discharge Point A, maximum cumulative thickness values of between 65.2 mm and 69.2 mm are predicted around the wellbore, progressively thinning out in a NW to SE direction to 0.5 mm at a maximum distance of 259 m from the discharge point (Q4) (Figure 4.2). The thickness deposit 10 years after the operations is still ~30 mm, which exceeds the 6.5 mm threshold value.
- Most of the deposit is attributable to the riserless discharges at the seabed from drilling of the top hole sections (36″ and 26″), remaining close to the discharge points due to the low current speeds at the seabed. For the other sections (17 ½'', 12 ¼" and 8 ½") discharged at the sea surface, the cuttings are spread in the water column towards N by stronger surface currents, leading to lower thickness at the seabed.
- The cuttings deposit thickness does not show significant 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 environmental risks[29] associated with the riserless drilling stage are primarily physical, induced by the thickness deposit at the modelled discharge and contributing a maximum of 65% to the risk factor (Q2) at the modelled discharge point D. For discharge point A, the environmental risk of changes in grain size and thickness deposit together contribute a,10% of the total risk.
- At discharge point A, oxygen depletion in the sediment in response to physical and chemical impacts is responsible for ~15% to the total risk.

[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.

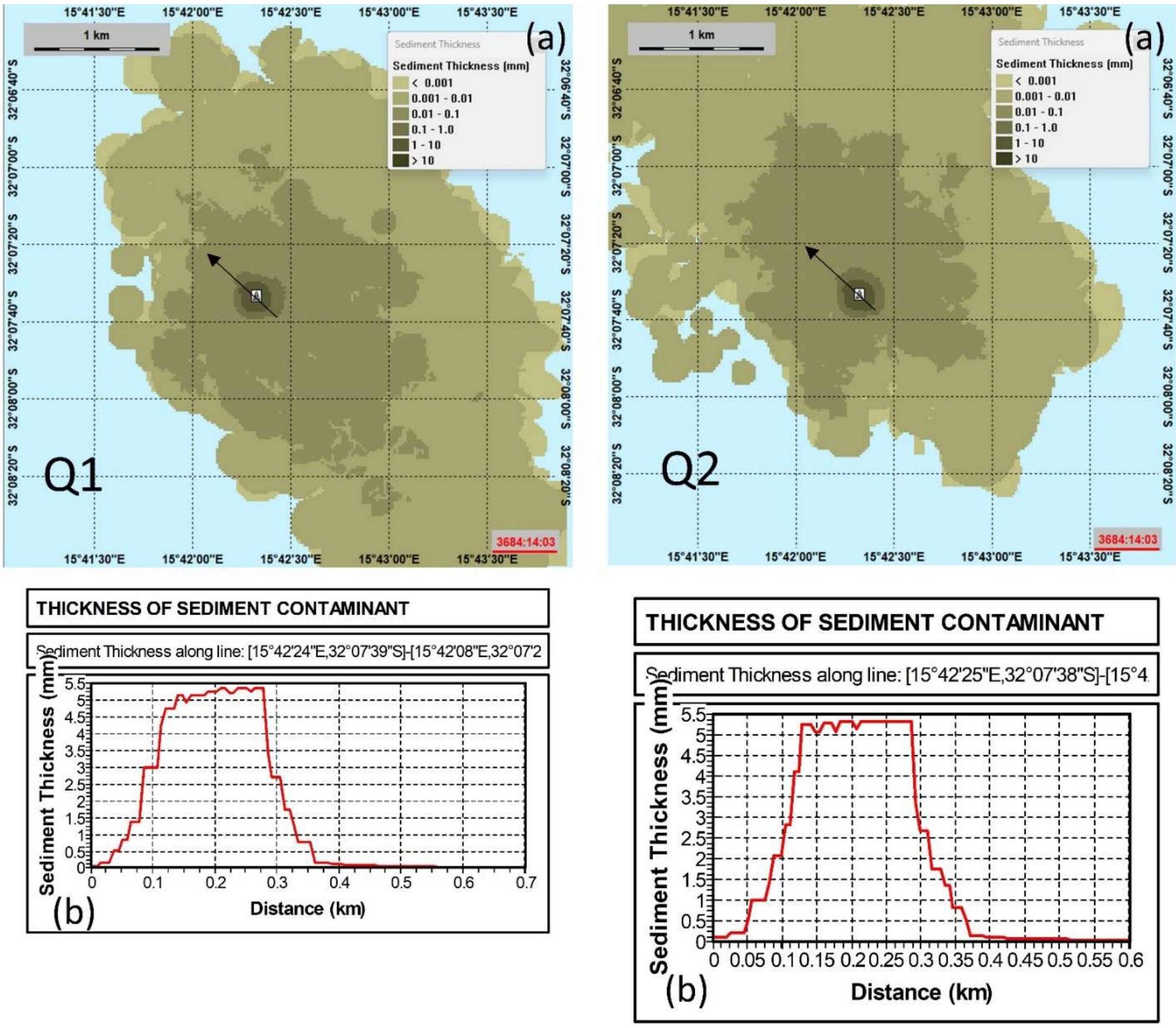

Figure 4.1: **Maximum thickness deposit on the seabed for Quarters 1 and 2, 10 years after operations for discharge point D (Source Livas 2023a).**

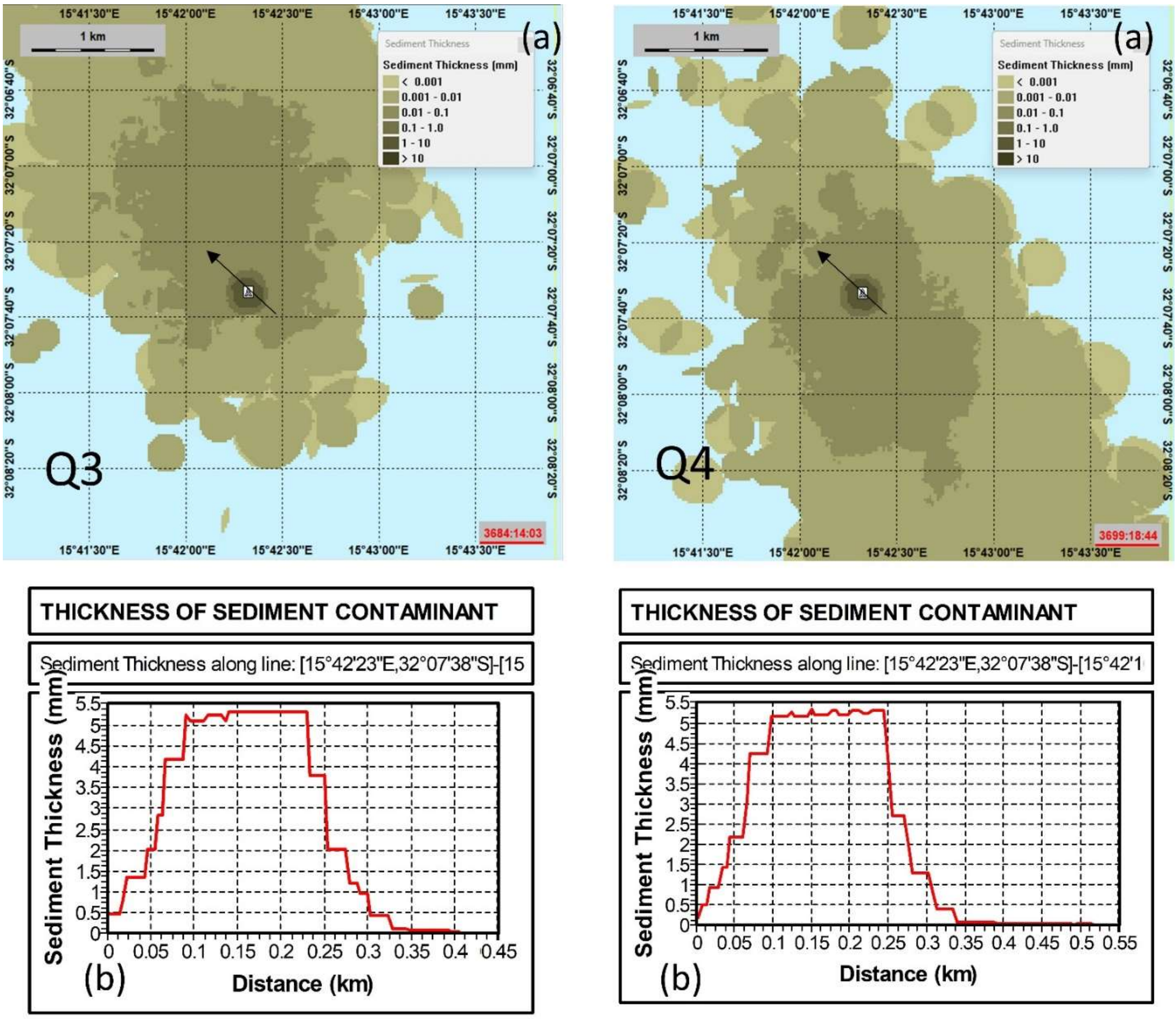

Figure 4.2: **Maximum thickness deposit on the seabed for Quarters 3 and 4, 10 years after operations for discharge point D (Source Livas 2023a).**

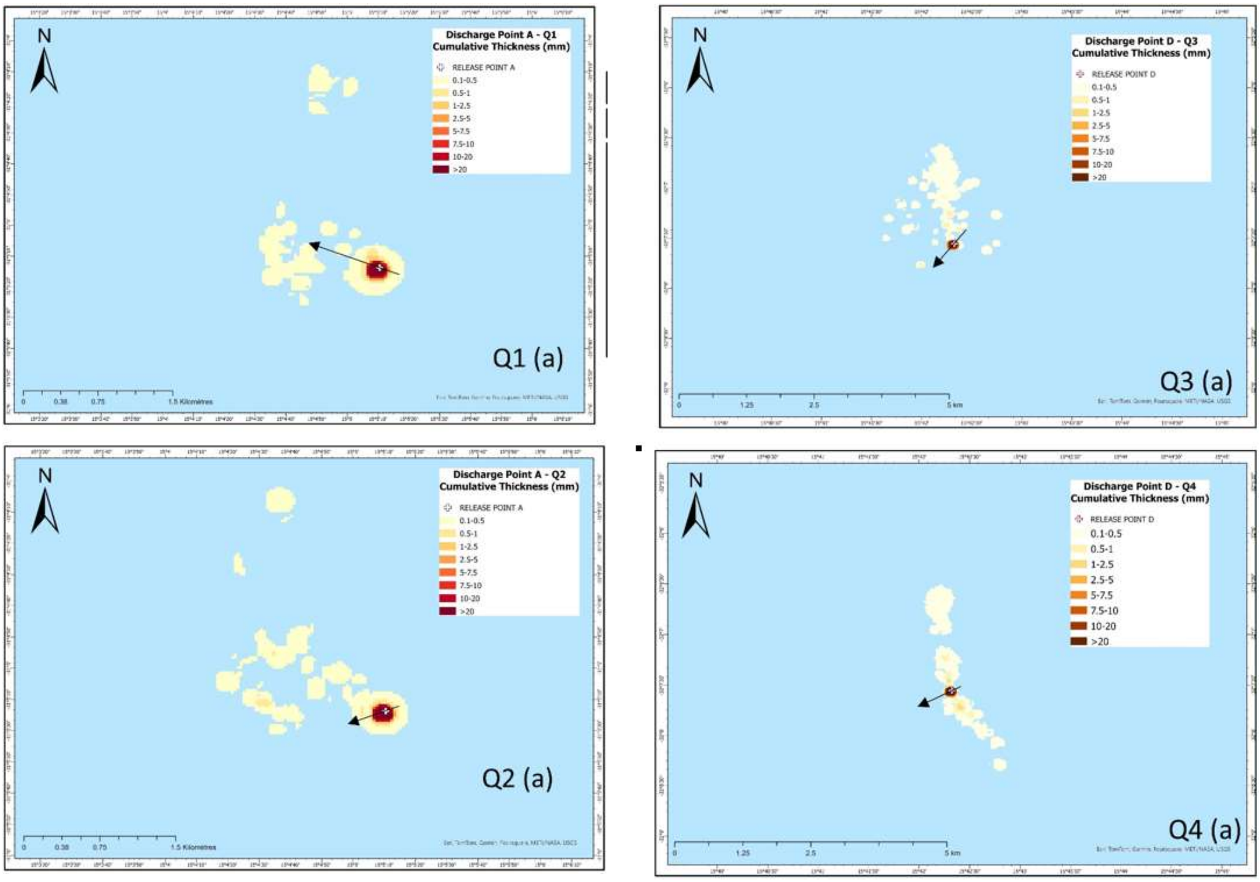

Figure 4.3: **Maximum thickness deposit on the seabed for discharge point A, 10 years after operations (Source Livas 2023a).**

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 discharge point D at the end of operations varying between 1700% and 1900% (compared to a natural median grain size of 7 µm) and that for discharge point A varying between 4300% and 5000%. Grain size variation is insignificant beyond 150 m from discharge point D and beyond 140 m from discharge point A. The grain size change is mostly due to discharges from drilling of the risered sections.
- Change in grain size around the wellbore associated with the riserless drilling stage are primarily physical, contributing a maximum of 48% (Q4) to the overall Environmental Impact Factor for the sediments during drilling of the riserless sections at discharge point D.

Environmental Risk due to Contaminant Concentrations in the Sediments

At the end of the operations, a significant risk (above 5%) is observed in the sediment around the discharge point up to a distance of between 100 m and 115 m, depending on the Quarter. A maximum risk of between 14% and 17% has been calculated. The highest risk is reached just after the end of riserless discharge, and decreases quickly 3 years after operations, with no more risk in the sediment after 3 years.

<u>Environmental Risk due to Contaminant Concentrations in the Water Column</u>

The results of the drilling discharges simulations performed for all quarters show similar trends, with a physical risk due to the riserless sections discharge and a chemical risk due to the risered sections discharge. The main contributors to the environmental risk in the water column are the Bentonite (riserless sections) and the hydrotreated light petroleum distillate present in the Base oil (risered section) for all the quarters. The volume of water at risk is mainly due to the risered sections.

The Environmental Impact Factor (EIF) is a relevant quantitative figure that, for the water column, represents the volume of sea water where the environmental risks exceed 5% (i.e. where a significant risk to the ecosystem exists). An EIF value of 1 (one) represents a volume of sea water of 100,000 m^3 (100 m x 100 m x 10 m) where the risks exceed 5% (i.e. where a significant risk to the ecosystem exists).

The outcomes of the model for the maximum cumulative risk in the water column associated with the discharge of drilling operations is presented in Figure 4.4 (Livas 2023a). This figure displays the cumulative risk at any time of the calculation (with significant risk in red). Modelling results show that the environmental risk of the riserless discharge for all Quarters is limited in the water column from 1240 m to 1500 m depth. This area at risk is centralized around the discharge point, following the bottom currents that are very low, with maximum distance varying from 210 to 260 m from the release point (depending on the Quarter). The risk induced by the risered discharge is null (i.e. the threshold value of 5% is not reached).

The environmental risk in the water column is short term because of the natural dispersion and dilution induced by the currents. The risk is highest close to the discharge point and rapidly decreases with the distance due to the currents and dilution. Figure 4.5 illustrates the cumulative risk value along a line from the discharge point towards the NW. The maximum risk distance reached is 260 m all around the discharge point but is quickly dispersed and diluted by the local currents, because there is no more risk after 5 days (i.e. after the 26” section displacement discharge).

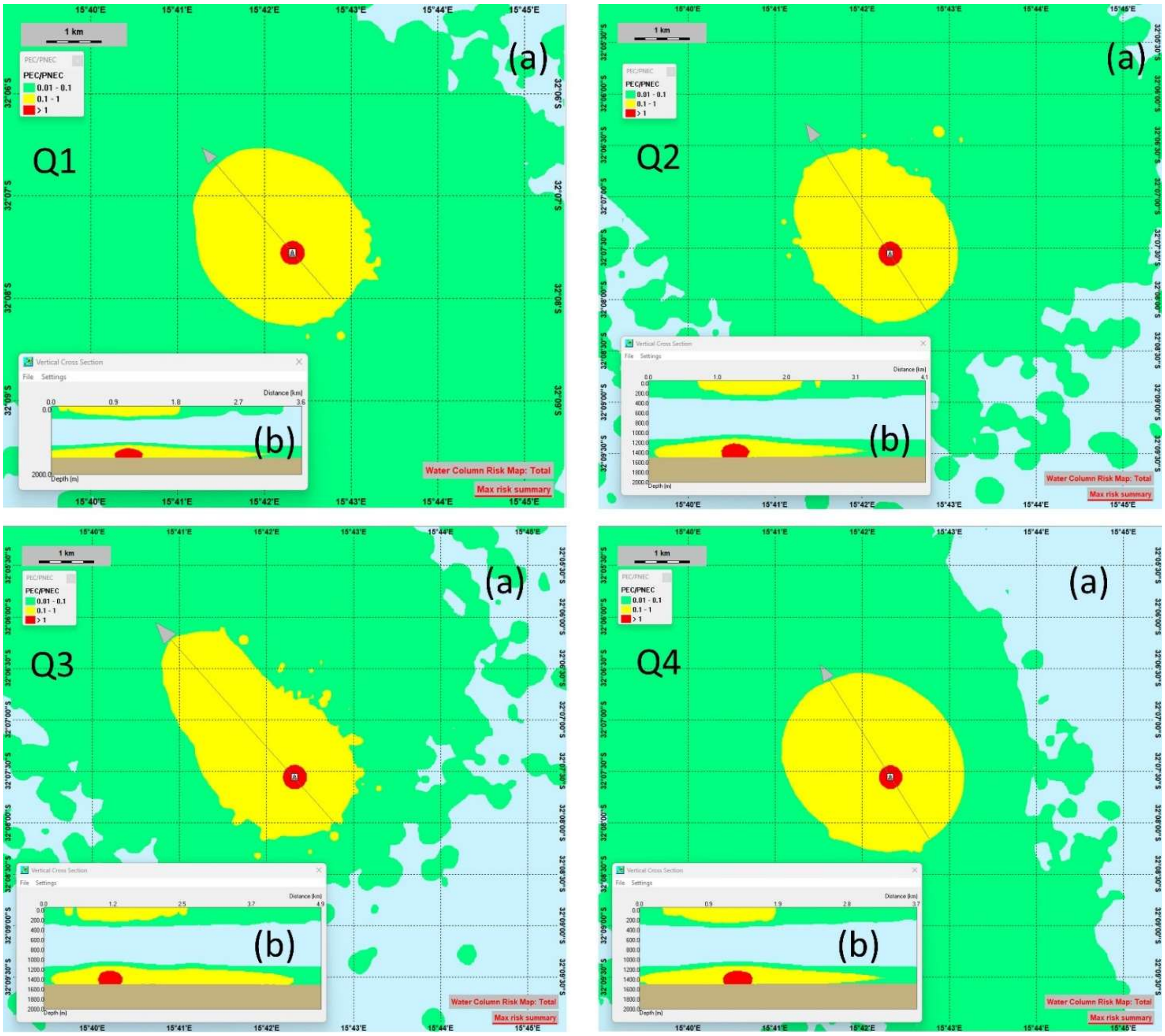

Figure 4.4: **Maximum cumulative risk of drilling operations for the four Quarters throughout the water column at any time for the discharge (a) Risk map – (b) Vertical cross section of the water column (Source Livas 2023a).**

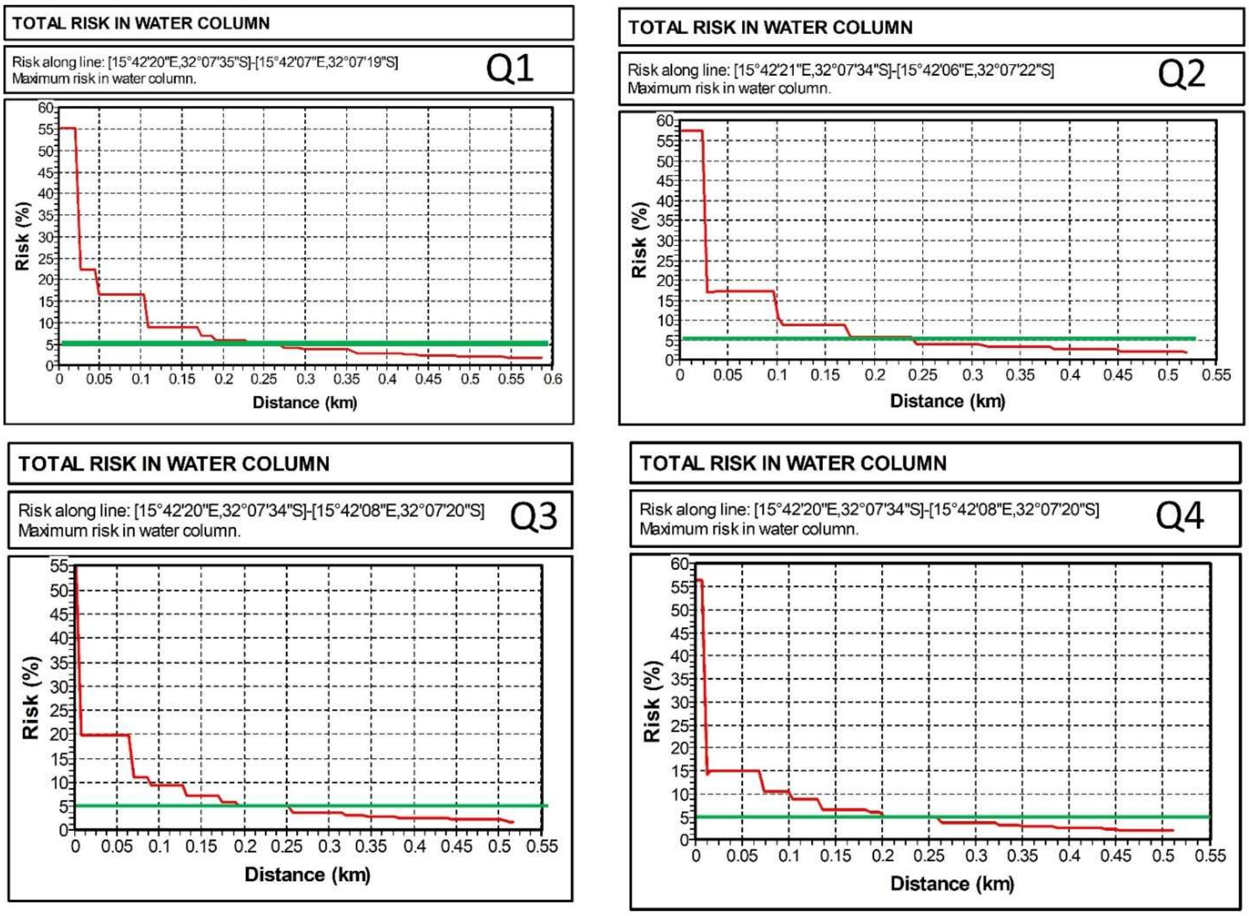

Figure 4.5: Risk value with displacement (distance) from the discharge point for the four Quarters (Source Livas 2023a).

Impact assessment

The main contributors to the environmental risk for the sediment are physical, i.e. the thickness deposit of the discharge and the grain size change of the natural sediment (due to higher grain size particles released during the discharge). For the use of WBM, the sediment deposit area is limited to less than 300 m around the release point. The depositional footprints on the seabed of the drilling discharges are highly localised, and do not overlap with the spawning areas or sensitive recruitment areas of benthic and demersal species on which the hake fisheries depend. The major fish spawning areas for commercial species such as hake and kingklip, occur further inshore on the shelf to the south of the Area of Interest and beyond the footprint of environmental risk. The depositional footprint does not coincide with any areas of demersal fishing operations. The affected area would fall entirely within any demarcated safety areas around the wellhead or abandoned well location.

The biochemical impacts to marine fauna were assessed by Pulfrich (2023) 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 4.6).

The smothering effects resulting from the discharge of drilling solids at the wellbore were assessed by Pulfrich (2023) to have a residual impact of low to medium significance on benthic macrofauna in the cuttings footprint (5 wells cumulative) depending on whether the area was unconsolidated sediment or hardground. Mortality of most fauna can be expected if deposit thickness of drilling solids at the well bore is >30 mm; this would, however, be expected only within a few metres around the wellbore therefore the site would be localised (<175 m of the wellbore). Discharges from the drilling unit would have a medium intensity impact as the depositional footprint would have a considerably lower deposit thickness, but be spread over a larger area (although outside of key spawning areas). Some biota will be smothered, but many will be capable of burying up through the deposited drilling solids. Since the model predicts that physical changes to the sediment structure within the deposition footprint would persist for 5 years, recovery of benthic communities to functional similarity is expected to occur within the medium term. The impact from riserless and risered drilling is assessed to be of **MEDIUM** magnitude for all 5 wells regardless of season.

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. The sediment discharge is unlikely to coincide with spawning areas.

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 and Ecological Baseline Surveys to provide sufficient information on seabed habitats, and to map sensitive and potentially vulnerable habitats (particularly in the modelled cuttings footprints) thereby preventing potential conflict with the well site. Undertake pre-drilling site surveys to ensure there is sufficient information on seabed habitats, including the mapping sensitive and 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 and 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	If sensitive and potentially vulnerable habitats are detected, adjust the well position accordingly or implement appropriate technologies, operational procedures and monitoring surveys to reduce the risks of, and assess the damage to, vulnerable seabed habitats and communities.	Avoid / reduce at source
4	Monitor (using ROV) cement returns and if significant discharges are observed on the seafloor terminate cement pumping.	Reduce at source

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** large pelagic longline	**LOW** large pelagic longline
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)
	SONAR survey
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. Drilling units generally produce underwater noise in the range of 10 Hz to 100 kHz (OSPAR commission, 2009) with major frequency components below 100 Hz and average source levels of up to 190 dB re 1 µPa at 1 m (rms) (the higher end of this range from use of bow thrusters).

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 (Canada) Ltd, 2023). For non-impulsive drilling noise, it is assumed that the source SEL levels are equivalent to their corresponding RMS SPL source levels, considering the consistency and longer durations of the typical continuous drilling noise emissions. The overall noise level from combined noise emissions from the drillship and three support vessels is approximately 201.9 dB re 1 µPa @ 1 m (or dB re 1 µPa2·S @ 1 m). The potential for underwater noise to be generated by helicopters is limited as broadband noise levels underwater due to helicopters flying at altitudes of 150 m or more are expected to be around 109 dB re 1 µPa (Richardson *et al.* 2013) at the most noise-affected point. This noise level is considerably less than the underwater noise generated by support vessels or the drilling platform and can be considered negligible in terms of the overall noise levels.

Vertical Seismic Profiling – VSP

If relevant, VSP will be undertaken in order to generate a high-resolution image of the geology in the well's immediate vicinity. It is expected to use a small dual airgun array, comprising a system of three 150 cubic inch airguns with a total volume of 450 cubic inches of compressed nitrogen at about 2 000 psi. VSP source will generate a pulse noise level in the 5 to 1 000 Hz range. The volumes and the energy released into the marine environment are significantly smaller than what is required or generated during conventional seismic surveys.

The source modelling results for the VSP array show the peak sound pressure level (Pk SPL) is 226 dB re 1 µPa @ 1 m, the root-mean-square sound pressure level (RMS SPL) 208.5 dB re 1 µPa @ 1 m, and the sound exposure level (SEL) 206 dB re $\mu Pa^2 \cdot s$ @ 1 m. It is expected that 125 VSP pulses are to be generated in total over approximately 6 hours of operation duration. Therefore, for cumulative noise modelling, two scenarios are considered for this study, including the worst case of 125 VSP pulses over the entire operation duration and 50 VSP pulses over approximately 2 hours.

SONAR survey (MBES System)

AOSAC intends undertaking pre-drilling sonar surveys within the AOI covering a survey area of approximately 150 km^2 across a depth range of 700 m and 1900 m. Each wellsite survey would take up to 10 days to complete. For sonar survey activities, AOSAC is proposing to utilise an MBES (70-100 kHz) with a single beam echo-sounder (38-200 kHz) and a sub-bottom profiler (2-16 kHz). The system consists of a fully integrated wide swath bathymeter and a dual frequency side scan sonar. The Kongsberg EM 712 MBES system with similar specifications to those proposed by AOSAC was used to model the planned sonar survey as worse case. The EM 712 MBES is a high-resolution seabed mapping system with a frequency range of 40-100 kHz. The source levels for the Kongsberg EM 712 MBES system show a Pk SPL of 240 dB, and RMS SPL of 237 dB, and a SEL of 210 dB.

An Underwater Noise Modelling Study has been undertaken to determine the underwater noise transmission loss with distance from well site and compare results with threshold values for marine fauna to determine zones of impact. The estimated maximum zones of impact on fish, fish eggs and fish larvae for all operational activities (VSP, Sonar and drilling) are summarised in Table 4.7 below (SLR 2023).

Table 4.7: Summary of the maximum zones of impact for fish, fish eggs, and fish larvae (Source: SLR 2023).

Animal type	Exploration Operations Activity		Maximum threshold distances, m			
			Mortality and potential mortal injury	Recoverable injury	TTS onset	Behavioural disturbance
Fish, fish eggs and fish larvae	VSP – immediate impact		40	40	-	2 240
	VSP - cumulative	125 VSP pulses	40	60	260	-
		50 VSP pulses	40	40	180	-
	Drilling		-	-	-	420
	Single MBES pulse		-	-	-	-
Note: A dash indicates the threshold is not applicable.						

Potential Impact Description

The effects of sound exposure on fishes can be broadly categorised as follows:

Mortality and mortal injury	Immediate or delayed death
Recoverable injury	Injuries, including hair cell damage, minor internal or external hematoma etc. Injuries unlikely to result in mortality
Permanent hearing threshold shifts	Causing direct physical injury to hearing or other organs, including permanent threshold shifts (PTS) in hearing;
Temporary hearing threshold shifts	Temporary threshold shifts (TTS) in hearing include short or long term changes in hearing sensitivity that may or may not reduce fitness.
Behavioural Response	Causing disturbance to the receptor resulting in behavioural changes or displacement from important feeding or breeding areas or alteration of migration patterns.
Masking	Masking or interfering with other biologically important sounds (e.g. communication, echolocation, signals, and sounds produced by predators or prey); impairment of hearing sensitivity

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 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 $\mu Pa^2 \cdot s$.

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 noise thresholds for mortality (or potentially mortal injury), as well as degrees of impairment such as temporary or permanent threshold shifts (TTS or PTS, indicators of hearing damage). Separate thresholds are defined for peak noise and cumulative impacts (due to continuous or repeated noise events) and for different noise sources (e.g. explosives, seismic airguns, pile driving, low- and mid-frequency sonar, 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. The ASA does provide numeric noise thresholds for physiological effects for some fish (those where the swim bladder is involved in hearing). Where insufficient data to infer thresholds exists, the relative risk of an effect is qualitatively rated at "high," "moderate," or "low" for three distances from the source. The three distances from the source are 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.

As a general guideline, a sound pressure level of 150 dB re 1 μPa RMS may be used as a suitable indicator at which behavioural modifications of fish start to take place (Navy, 2017). Behavioural effects are generally short-term, however, with duration of the effect being less than or equal to the duration of exposure, although these vary between species and individuals, and are dependent on the properties of the received sound.

The 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). High-frequency sonar from MBES sources is not expected to cause an adverse hearing impact on fish species.

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-

[30] See also: Hawkins, A.D., Pembroke, A.E., and Popper, A.N. 2014. Information Gaps in Understanding the Effects of Noise on Fishes and Invertebrates. Rev Fish Biol Fisheries (2015) 25:39–64.

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 4.8 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 150 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 4.8 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 $\mu Pa^2 \cdot s$. 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, 2023). 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 $\mu Pa^2 \cdot s$.

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.

The noise emissions from the drillship are predominantly generated by propeller and thruster cavitation especially when the dynamic-positioning system is operating, with a smaller fraction of sound produced by transmission through the hull, such as by engines, gearing, and other mechanical systems. For modelling predictions, all thrusters were assumed to operate at nominal speed. The vertical position of the drill rig thrusters is assumed to be 27.75 m below the sea surface at the operating draft. For offshore support vessels to maintain position in strong current conditions, they are required to have two bow thrusters plus an azimuth thruster forward. The vertical positions of the thrusters are assumed to be 5 m below the sea surface. There are three support vessels acting simultaneously as a worst-case consideration. The drillship and support vessel noise levels are estimated based on a source level predicting empirical formula suggested by Brown (1977). The formula predicts the source level of a propeller based on the propeller diameter (m) and the propeller revolution rate (rpm). For non-impulsive drilling noise, it is assumed that the source SEL levels are equivalent to their corresponding RMS SPL source levels, considering the consistency and longer durations of the typical continuous drilling noise emissions. The overall noise level from combined noise emissions from the drillship and three support vessels is approximately 201.9 dB re 1 µPa @ 1 m (or dB re 1 $\mu Pa^2 \cdot S$ @ 1 m).

For all drilling activities, the cumulative exposure level at certain locations is modelled based on the assumption that the marine animals are constantly exposed to the source at a fixed location over the entire operational period (e.g., up to 10 hours for 250 VSP pulses or up to 24 hours for continuous drilling). However, marine fauna species, such as marine mammals, fish, and sea turtles, would not (under realistic circumstances) stay in the same location for the entire period unless either the species were attached to a specific feeding/breeding area or a species that can be considered immobile (e.g., plankton and fish eggs/larvae). Therefore, the zones of impact assessed for marine mammals, fish species, and sea turtles represent the worst-case consideration.

In terms of ambient marine traffic noise, the majority of shipping traffic is located on the outer edge of the continental shelf, with traffic inshore of the continental shelf along the West Coast largely comprising fishing vessels. The block is shows a high level of shipping traffic density over the eastern area, particularly the northeastern corner of the block. As such, the shipping noise component of the ambient noise environment is expected to be significant within some sections of the block area. Given the significant local shipping traffic and relatively strong metocean conditions specific to the area, the ambient noise levels are expected to be at least 10 dB higher than the lowest level, within the higher range of the typical ambient noise levels, i.e., 90 - 130 dB re 1 µPa for the frequency range 10-10 k Hz.

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.

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.

[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).

The **magnitude** of the impact of sound on catch rates during these activities is assessed to be **VERY LOW** for all 5 wells. Refer to Table 4.9 for the impact ratings on commercial fisheries during the drilling activities.

Impact Significance

The overall significance of the impact is assessed to be **VERY LOW** 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.

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 **VERY LOW** for the large pelagic longline sector (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** large pelagic longline	**MEDIUM** large pelagic longline,
Magnitude (or Consequence)	**VERY LOW**	**VERY LOW**
Intensity	**MEDIUM**	**LOW**
Extent	**Local**	**Local**
Duration	**Short-term**	**Short-term**
Significance	**VERY LOW** large pelagic longline	**VERY LOW** large pelagic longline
Probability	**Possible**	**Possible**
Confidence	**Medium**	**Medium**
Reversibility	**Fully reversible**	**Fully reversible**
Loss of Resources	**Low**	**Low**
Mitigation Potential	**Very Low**	**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 125 pulses) were modelled and the zones of cumulative impact on fish were found to extend from the drilling site to distances of 450 m (TTS effects), 40 m (mortality and recoverable injuries) (refer to Table 4.6).

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.

VSP pulses are predicted to cause immediate physiological impacts (both mortality and recovery injury) for fishes directly adjacent to the VSP source (40 m). Potential effects of behavioural disruption from VSP pulses for all fish species may occur within 2.8 km from the assessed deepest water drilling location and within 2.9 km from the assessed shallowest water drilling location. The zone of impact relevant to fish and fish eggs and larvae for potential mortal injury is within 45 m of the VSP source. The cumulative impacts from VSP pulses are predicted to cause potential recoverable injury for fish adjacent to the seismic source (within 70 m) and TTS-onset up to 450 m from the source under the worst-case VSP pulse exposure scenario (i.e., 250 pulses within 9 hours). Under the exposure scenario of 50 pulses with approximately 2 hours period, the maximum TTS impact zones are predicted to be less than 225 m from the VSP source.

Relatively low behavioural risks are expected for fish species at far field distances (thousands of meters) from the source location. The estimated zone of noise disturbance up to a distance of 2.9 km from the drilling unit could result in an affected area of up to 24.63 km^2. This zone of disturbance coincides only with the area fished by the large pelagic longline sector. Placed across the area of highest fishing activity within the Area of Interest for proposed drilling, this coincides with an average annual catch of 3.2 tons from 3 lines (0.12% of the overall national 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, the impact has been rated as being **LOCAL** in extent. The fishing grounds of the large pelagic longline sector falls 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, 2023), 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 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 and to the south of the Area of Interest for drilling.

The overall **magnitude** of the impact of sound on catch rates during these activities is assessed to be **VERY LOW** for the large pelagic longline sector.

Impact Significance

The overall significance of the impact is assessed to be 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 2023) 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 **VERY LOW** significance for the large pelagic longline sector (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** pelagic longline	**MEDIUM** longline
Magnitude (or Consequence)	**VERY LOW**	**VERY LOW**
Intensity	**MEDIUM**	**LOW**
Extent	**Local**	**Local**
Duration	**Short-term**	**Short-term**
Significance	**VERY LOW** Large pelagic longline	**VERY LOW** 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**

4.3.3 SONAR SURVEY (MBES SURVEY)

Impact Magnitude (or Consequence)

The noise generated by the acoustic equipment utilised during geophysical surveys falls within the hearing range of most fish, and at sound levels of between 200 to 240 dB re 1 μPa at 1 m, will be audible for considerable distances (in the order of tens of km) before attenuating to below threshold levels (Findlay 2005). However, unlike the noise generated by airguns during seismic surveys, the emission of underwater noise from geophysical surveying and vessel activity is not considered to be of sufficient amplitude to cause auditory or non-auditory trauma in marine animals in the region.

High-frequency active sonar sources, such as MBES sources with a frequency range of 10 kHz or greater, are not expected to cause an adverse hearing impact on fish species due to the low-frequency hearing ranges of these marine animals (from below 100 Hz to up to a few kHz) (Popper et al., 2014). It should be noted that the period over which the cumulative sound exposure level (SELcum) is calculated must be carefully specified. For example, SELcum may be defined over a standard period (e.g., 12 hours of drilling or for the duration of an activity) or over the total period that the animal will be exposed. Whether an animal would be exposed to a full period of sound activity will depend on its behaviour, as well as the source movements. To be in line with assessment criteria for marine mammals, an exposure period of 24 hours is specified for fish. The receiving exposure levels over this period are expected to reflect the total exposure in the near field where the major adverse impacts are expected to occur for fish species. For behavioural disruption threshold levels for all fish species, the National Marine Fisheries Services (NMFS) uses the U.S. Navy Phase III criteria for all noise thresholds (Navy, 2017). As of December 2021, potential effects on endangered listed fish species may occur when impulsive or non-impulsive activities produce sounds that exceed the thresholds.

For modelling purposes, the same locations as the modelling drilling activities and an overall sonar survey of approximately 50 km^2 (approximately 7 km X 7 km) over a period of approximately 15 days was used. The proposed MBES source has extremely strong source directionalities towards cross-track directions, with a cross-track beam fan width of 140° and an along-track beam width of up to 2°. As a result, the sound field at cross-track directions is expected to be significantly higher than the along-track sound field. Considering the extremely narrow source directionalities towards the cross-track directions and the moving MBES source during the survey, it is reasonable to expect that the adjacent receiving locations along the cross-track directions from the MBES source would be exposed to what would essentially be the acoustic energy from a single sonar pulse for the duration of the survey. As such, the sonar survey modelling is proposed to be based on the sound field modelling for a single MBES pulse at the represented source location (i.e., the selected discharge location). Consequently, the overall impact zones applied for the entire sonar survey are based on the impact zones estimated for the single MBES pulse, predominantly along the cross-track directions. From the results of the Noise specialist report, high-frequency sonar from single MBES pulse is not expected to cause an adverse hearing impact on fish species, including cumulative exposure. The modelling results show that the maximum impact distance for the behavioural disturbance caused by the immediate exposure to individual MBES pulses is predicted to reach 770 m from the source for fish.

In the case of noise generated during sonar surveys, the effects on fish are considered to be of **MEDIUM** intensity, with a **LOCAL** extent for the duration of the sonar survey activities (**SHORT-TERM**).

Impact Significance

The impact of underwater noise generated during sonar surveys is thus considered of very low magnitude (or consequence) for a 4-week survey.

Mitigation

Mitigation as per VSP activities included in Section 4.3.2 above.

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 sonar operations is assessed to be of **VERY LOW** significance for the large pelagic longline sector (refer to Table 4.11). There is no impact expected on other fisheries sectors.

Table 4.11: Overall Impact of Underwater Noise from Sonar Surveys on Catch Rates.

6	Impact of Sound on Catch Rates Sonar Surveys	
Project Phase:	**Operational**	
Type of Impact	**Indirect**	
Nature of Impact	**Negative**	
	Pre-Mitigation Impact	**Residual Impact**
Sensitivity of Receptor	**MEDIUM** pelagic longline	**MEDIUM** longline
Magnitude (or Consequence)	**VERY LOW**	**VERY LOW**
Intensity	**MEDIUM**	**LOW**
Extent	**Local**	**Local**
Duration	**Short-term**	**Short-term**
Significance	**VERY LOW** Large pelagic longline	**VERY LOW** 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

The project activities that could result in the accidental release of diesel / oil are listed below.

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:

- 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.

There is a possibility that the hydrocarbon resource targeted by the proposed exploration wells is condensate rather than crude oil. However, to ensure that all potential worst-case scenarios both scenarios were considered. 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. The release quantities for condensate are typically significantly lower and the persistence of the condensate at sea much lower than oil. The environmental impacts realised during a condensate blowout would therefore also be much lower.

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 (API), viscosity and pour point, all of which are dependent on the oils chemical composition (e.g. the amount of asphaltenes, resins and waxes). 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). Although the individual weathering processes may act simultaneously, their relative importance varies with time. 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.

Description of Impact

Marine diesel, hydraulic fluid and/or oil spilled in the marine environment would have an immediate detrimental effect on water quality, with the toxic effects potentially resulting in mortality (e.g. suffocation and poisoning) of marine fauna or affecting faunal health (e.g. respiratory damage) (direct negative impact). Sub-lethal and long-term effects can include disruption of physiological and behavioural mechanisms, reduced tolerance to stress and incorporation of carcinogens into the food chain. 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:

- **Contamination of Product:** Oil spills in marine environments can lead to the contamination of fish and seafood products. Fish exposed to oil spills may absorb toxic substances, such as polycyclic aromatic hydrocarbons (PAHs), which can accumulate in their tissues (Gracia et al. 2020). This contamination poses significant risks to human health if contaminated fish are consumed. Studies have shown that PAHs can cause various health issues, including carcinogenic effects and reproductive toxicity (Short, 2017; Sandifer *et al.*, 2021). Furthermore, the presence of oil residues can render fish visually unappealing and unsuitable for sale, leading to financial losses for fishing operations (Pascoe and Innes, 2018).

- **Avoidance of Contaminated Fishing Areas:** Impacts on fisheries livelihoods from oil spills have included periodic closure of fishing grounds for clean-up and rejuvenation, long-term displacement from fishing areas to minimize pollution effects, lost jobs and unemployment, and lost seafood markets and revenues (Levy and Gopalakrishnan, 2010; Watts and Zalik, 2020). Following an oil spill, fishing vessels may avoid areas affected by contamination to prevent the capture of contaminated fish and ensure product safety (Gracia et al. 2020; Andrews, N. et al. 2021). This avoidance behaviour can disrupt fishing operations, as vessels may need to relocate to alternative fishing grounds, resulting in increased fuel costs and reduced catch efficiency (Gracia et al. 2020). Studies have documented the displacement of fishing activities away from oil-affected areas following major spills, such as the Deepwater Horizon oil spill in the Gulf of Mexico (Pascoe and Innes, 2018; Andrews, N. et al. 2021). Avoidance of contaminated areas may also lead to competition among fishing vessels for access to unaffected fishing grounds, exacerbating resource conflicts and management challenges. Additionally, fish species have been shown to avoid areas contaminated with PAHs (Schlenker *et al.,* 2019).

- **Loss of Marketable Product:** In cases where fish are exposed to oil spills and subsequently captured by fishing operations, there is a risk of product rejection due to contamination. Fish contaminated with oil residues may fail to meet quality standards set by regulatory agencies and seafood markets, resulting in the rejection of entire catch batches (Challenger and Mauseth, 2011; Gracia et al. 2020). This rejection not only leads to financial losses for fishing operations but also undermines consumer confidence in seafood products sourced from affected regions. Studies have shown that seafood market demand can decline significantly in the aftermath of oil spills, particularly in regions directly impacted by contamination (Challenger and Mauseth, 2011; Gracia et al. 2020). Loss of market access can have long-term economic consequences for fishing communities reliant on seafood trade.

- **Indirect Impact on Fisheries from Contamination:** The introduction of oil into marine ecosystems can lead to a range of adverse effects on phytoplankton. Petrogenic carbon may contain toxic compounds such as PAHs and heavy metals, which can inhibit photosynthesis, disrupt cellular processes, and impair growth and reproduction in phytoplankton species (Quigg *et al.*, 2021; Gracia et al. 2020; Tang *et al.*, 2019). Additionally, the physical presence of oil slicks can block sunlight, thereby reducing light availability for photosynthesis and further suppressing phytoplankton productivity (Quigg *et al.*, 2021; Gracia et al. 2020; Tang *et al.*, 2019). The reduced productivity is likely to lead to reduced productivity on higher trophic levels, such as economically important fish species.

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, to set in motion the necessary actions to stop or minimise the discharge, 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.

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.

Other project controls include the preparation and implementation of a Shipboard Oil Pollution Emergency Plan (SOPEP), an 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 the response and prevention strategies.

Sensitivity of Receptors

Fisheries may be vulnerable to water contamination in that vessels would avoid working in areas of surface contamination. Fish may be contaminated by any hydrocarbon slicks as the catch is hauled on board and the quality of the product may be compromised or rejected due to health and safety limits. The large pelagic longline and tuna pole sectors are particularly sensitive to the risk of product contamination and potential rejection of the catch for export. The sensitivity of fisheries could therefore relate to the avoidance of areas affected by the release of hydrocarbons either as low-volume spills arising from vessel collision, or subsea blow-outs at the wellhead. Therefore the sensitivity of fisheries and the magnitude of the impact is related to the predicted areas of contamination with respect to fishing grounds.

Fisheries sensitivity also relates to reproductive success and recruitment. The impact of a large-scale blow-out on the health of marine fauna is assessed by Pulfrich (2023) as part of the marine fauna impact assessment. The sections considered relevant to fisheries 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 2023). 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 2023). 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 can 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 kingklip, squid, hake, anchovy and pilchard spawning areas, it could result in 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. Figure 3.2 provides a general depiction of spawning areas of key targeted species areas in relation to Block 3B/4B.

Various pelagic and demersal fish species are known to spawn in the inshore regions of the southern Benguela, (including pilchard, round herring, chub mackerel lanternfish and hakes (Crawford *et al.* 1987; Hutchings 1994; Hutchings *et al.* 2002). The eggs and larvae are carried around Cape Point and up the coast in northward flowing surface waters. At the start of winter every year, the juveniles recruit in large numbers into coastal waters across broad stretches of the shelf between the Orange River and Cape Columbine to utilise the shallow shelf region as nursery grounds before gradually moving southwards in the inshore southerly flowing surface current, towards the major spawning grounds east of Cape Point. Following spawning, the eggs and larvae of snoek are transported to inshore (<150 m) nursery grounds north of Cape Columbine and east of Danger Point, where the juveniles remain until maturity. There is no overlap of the licence block with the northward egg and larval drift of commercially important species, and the return migration of recruits, thus, ichthyoplankton abundance is expected to be low. 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, should the affected area coincide with areas of spawning activity.

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. 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.

4.4.1 CONDENSATE

The environmental impacts associated with the oil spill scenario modelled by Livas (2023) for a single potential well site within the AOI at 1 499 m depth and ~215 km from the closest shoreline are assessed below, based on the footprints for the probability of surface oiling from spill events during each of four Quarters: Quarter 1 (Q1) January to March, Quarter 2 (Q2) April to June, Quarter 3 (Q3) July to September and Quarter 4 (Q4) October to December.

Note: The oil spill modelling study assumed the worst case scenario of a continuous blowout of 238.8 m^3/d of condensate and 930 000 Sm^3/d of gas for a period of 20 days assuming the characteristics of Condensate SKARV 13 DEG -2014 as the closest equivalent of the condensate expected from an exploration well in Block 3B/4B.

The assessment below assumes the worst-case scenario of a 20-day blow-out of condensate and gas at a rate of 238.8 m^3/d and 930 000 Sm^3/d, respectively. The modelling assumed various spill response combinations, namely:

- Capping stack only after 20th day; and
- Subsea dispersant injection (SSDI) kit after 15th day and surface dispersion using aircrafts and vessels for chemical dispersion and vessels for containment and recovery.

Two scenarios were modelled, namely:

- Capping stack only; and
- Combination of surface response + SSDI + capping stack

Threshold values applied to illustrate modelling output results are 58 ppb for oil in the water column, 0.04 μm for the surface oil thickness and 10 g/m^2 for shoreline oiling (Livas 2023b for details).

The discussion of modelling results and impact assessment below is based on the worst case scenario of assuming **capping only** in the event of a blow-out. Should a combination of surface response, capping and SSDI be implemented in the unlikely event of a blow out, spill footprints would be much reduced.

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.

Surface Layer and Water Column Probability of Contamination

Stochastic simulation results of the oil spill modelling study indicated that the main drift direction of the spill is NNW due to the main surface currents towards NW and winds from S to SSE in the area. In the event of a blow-out the oil would reach the surface within 3 hrs. Figure 4.6 shows probabilities of surface contamination (>0.04 µm surface oil thickness) for each quarter (assuming capping only). For this surface layer, 80 - 100% probability of surface oiling is reached at a distances of 42 km from the release point during Q1 (January to March) with a distance of 29 km during Q2 and Q4 and 32 km during Q3.

No oil is predicted to reach the shore due to main currents and wind driving the spill toward the NW, away from the coasts. Nevertheless, because those currents and winds are strong, the oil travels further. The plume is predicted to spread a maximum of ~300 km towards the Namibian EEZ (<10% probability). There is a 3.3% probability of surface oiling reaching Namibian waters.

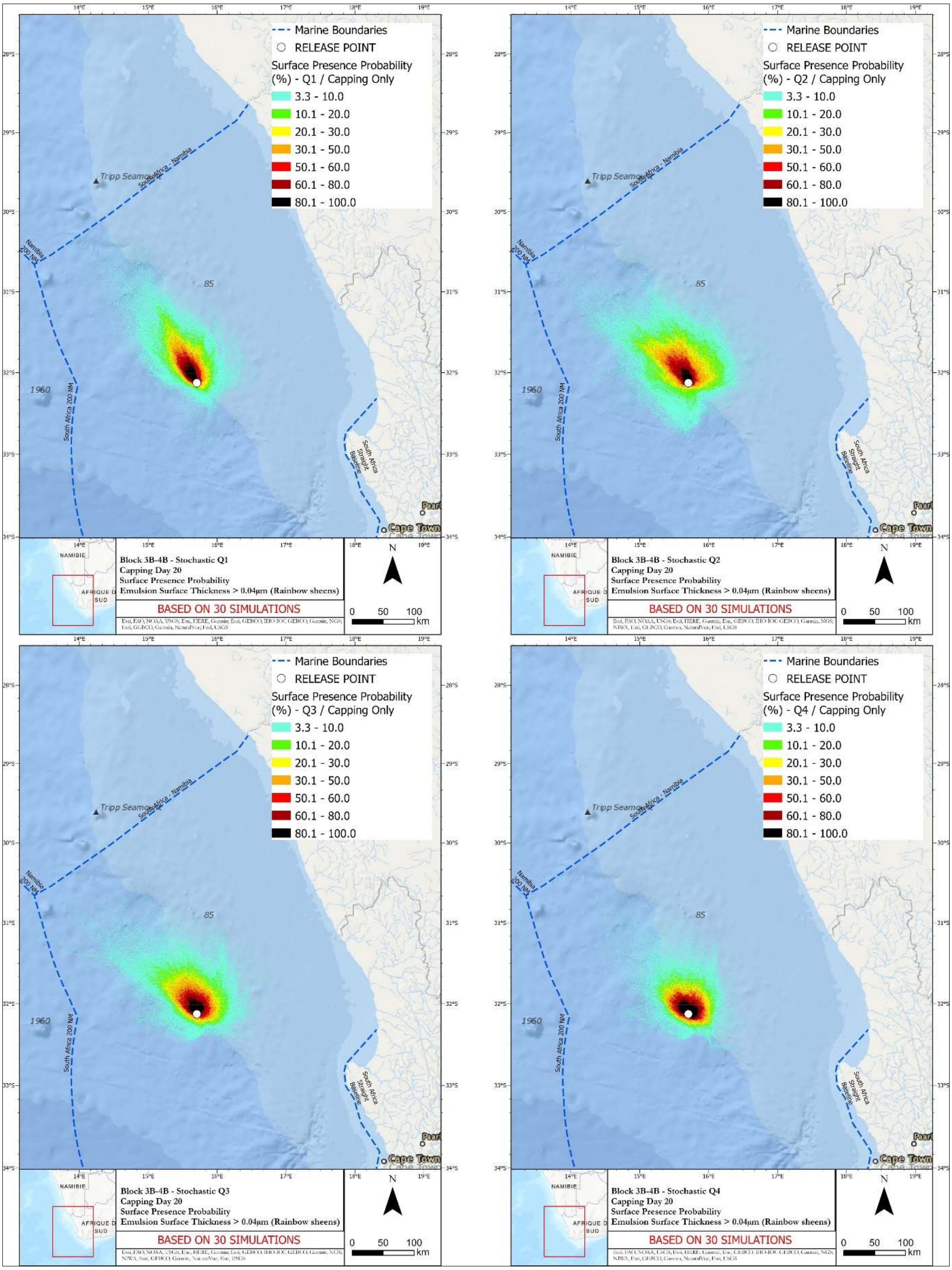

Figure 4.6 **Surface probability of contamination >0.04 µm surface oil thickness for all quarters with capping only (Source: Livas 2023b).**

The maximum emulsion thickness at the surface is 7.5 µm, extending as localised around the release point. Once at the surface, the condensate is rapidly evaporated, dispersed and biodegraded and no oil remained at the surface at the end of the simulations modelled (60 days). Oil dispersed on the surface will affect the upper water layers, but modelling results suggest that the probability of oil presence on the surface is <10%. The high proportion of gas contained in the release results in rapid ascent up to 600 m off the seabed. Consequently, there is no contamination of the deep layers (900 – 1 499 m). The most contaminated layer occurs in mid-water (725 – 900 m depth) but remains relatively contained around the release point, spreading to a maximum of 5 km to the NNW (Figure 4.7). The spread of the mid-water plume and surface slick coincides with grounds fished by the large pelagic longline sector.

The implementation of SSDI and surface response after 15 days results in an insignificant decrease of the surface slicks and spread in the shallower layers as condensate naturally disperses well in the water column and evaporates rapidly once at the surface. Deployment of these control measures would thus be ineffectual in reducing the oil presence probability areas. The same holds true for the minimum arrival time at the surface and maximum emulsion thickness at the surface.

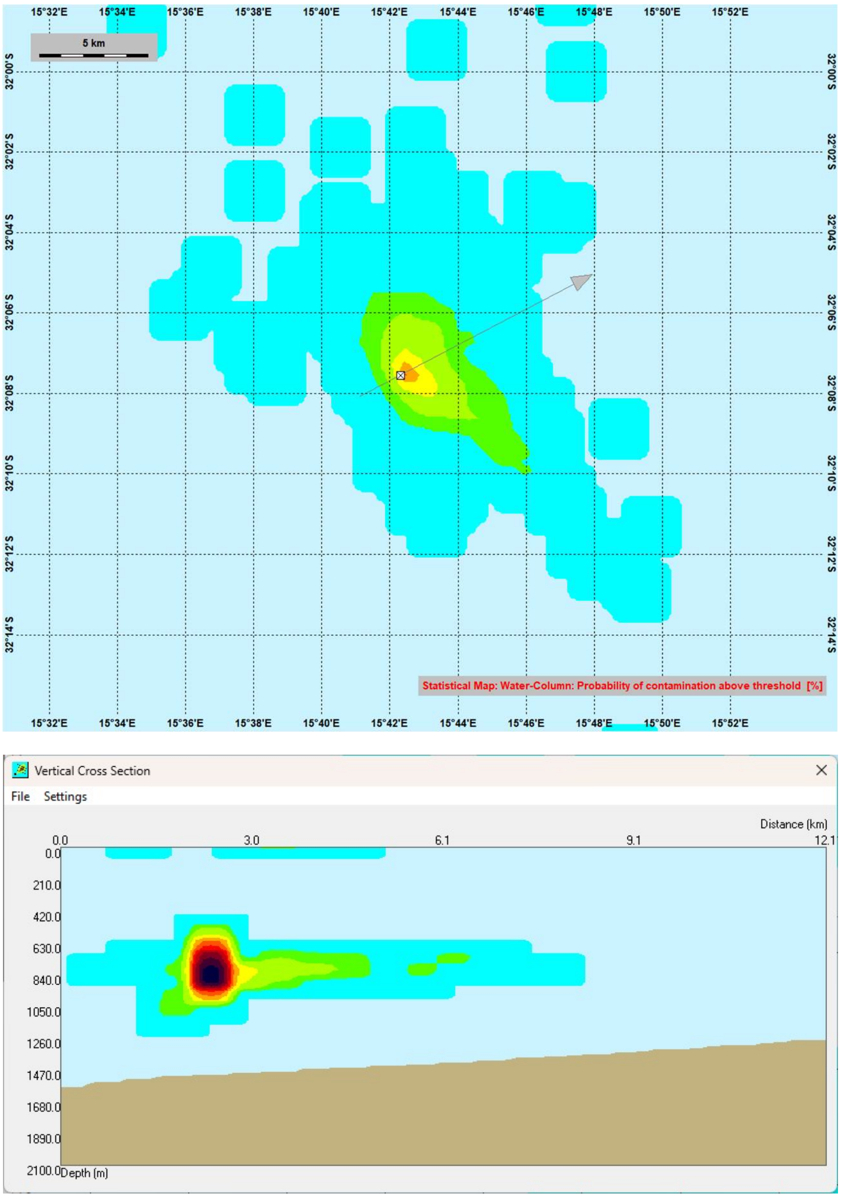

Figure 4.7 Water column probability of contamination >58 ppb (Q3) with capping only (Source: Livas 2023b).

Impact Magnitude

Condensate (Capping only scenario): The extent of the surface oiling could be regional in extent. Large scale effects on fishing operations would likely include area closures and exclusion of fisheries from areas that may be polluted or closed to fishing due to contamination of surface waters. Based on the possible extent of surface oiling (across all quarters), the impact could affect the large pelagic longline, tuna pole-line, demersal trawl and demersal longline sectors. The likelihood of the impact materialising differs according to the predicted extent of the surface contaminated areas in respect to the location of fishing grounds. The likelihood of contamination is definite (100%) for large pelagic longline, 50% for tuna pole-line, 30% for demersal trawl and 20% for demersal longline. Based on the extent of predicted surface oiling, there would be no impact on the operations of any of the other sectors. For condensate the weathering processes include evaporation, dispersion, dissolution, photo-oxidation, emulsification and spreading and the duration of the impact has been classified as immediate (<1 year).

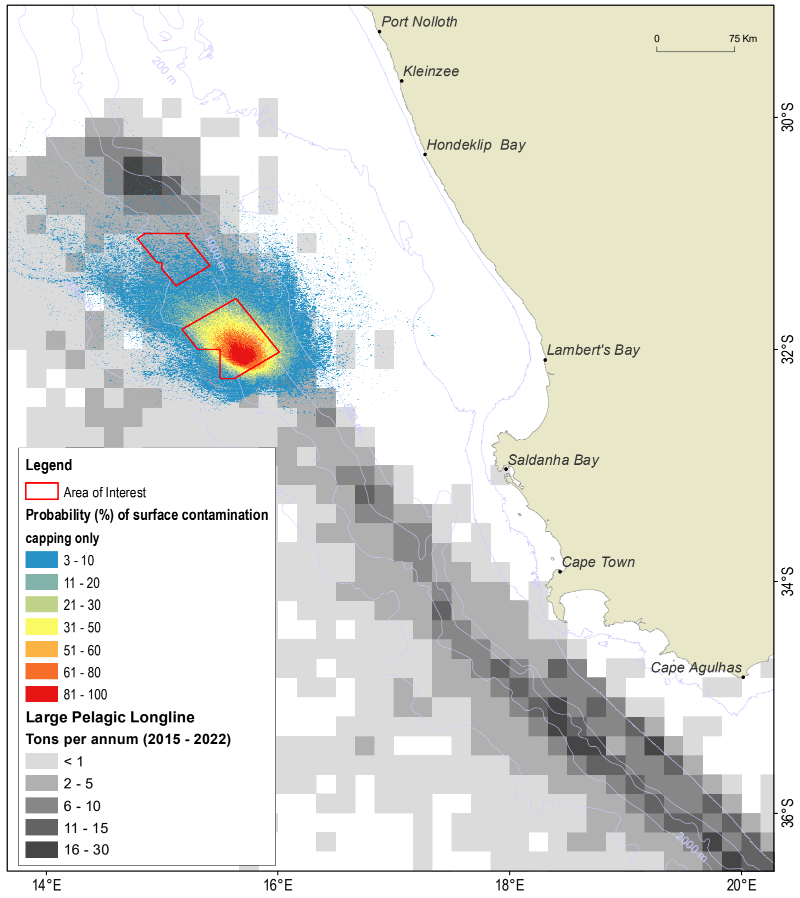

Figure 4.8 Fishing grounds of the large pelagic longline sector in relation to the surface probability of contamination during well blowout (Q3; with capping response).

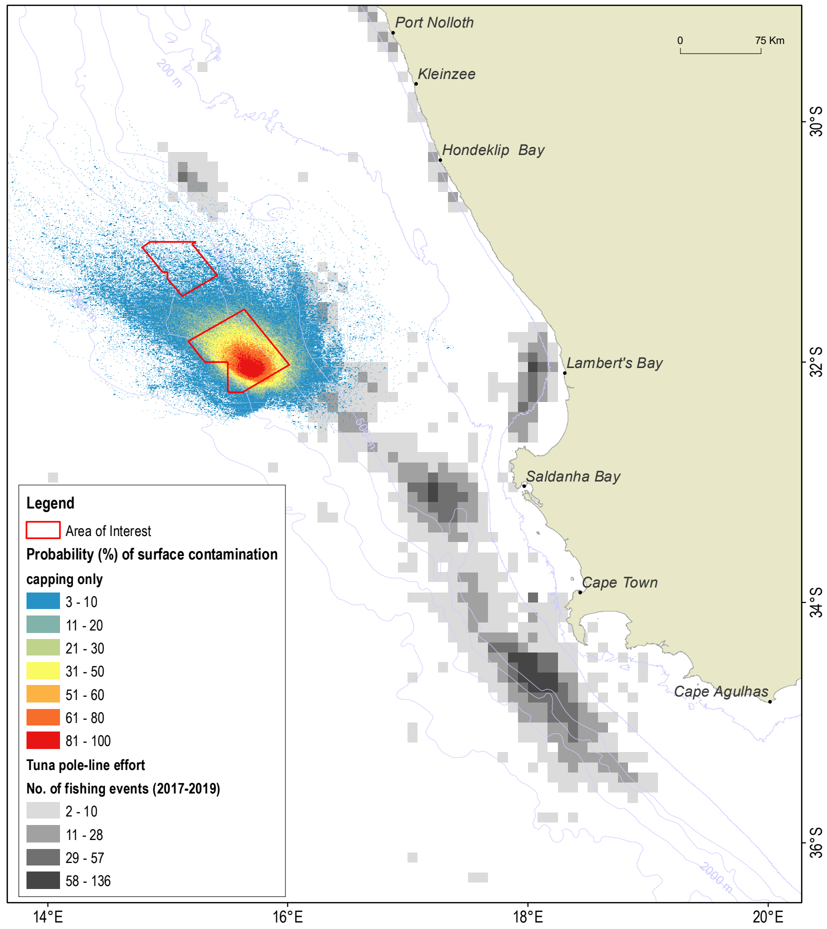

Figure 4.9 Fishing grounds of the tuna pole-line sector in relation to the surface probability of contamination during well blowout (Q3; with capping response).

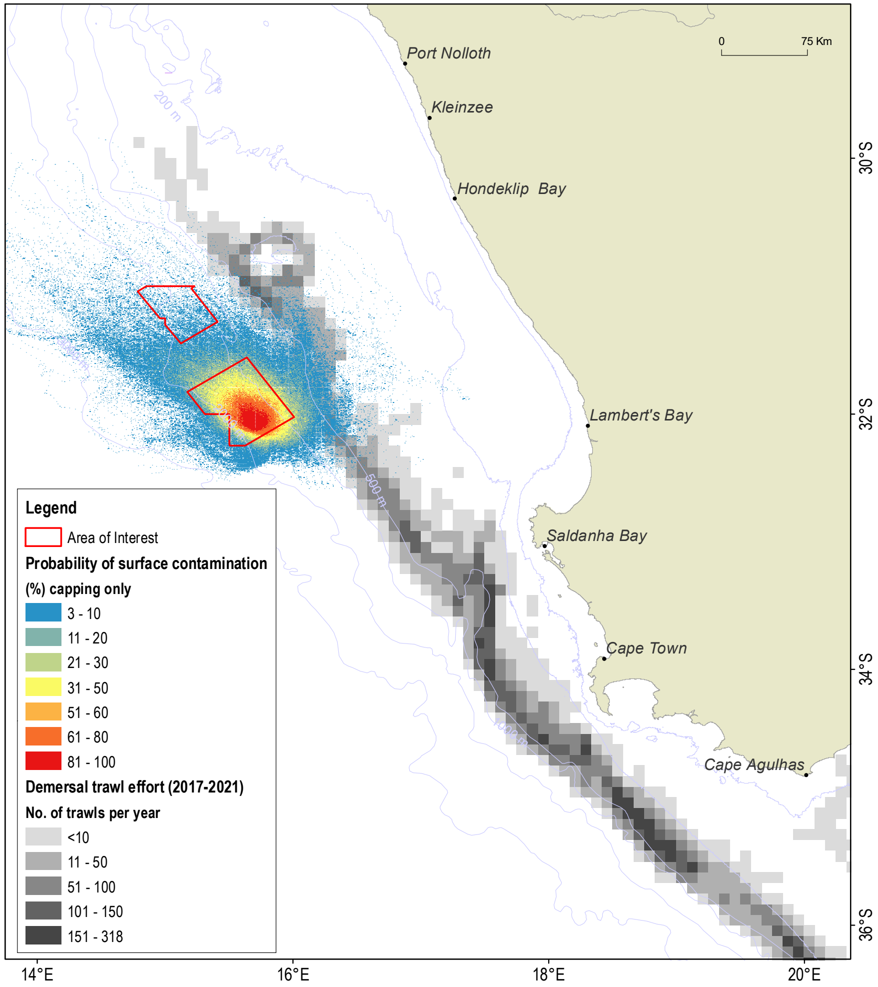

Figure 4.10 Fishing grounds of the demersal trawl sector in relation to the surface probability of contamination during well blowout (Q3; with capping response).

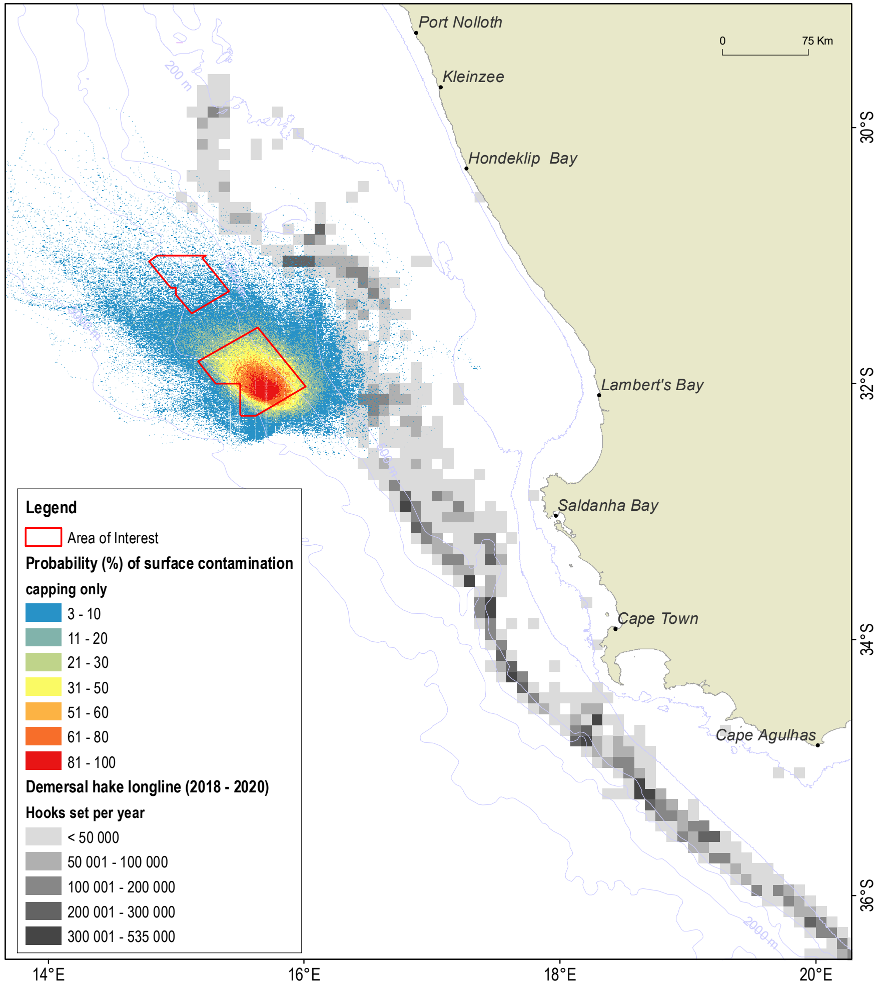

Figure 4.11 Fishing grounds of the demersal longline sector in relation to the surface probability of contamination during well blowout (Q3; with capping response).

4.4.2 CRUDE OIL

The environmental impacts associated with the oil spill scenario modelled by Livas (2023b) for two potential well sites within the AOI were assessed based on the footprints for the probability of surface oiling from spill events during each of the four Quarters: Q1 (January to March), Q2 (April to June), Q3 (July to September) and Q4 (October to December). As the exact locations of the wells to be drilled within the area of interest are not yet known, the two locations were selected for modelling based on:

- Distance from the coast: it will directly influence the travel time and quantities that may be stranded on the shoreline.
- Proximity of marine protected areas (MPAs) and critical biodiversity areas (CBAs) that might be impacted especially by drilling discharges which are more localized than oil spill.
- Winds and Currents directions that could potentially cause the oil slick to drift ashore.

Point D (water depth 1499m) was selected as the worst-case release point for Condensate cases and Crude Oil cases. Point A (water depth 1626m) was selected as an additional worse-case release point for the Crude Oil cases only.

The oil spill modelling study assumed the worst-case scenario of a continuous blowout of 5405.6 m^3/d (34 000 barrels per day) of crude oil and 1 443 243 Sm^3/d of gas for a period of 20 days assuming a crude oil analogous with OSEBERG BLEND 2006 (selected from SINTEF'S OSCAR Database). The modelling assumed the following spill response, namely the installation of a capping stack only on the 20^{th} day following the blow-out.

Threshold values applied to illustrate modelling output results are 58 ppb for oil in the water column, 0.04 µm for the surface oil thickness and 10 g/m^2 for shoreline oiling (Livas 2023b for details).

The discussion of modelling results and impact assessment below is based on the worst-case scenario of assuming **capping only** in the event of a blowout.

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.

<u>Surface Layer and Water Column Probability of Contamination (Release Point D)</u>

Stochastic simulation results of the oil spill modelling study indicated that the crude oil and gas mixture escaping from the well reaches the higher probability for contamination of the surface (assuming capping only) forming a plume that is transported in a WNW to NNW direction by the current. Figure 4.12 shows probabilities of surface contamination (>0.04 µm surface oil thickness) for each quarter (assuming capping only). Based on Figure 4.12, one can notice that:

- The main drift direction of the spill simulated is towards WNW to NNW for all quarters. This is due to the main surface currents towards NW and winds from S to SSE in this area.
- In consequence, there is no oil reaching the shore for all these seasons. An oil presence with low probabilities (<10%) can be noted on the East direction from the release Point D, towards the shoreline, for Quarters 2 and 3. This may correspond to a short episode of wind coming from the west, but which does not last long enough to drift the oil to the coast.
- The maximum distance for the 80 to 100% oil surface probability is 687 km NW from the release point for Quarter 1 (January to March).

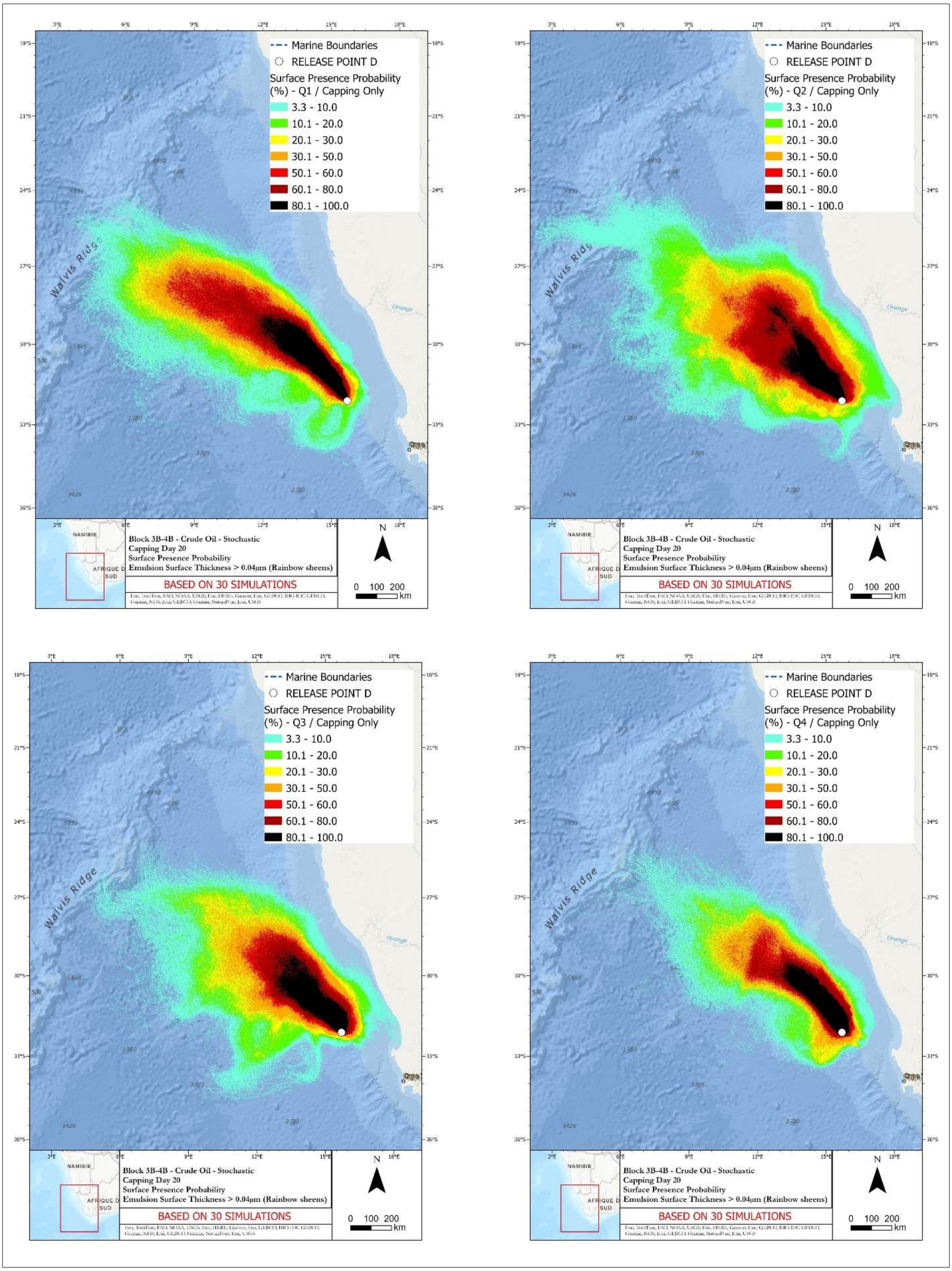

Figure 4.12 Surface probability of contamination >0.04 µm surface oil thickness for each quarter with capping only (release point D) (Source: Livas 2023b).

Table 4.12 below presents the main results of the Crude Oil Spill stochastic Scenarios for all the Quarters.

Table 4.12: Summary of the results of the Stochastic simulations for Capping Only / All Quarters for Point D.

Quarter	Max Distance of Oil Presence Probability 80 to 100% in 60 days / Drift Direction (Thickness >0.04µm)	Minimum Surface Arrival Time	Max. Distance Surface Arrival Time in 1 day	Maximum Emulsion Surface Thickness	MAX. % shoreline impact probability	Offshore surface waters reached by a spill
Q1	687 km NW	3 hours	83 km NW	412 µm at 80 km NNE from release point	NA	**South African Waters for the highest probabilities** **Namibia and International Waters**
Q2	589 km NNW		80 km NW & 38 km E	619 µm 40 km W from release point		
Q3	510 km NNW		70 km NW & 60 km SE	589 µm 33 km ENE from release point		
Q4	452 km NNW		65 km NW & 38 km SE	464 µm 51 km NE from release point		

In the event of a blowout the oil would reach the surface between 900 m and 1 200 m to the S and SW of the release point within 3 hrs of the blowout. The maximum emulsion thickness reached at the surface is 619 µm, at localised spots to a maximum of 40 km W from the release point (Q2). Although the oil is evaporated, dispersed and biodegraded once at the surface, some oil remains at the surface at the end of the simulations modelled (60 days) between 700 km and 1 000 km to the NW of the release. In the case of Q2 and Q3, if the oil is not recovered from the surface, there is potential for it reaching the shoreline north of Saldanha Bay. Oil dispersed on the surface will affect the upper water layers. The high proportion of gas contained in the release results in rapid ascent to the surface. Consequently, there is no contamination of the deep layers (900 – 1 499 m), but some oil does remain in the water column as long as 20 days following release.

<u>Capping Only Scenario - Stochastic Simulation – Release Point D</u>

Table 4.13 presents the predicted area of contaminated fishing ground based on the probability of presence of oil above the threshold (0.04 µm) at sea surface.

After 60 days, most of the oil is evaporated, biodegraded and dispersed. Some oil is remaining at the surface. i.e. duration of impact on fishing operations could be considered to be maximum of 60 days but shorter than this if recovery measures/surface response is implemented.

Q2 shows the highest likelihood of surface oiling extending into areas inshore of the release point as a result of westerly winds having an effect on the trajectory of the surface oil slick (i.e. in addition to the prevailing water current moving the slick in a predominantly NW direction away from the coastline). Although the findings of the modelling are that the surface oil travels the greatest distance during Q1 (due to environmental conditions), the risk to fisheries of surface oiling is highest if inshore areas are contaminated as this could affect nearshore activities and sensitive areas.

Table 4.13: Summary of the results of the Stochastic simulations for Capping Only / All Quarters for Point D.

Scenario STO-A Point D Q2	Results Contaminated area (Capping Stack Day 20)	Oil-surface probability contour			
		3.3%	10%	50%	90%
Fishery Sector	**Main spill direction**	WNW to NNW			
Demersal longline	**Contaminated surface area of fishing ground (km²)**	25 173	22 848	7 980	-
	Contaminated proportion of fishing ground (%)	25.51	23.15	8.09	-
	Catch (tons of hake per year; ave 2000-2017)	725	713	202	-
	Catch (%)	9.06	8.91	2.52	-
Small pelagic purse-seine	**Contaminated surface area of fishing ground (km²)**	13 160	6 870	-	-
	Contaminated proportion of fishing ground (%)	27.19	14.19	-	-
	Catch (tons per year; ave 2017-2022)	71 373	6 027	-	-
	Catch (%)	24.4	2.06	-	-
Large pelagic longline	**Contaminated surface area of fishing ground (km²)**	108 159	84 329	51 470	28 166
	Contaminated proportion of fishing ground (%)	22.51	17.55	10.71	5.86
	Catch (tons per year; ave 2015-2022)	562	491	397	241
	Catch (%)	19.85	17.34	14.02	8.51
Demersal trawl	**Contaminated surface area of fishing ground (km²)**	15 300	15 300	8 908	-
	Contaminated proportion of fishing ground (%)	20.59	20.59	11.99	-
	Catch (tons per year; ave)	7 573	7 573	4 457	-
	Catch (%)	7.71	7.71	4.54	-
Tuna pole-line	**Contaminated surface area of fishing ground (km²)**	37 560	26 867	10 694	664
	Contaminated proportion of fishing ground (%)	44.22	31.63	12.59	0.78
	Catch (tons of albacore per year; ave)	511	401	169	3
	Catch (%)	14.65	11.49	4.85	0.04
Linefish	**Contaminated surface area of fishing ground (km²)**	2 103	881	-	-
	Contaminated proportion of fishing ground (%)	4.87	2.04	-	-
	Catch (tons per year: ave 2000-2021)	1 225	24	-	-
	Catch (%)	10.47	0.21	-	-
WCRL nearshore/ bakkies	**Number of contaminated management sub-areas of total active management sub-areas**	7 of 40	2 of 40	-	-
	Catch (tons per year: ave 2016-2020)	9	<1	-	-
	Catch (%)	4.23	0.05	-	-
WCRL offshore/ trapboats	**Number of contaminated management sub-areas of total active management sub-areas**	9 of 21	1 of 21	-	-
	Catch (tons per year: ave 2016-2020)	95	2	-	-
	Catch (%)	7.47	0.13	-	-

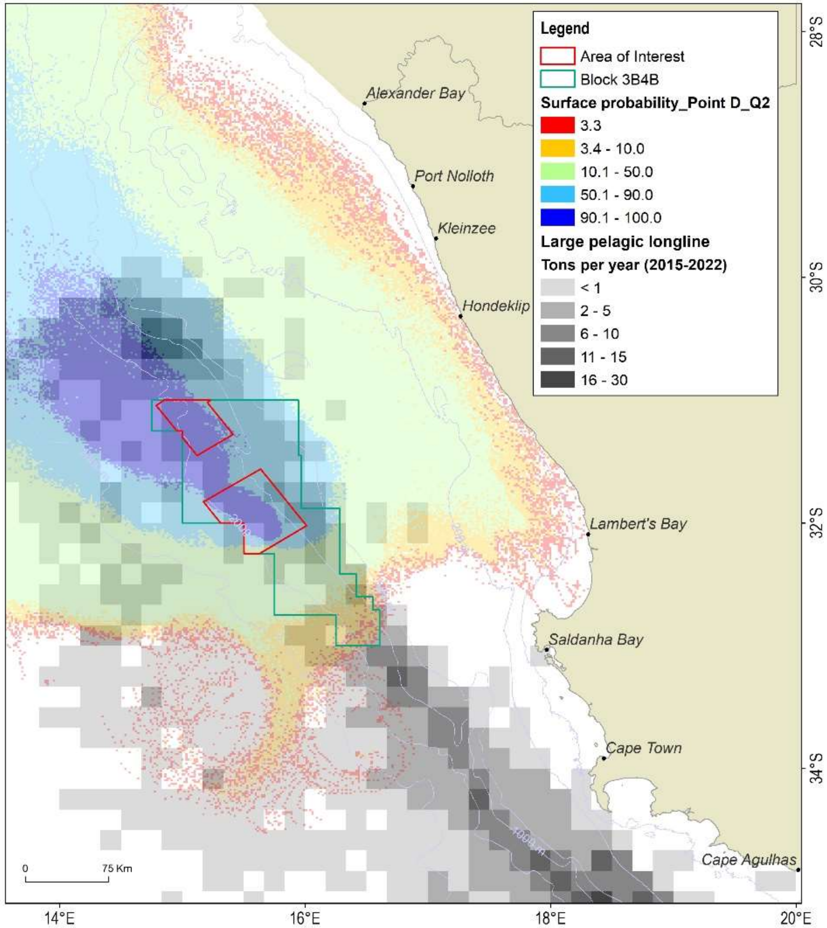

Figure 4.13 Fishing grounds of the large pelagic longline sector in relation to the surface probability of contamination during well blowout of crude oil (Q2; with capping response only).

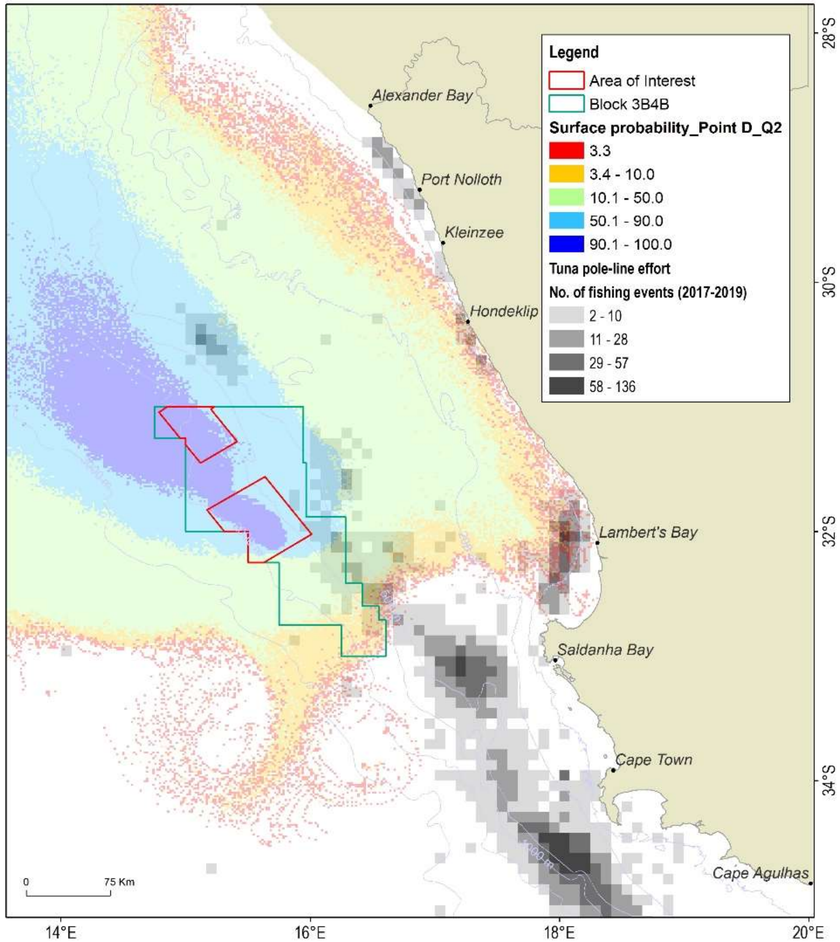

Figure 4.14 Fishing grounds of the tuna pole-line sector in relation to the surface probability of contamination during well blowout of crude oil (Q2; with capping response only).

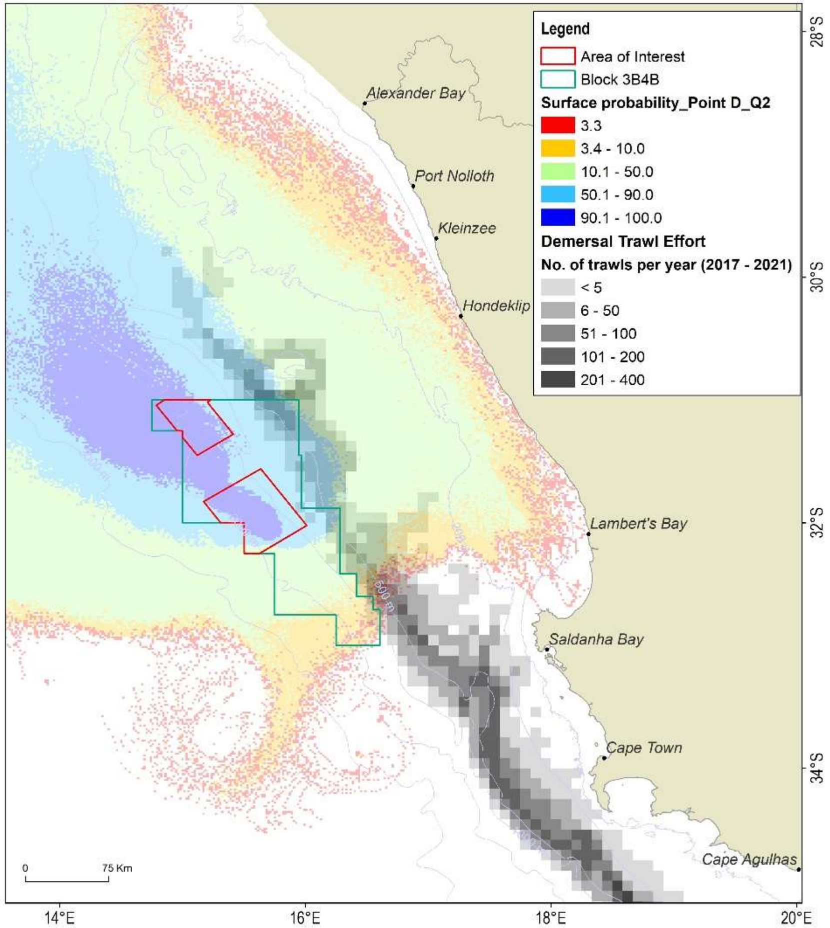

Figure 4.15 Fishing grounds of the demersal trawl sector in relation to the surface probability of contamination during well blowout of crude oil (Q2; with capping response only).

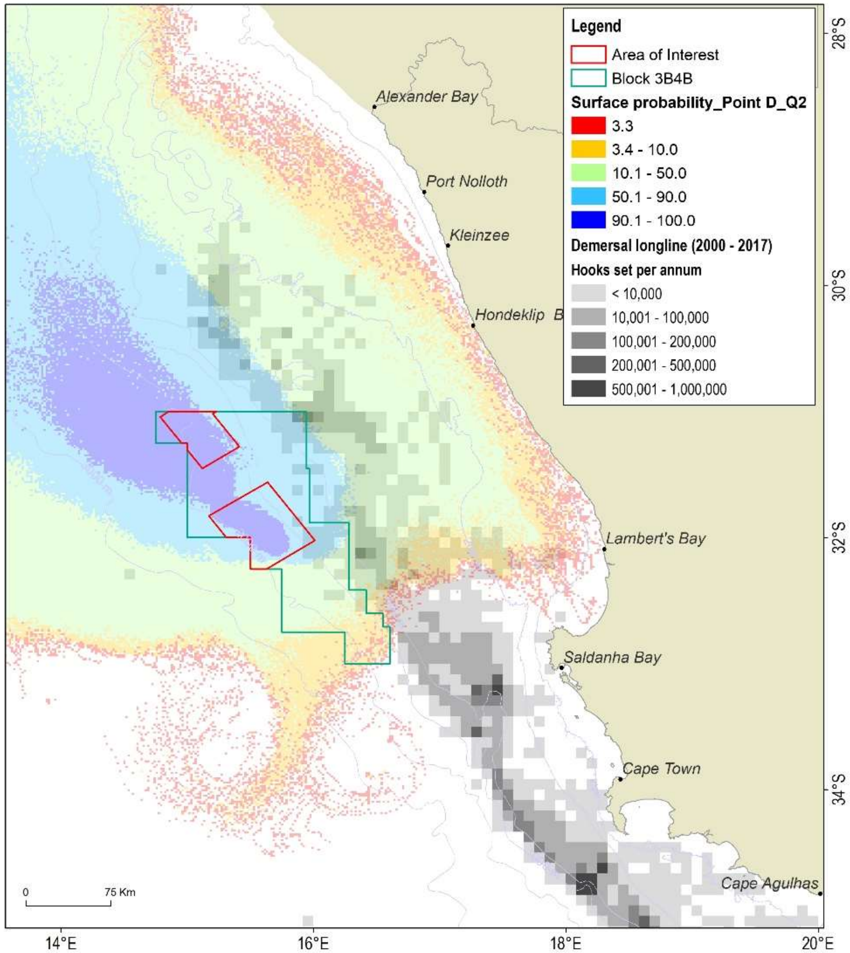

Figure 4.16 Fishing grounds of the demersal longline sector in relation to the surface probability of contamination during well blowout of crude oil (Q2; with capping response only).

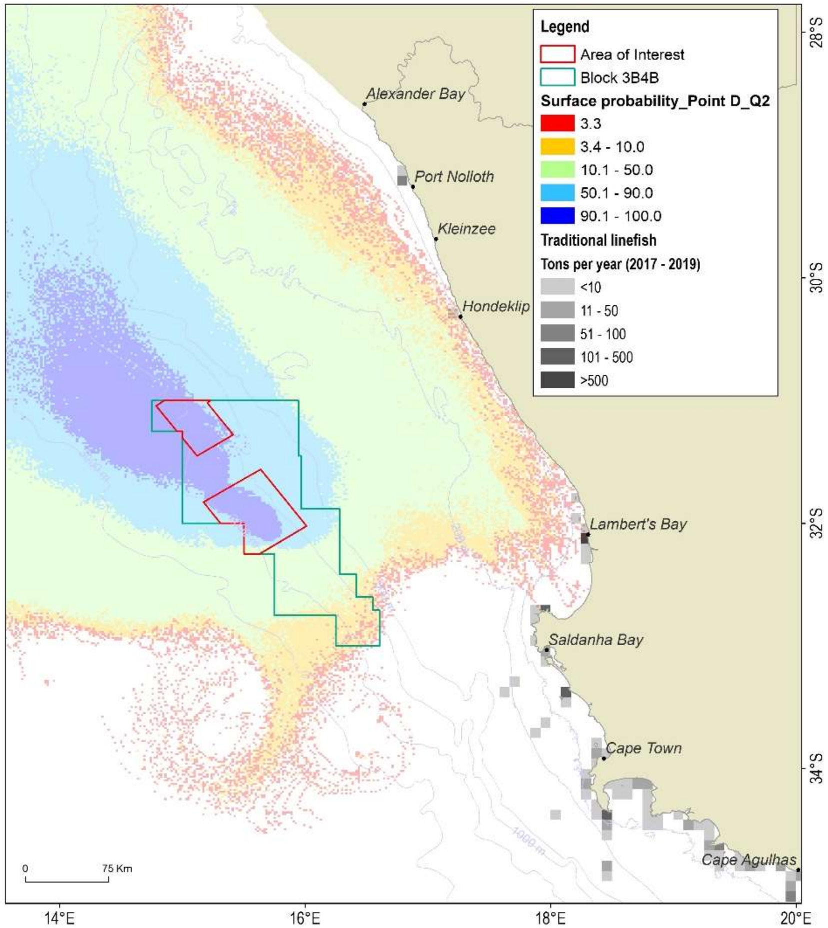

Figure 4.17 Fishing grounds of the traditional linefish sector in relation to the surface probability of contamination during well blowout of crude oil (Q2; with capping response only).

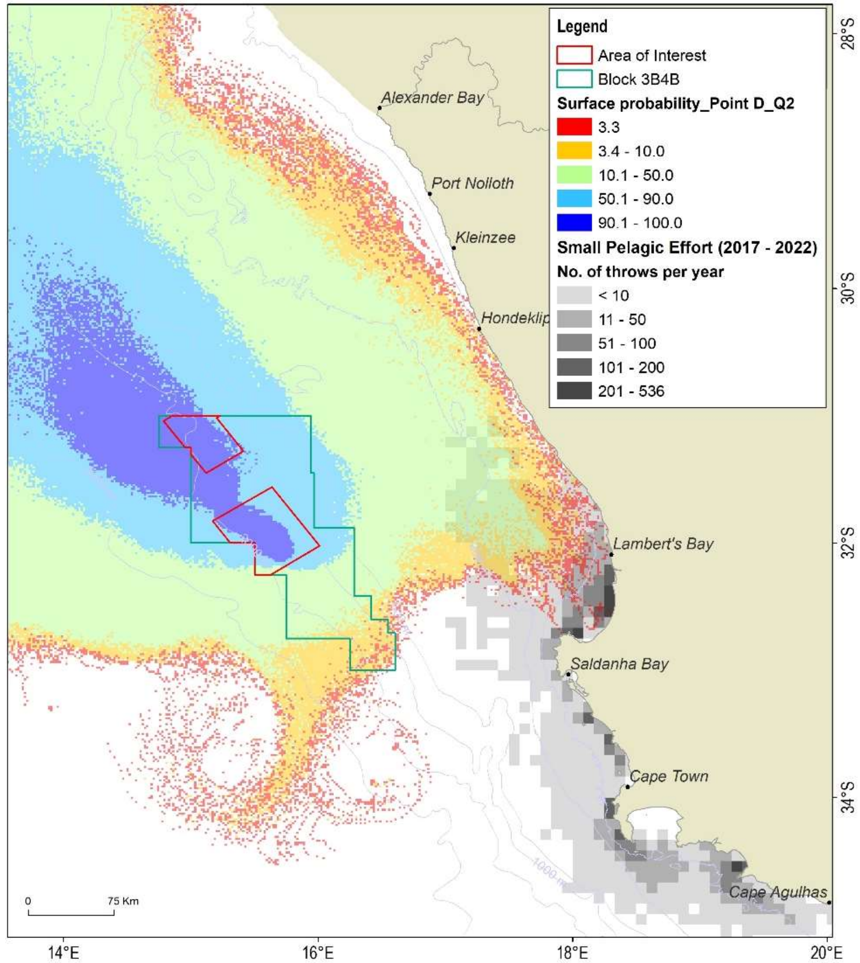

Figure 4.18 Fishing grounds of the small pelagic purse-seine sector in relation to the surface probability of contamination during well blowout of crude oil (Q2; with capping response only).

Impact Magnitude

Crude oil (Capping only scenario at Release Point D during Q2): Large scale effects on fishing operations would likely include area closures and exclusion of fisheries from areas that may be polluted or closed to fishing due to contamination of surface waters. The extent of the surface contaminated areas in respect to the location of fishing grounds have been identified for four oil-spill probability contours (3.3%, 10%, 50% and 90%). The 90% probability contour overlaps ~6% of fishing grounds of the large pelagic longline sector and ~1% of that of the tuna pole-line sector. The 50% probability contour overlaps ~8% of fishing grounds of the demersal longline and ~12% of demersal trawl sectors, ~11% and ~13%, respectively, of the large pelagic longline and tuna pole-line sectors. The 10% probability contour overlaps ~23% of demersal longline, ~21% demersal trawl fishing ground, ~14% small pelagic purse-seine, ~18% large pelagic longline, ~32% tuna pole-line, ~2% linefish and <1% of the west coast rock lobster grounds. The 3% probability contour extends across ~26% of demersal longline and ~21 % of demersal trawl fishing ground, ~27% small pelagic purse-seine, ~23% large pelagic longline, ~44% tuna pole-line, ~5% linefish and 4% and 7%, respectively, of the inshore and offshore west coast rock lobster grounds.

Impact Significance

The extent of surface oiling could be international in extent. The intensity of the impact is considered to be high and the duration ranging from short-term to medium-term. Short-term impacts relating to the presence of oil above threshold levels, and medium-term relating to potential impacts on recruitment. Due to the main drift of the oil offshore and away from the majority of fishing grounds and sensitive recruitment areas (nursery grounds), the sensitivity of fisheries has been rated as medium. The overall impact significance before mitigation is rated high.

Small spills: For small spills of diesel or hydraulic fuel during normal operations, the dominant weathering processes are evaporation and dispersion over the immediate-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 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 immediate-term. In nearshore water, the magnitude of a small spill on all fisheries is expected to be of MEDIUM. 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.

Mitigation

Mitigation measures would require the implementation of an oil spill contingency plan including specialised well capping facilities for uncontained blow-outs.

In addition to the best industry practices and the project standards, Table 4.14 lists the recommended measures to manage the impacts associated with blow-outs.

Table 4.14: Measures for mitigating impacts of an emergency oil spill event on fisheries.

No.	Mitigation measure	Classification
1	The safe operating metocean conditions need to be defined based on the drill rig/ ship. Operations should not occur outside of these pre-defined metocean conditions..	Avoid
2	Develop a response strategy and plan (OSCP), aligned with the National OSCP that identifies the resources and response required to minimise the risk and impact of oiling (shoreline and offshore). This response strategy and associated plans must take cognisance to the local oceanographic and meteorological seasonal conditions, local environmental receptors and local spill response resources. The development of the site-specific response strategy and plans must include the following:	Avoid / Abate on and off site / Restore
2.1	Assessment of onshore and offshore response resources (equipment and people) and capabilities at time of drilling, location of such resources (in-country or international), and associated mobilisation / response timeframes.	Avoid / Abate on and off site / Restore
2.2	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.	
2.3	Well-specific oil spill modelling for planning purposes taking into consideration site- and temporal-specific information, the planned response strategy, and associated resources.	
2.4	Develop intervention plans for the most sensitive areas to minimise risks and impacts and integrate these into the well-specific response strategy and associated plans.	
2.5	If modelling and intervention planning indicates that the well-specific response strategy and plans cannot reduce the response times to less than the time it would take oil to reach the shore, additional proactive measures must be committed to. For example: Implement measures to reduce surface response times (e.g. pre-mobilise a portion of the dispersant stock on the support vessels, contract additional response vessels and aircrafts, improve dispersant spray capability, etc.).	
3	Schedule joint oil spill exercises including AOSAC and local departments / organisations to test the Tier 1, 2 & 3 responses.	Abate on site / Restore
4	Ensure contract arrangements and service agreements are in place to implement the OSCP, e.g. capping stack in Saldanha Bay and other international locations, surface response equipment (e.g. booms, dispersant spraying system, skimmers, etc.), dispersants, response vessels, etc.	Abate on site / Restore
5	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
6	Ensure a standby vessel is within 30 minutes of the drilling unit, equipped for dispersant spraying and can be used for mechanical dispersion (using the propellers of the ship and/or firefighting equipment). It should have at least 5 m^3 of dispersant onboard for initial response.	Abate on 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 drifter buoys and 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

No.	Mitigation measure	Classification
9	The Operator is to submit all forms of financial insurance and assurances to PASA to manage all damages and compensation requirements in the event of an unplanned pollution event.	Restore
10	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.	Restore

Residual Impact

With the implementation of the above-mentioned intrinsic mitigation measures, the residual impact would be of **LOW significance** for small spills (refer to Table 4.15), of **MEDIUM significance** for large spills of condensate (refer to Table 4.16) and of **MEDIUM significance** for large spills of crude oil (refer to Table 4.17).

Table 4.15 Impact on the fishing industry of an unplanned, small operational spill from drilling and associated activities.

7	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	Low	Low

Table 4.16 Impact on the fishing industry of an unplanned, large-scale blow-out of condensate.

8	Impact on fisheries of large-scale hydrocarbon spill	
Project Phase	Operational	
Type of Impact	Direct	
Nature of Impact	Negative	
	Pre-Mitigation Impact	Residual Impact
Sensitivity of Receptor	MEDIUM	MEDIUM
Magnitude (or Consequence)	VERY HIGH	HIGH
Intensity	High	High
Extent	Regional	Regional
Duration	Short-Term	Short-Term
Significance	MEDIUM	MEDIUM
Probability	Unlikely	Unlikely
Confidence	Medium	Medium
Reversibility	Partially Reversible	Partially Reversible
Loss of Resources	High	Medium
Mitigation Potential	-	Medium
Cumulative potential	Medium	Medium

Table 4.17 Impact on the fishing industry of an unplanned, large-scale blow-out of crude oil.

9	Impact on fisheries of large-scale hydrocarbon spill	
Project Phase	Operational	
Type of Impact	Direct	
Nature of Impact	Negative	
	Pre-Mitigation Impact	Residual Impact
Sensitivity of Receptor	MEDIUM	MEDIUM
Magnitude (or Consequence)	VERY HIGH	HIGH
Intensity	High	High
Extent	International	Regional
Duration	Short-Term to Medium-Term	Short-Term
Significance	HIGH	MEDIUM
Probability	Unlikely	Unlikely
Confidence	Medium	Medium
Reversibility	Partially Reversible	Partially Reversible
Loss of Resources	High	Medium
Mitigation Potential	-	Medium
Cumulative potential	Medium	Medium

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 while in transit to the well-drilling Area of Interest. Floating equipment could become entangled with fishing gear designed to target the pelagic zone or surface waters (e.g. pelagic longlines). 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 4.18: 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 4.19).

Table 4.19 Impact on the Fishing Industry of Lost Equipment.

10	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[32] .

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). Approximately 40 wells have been drilled in the Southern Benguela Ecoregion, with the majority of these occurring in the iBhubesi Gas field in Block 2A inshore of the Deep Water Orange Basin Block. Eco Atlantic recently completed the drilling of the Gazania-1 well in Block 2B which was spudded on 10 October 2022. Prior to 1983, technology was not available to remove wellheads from the seafloor, thus of the approximately 40 wells drilled on the West Coast, 35 wellheads remain on the seabed.

There is no current development or production from the South African West Coast offshore. The Ibhubesi Gas Field (Block 2A) 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 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

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

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 3B/4B 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 Namibia, wells have recently been drilled by TotalEnergies in Block 2913B (2021 to 2024) and Block 2912 (2023), Shell in PEL39 (2021, 2022) and GALP in PEL83 (2024).

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 (Searcher, 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 could potentially have overlapping impacts such as 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.

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, 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.

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 4.20: Known 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	Drilled Gazania 1 in November 2022
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	Yes	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

YEAR	RIGHT HOLDER / OPERATOR	BLOCK	ACTIVITY	APPROVAL	CONDUCTED / COMPLETED
2018	PGS	West Coast regional	2D and 3D Seismic	Yes	No
2019	Anadarko	Block 5/6/7	2D Seismic	Yes	
2021	Searcher	West Coast regional	2D and 3D Seismic	Yes	2D: Jan 2022 (incomplete due to court interdict to stop survey)
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	Withdrawn	No
2022	Searcher	Deep Water Orange Basin	3D Seismic	Yes (currently appealed)	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	Yes	No - current project
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 - current
2019	Galp Namibia	PEL83	Exploration drilling	Yes	No (Applying for ECC extension)
2019	TEEPNA	Block 2913B (PEL56)	Exploration drilling	Yes	Drilling: Nov 2021 – current
2020	TEEPNA	Block 2912, 2913B (PEL91; PEL56)	3D Seismic EIA Application (2023) for exploration drilling ongoing	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

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; and 6) noise emissions during sonar surveys. The potential impact of unplanned (accidental) events were identified as: 7) low volume release of diesel or hydraulic fuel from vessels or drilling unit; 8) a large-scale, uncontrolled blow-out of hydrocarbons at the well due to a failure of pressure control systems; and 9) 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 3B/4B, the proposed new area for well drilling and impacted areas.

Sector	% of National Catch					
	Within Block 3B/4B	Within AOI for drilling	Within Affected Area			
			Drilling unit (500 m)	Abandoned wellhead (500 m)	Sound (3 km)	Smothering
Demersal Trawl	0	0	0	0	0	0
Midwater Trawl	0	0	0	N/A	0	N/A
Demersal Longline	0	0	0	N/A	0	0
Small Pelagic Purse-Seine	0	0	0	N/A	0	N/A
Large Pelagic Longline	6.6	4.5	2.76*	N/A	0.12	N/A
Tuna Pole-Line	0	0	0	N/A	0	N/A
Traditional linefish	0	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	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	LOW
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	LOW
5	VSP Noise	Operation	LOW	LOW
6	Sonar Noise	Operation	LOW	LOW
7	Accidental Oil Spill: Minor	Unplanned Event	LOW – MEDIUM	LOW
8	Accidental Oil Spill: Major	Unplanned Event	HIGH	MEDIUM
9	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	The safe operating metocean conditions need to be defined based on the drill rig/ ship. Operations should not occur outside of these pre-defined metocean conditions.	Avoid
2	Develop a response strategy and plan (OSCP), aligned with the National OSCP that identifies the resources and response required to minimise the risk and impact of oiling (shoreline and offshore). This response strategy and associated plans must take cognisance to the local oceanographic and meteorological seasonal conditions, local environmental receptors and local spill response resources. The development of the site-specific response strategy and plans must include the following:	Avoid / Abate on and off site / Restore
2.1	Assessment of onshore and offshore response resources (equipment and people) and capabilities at time of drilling, location of such resources (in-country or international), and associated mobilisation / response timeframes.	
2.2	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.	
2.3	Well-specific oil spill modelling for planning purposes taking into consideration site- and temporal-specific information, the planned response strategy, and associated resources.	
2.4	Develop intervention plans for the most sensitive areas to minimise risks and impacts and integrate these into the well-specific response strategy and associated plans.	
2.5	If modelling and intervention planning indicates that the well-specific response strategy and plans cannot reduce the response times to less than the time it would take oil to reach the shore, additional proactive measures must be committed to. For example: Implement measures to reduce surface response times (e.g. pre-mobilise a portion of the dispersant stock on the support vessels, contract additional response vessels and aircrafts, improve dispersant spray capability, etc.).	
3	Schedule joint oil spill exercises including AOSAC and local departments / organisations to test the Tier 1, 2 & 3 responses.	Abate on site / Restore

4	Ensure contract arrangements and service agreements are in place to implement the OSCP, e.g. capping stack in Saldanha Bay and other international locations, surface response equipment (e.g. booms, dispersant spraying system, skimmers, etc.), dispersants, response vessels, etc.	Abate on site / Restore
5	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
6	Ensure a standby vessel is within 30 minutes of the drilling unit, equipped for dispersant spraying and can be used for mechanical dispersion (using the propellers of the ship and/or firefighting equipment). It should have at least 5 m3 of dispersant onboard for initial response.	Abate on 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 drifter buoys and 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	The Operator is to submit all forms of financial insurance and assurances to PASA to manage all damages and compensation requirements in the event of an unplanned pollution event.	Restore
10	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.	Restore

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 EIA Team has adopted a set of conventions for purposes of the integrated assessment of potential impacts, and the determination of impact significance. The impact significance rating methodology, as provided by EIMS, is guided by the requirements of the NEMA EIA Regulations, 2014. The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/ likelihood (P) of the impact occurring. This determines the environmental risk. In addition other factors, including cumulative impacts, public concern, and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall significance (S).

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

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

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

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in Table 4.

Table 4: Criteria for determination of impact consequence

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact

Extent	1	Activity (i.e. limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property boundary),
	3	Local (i.e. the area within 5 km of the site),
	4	Regional (i.e. extends between 5 and 50 km from the site
	5	Provincial / National (i.e. extends beyond 50 km from the site)
Duration	1	Immediate (<1 year)
	2	Short term (1-5 years),
	3	Medium term (6-15 years),
	4	Long term (the impact will cease after the operational life span of the project),
	5	Permanent (no mitigation measure of natural process will reduce the impact after construction).
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected),
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected),
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way),
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease), or
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease).
Reversibility	1	Impact is reversible without any time and cost.
	2	Impact is reversible without incurring significant time and cost.
	3	Impact is reversible only by incurring significant time and cost.
	4	Impact is reversible only by incurring prohibitively high time and cost.
	5	Irreversible Impact

Once the C has been determined the ER is determined in accordance with the standard risk assessment relationship by multiplying the C and the P. Probability is rated/scored as per Table 18.

Table 5: Probability scoring

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

	4	High probability (it is most likely that the impact will occur- > 75% probability), or
	5	Definite (the impact will occur),

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

ER= C x P

Table 6: Determination of environmental risk

Consequence	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
	Probability					

The outcome of the environmental risk assessment will result in a range of scores, ranging from 1 through to 25. These ER scores are then grouped into respective classes as described in Table 7.

Table 7: Significance classes

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

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

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

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

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

Table 8: Criteria for the determination of prioritisation

Cumulative Impact (CI)	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.
	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.
Irreplaceable loss of resources (LR)	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.
	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in Table 21. The impact priority is therefore determined as follows:

Priority = CI + LR

The result is a priority score which ranges from 3 to 9 and a consequent PF ranging from 1 to 1.5 (refer to Table 22).

Table 9: Determination of prioritisation factor

Priority	Prioritisation Factor
2	1
3	1.125
4	1.25
5	1.375
6	1.5

In order to determine the final impact significance the PF is multiplied by the ER of the post mitigation scoring. The ultimate aim of the PF is to be able to increase the post mitigation environmental risk rating by a factor of 0.5, if all the priority attributes are high (i.e. if an impact comes out with a medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential and significant potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a high significance).

Table 10: Environmental Significance Rating

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

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

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

APPENDIX 2: SMALL-SCALE FISHING CO-OPERATIVE 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						UMGABABA	Durban	29
2						MEREBANK	Durban	70
3		Ethekwini Metropolitan	190	ethekwini	190	CROSSMOOR	Durban	31
4						ISIPHINGO	Durban	28
5						CLAIRWOOD	Durban	32
6						THUKELA	Mandeni	44
7				Kwadukuza	83	GROUTVILE	Stanger	
8						NONOTI	Stanger	39
9		Ilembe	147			WANGU	Mandeni	
10				Mandeni	64	AMATIKULU	Mandeni	33
11						DOKODWENI	Mandeni	31
12				uMhlathuze	34	ESIKHALENI+NOZALELA	Richards Bay	34
13						NZALABANTU+ AQUADENE	Richards Bay	45
14		King Chwetshayo	399			NHLABANE	Richards Bay	59
16				Umfolozi	365	KWA-MBONAMBI	Richards Bay	37
17						SOKHULU	Richards Bay	224
18						GAMALAKHE	Port Shepstone	36
19						NZIMAKWE	Port Edward	20
20	KZN			Ray Nkonyeni	304	ISIHLONYANENI	Port Shepstone	169
21		ugu	456			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						KWA-GEORGE	Manguzi	17
26						MAZAMBANE	Manguzi	75
27						KWA-DAPHA	Manguzi	26
28				Umhlabuyalingana	364	MANZENGWENYA+MPUKANE	Manguzi	26
29						MAHLUNGULA+MVUTSHANA	Manguzi	54
30						MABIBI	Mbazwana	30
31						KWAMBILA	Mbazwana	115
32		Umkhanyakude	816			NKOVUKENI	Manguzi	21
33						QAKWINI	Mtubatuba	39
34						DUKUDUKU & KHAYELISHA	Mtubatuba	61
35				Mtubatuba	452	MFEKAYI	Mtubatuba	35
36						NIBELA	Hluhluwe	108
37						MPEMBENI	Richards Bay	143
38						NKUNDUSI	Mtubatuba	66
39	**Total**							
40						MZAMBA		66
41						MTHOLANI		27
42		ALFRED NZO	221	MBIZANA	221	XHOLOBENI	BIZANA	28
43						MDATYA		21
44						LUPHITHINI		35
45						MTHENTHU		44
46						NDENGANE/KHANYAYO		66
47				INGQUZA HILL	324	RHOLE/DIMFI/KHONJWAYO	LUSIKISIKI	110
48						MBOTYI		124
49						CUTWINI		24
51						SICAMBENI/VUKANDLULE		66
52						MTUMBANA		40
53		O.R TAMBO	2409			PORT ST. JOHNS		47
54						NOQHEKWANA/ BOLANI		101
55				PORT ST. JOHNS	1124	LUPHOKO	PORT ST JOHNS	29
56						MTHAMBALALA/LUJAZO		56
57						MANTEKU		81
58						TSWELENI/SIHLANJENI		75
59	EC					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	CENTANI	226
97						GCINA/GQUNQE		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				NGQUSHWA	186	HAMBURG	PEDDIE	76
106						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		NELSON MANDELA BAY		NELSON MANDELA BAY		KWAZAKHELE/SWARTKOPS/		130
116					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
Academic Record: University of Cape Town, South Africa; BSc Honours (2001)
University of Cape Town; BSc (Oceanography 1998 – 2000)

Employment Record: Capricorn Marine Environmental (Pty) Ltd (2003 – present)

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

Key Experience:

- Geographical information systems, mapping and data analysis with focus on fisheries in the Benguela and Agulhas Current Large Marine Ecosystems.
- Specialist assessments on the impact of offshore hydrocarbon exploration, installation activities and marine infrastructure on fisheries in South Africa, Namibia, Mozambique and Angola (in accordance with scoping and EIA requirements). Refer to recent reports listed below:

Oil & Gas Exploration & Extractive

Applicant	Activity	Area	Date
TotalEnergies Namibia	Well Drilling	Bock 2912, Namibia	2023
TGS	Seismic Survey	West Coast, SA, regional	2023
TotalEnergies Namibia	Well Drilling	Block 293B, Namibia	2022
TotalEnergies South Africa	Well Drilling	Block 5/6/7, SA	2021
CGG	Seismic Survey	Transkei Basin, SA	2021
Searcher Seismic	Seismic Survey	West Coast, SA	2021
Spectrum	Seismic Survey	Orange Basin, SA	2021
Shearwater Geo-Services	Seismic Survey	East Coast, SA	2021
Tosaco Energy	Seismic Survey	Block 1, South Africa	2021
Tullow Ltd	Seismic Survey	PEL90, Namibia	2021
Total E&P South Africa	Well Drilling	Block 11B/12B, SA	2020
Total E&P South Africa	Seismic Survey	South Outeniqua, SA	2020
Total E&P Namibia	Seismic Survey	2912 & 2913B, Namibia	2020
Total E&P South Africa	Seismic Survey	Block 11B/12B, SA	2019
Total E&P South Africa	Well Drilling	Southeast Coast, SA	2019
Petroleum Geo-Services	Seismic Survey	West & Southwest Coasts, SA	2018
ENI	Well Drilling	East Coast, SA	2018
Petroleum Geo-Services	Seismic Survey	East & South Coasts, SA	2018
Impact Africa Ltd	Seismic Survey	Orange Basin, SA	2017
Sungu Sungu Oil (Pty) Ltd	Seismic Survey	Pletmos Basin, SA	2017
Windhoek PEL 23 & 28 B.V.	Well Drilling	PEL82 & PEL83, Namibia	2019
Shell Namibia B.V.	Seismic Survey	PEL39, Namibia	2018
Shell Namibia B.V.	Well Drilling	PEL39, Namibia	2019
Spectrum Geo Ltd	Seismic Survey	Regional, Namibia	2017
GALP	Seismic Survey	PEL82 & PEL83, Namibia	2017
Spectrum Geo Ltd	Seismic Survey	Regional, Namibia	2016
Murphy Lüderitz Oil Co. Ltd	Well Drilling	2613A & 2613B, Namibia	2015

Marine Minerals

Belton Park Trading 127 Pty Ltd	Marine Prospecting	14B, 15B, 17B, West Coast, SA	2021
De Beers Marine	Marine Mining	West Coast, SA	2021
LK Mining	Marine Mining	EPL5965, Namibia	2021
Belton Park Trading 127 Pty Ltd	Marine Prospecting	13C, 15C, 16C, 17C, 18C, SA	2020
Belton Park Trading 127 Pty Ltd	Marine Mining	2C & 3C, SA	2018
De Beers Marine	Marine Mining	6C, SA	2018
Alexkor	Marine Mining	1A-C,2A,3A,4A-B, SA	2017
West Coast Resources Pty Ltd	Marine Mining	6A-8A, SA	2016
Belton Park Trading 127 Pty Ltd	Marine Mining	2C, SA	2016
LK Mining	Marine Mining	EPL5965, Namibia	2016

Subsea Cables and Pipelines

Alcatel Submarine Networks	Subsea Cable	2AFRICA West, South Africa	2021
Alcatel Submarine Networks	Subsea Cable	2AFRICA East, South Africa	2021
Equiano	Subsea Cable	Regional, Namibia	2020
Telkom SA SOC Ltd/Equiano	Subsea Cable	West Coast, South Africa	2019
METISS Cable System	Subsea Cable	East Coast, South Africa	2019
IOX	Subsea Cable	South Coast, South Africa	2018
PetroSA (Pty) Ltd	Subsea Pipeline	E-BK, Block 9, South Africa	2017
ACE Cable / MTN (Pty) Ltd	Subsea Cable	West Coast, South Africa	2016
Xaris Energy Namibia	Subsea Pipeline	Walvis Bay, Namibia	2015

Other Experience:

- 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 ship-based scientific observer programmes for the South African Pelagic Fishing Industry Association and South African Deepsea Trawling Industry Association.
- 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; WWF South Africa).
- Ringfencing the trawl footprint (South African Deepsea Trawling Industry Association).
- Mapping of benthic habitat types, Southern Namibia inshore and nearshore region for Namdeb.

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.

Norman, S.J, Wilkinson, S.J. Japp, D.W., Reed, J and K.J Sink. 2018. A Review and Strengthening of the Spatial Management of South Africa's Offshore Fisheries. Prepared for the South African National Biodiversity Institute

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.

Sink K, Wilkinson S, Atkinson L, Sims P, Leslie R and C Attwood 2012. The potential impacts of South Africa's demersal trawl fishery on benthic habitats: Historical perspectives, spatial analyses, current review and potential management actions. South African National Biodiversity Institute (SANBI).

Technical Report: Spatial/data layers of South African commercial fisheries (May 2009). Prepared for South African National Biodiversity Institute.

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.

EIMS | ENVIRONMENTAL IMPACT MANAGEMENT SERVICES

SPECIALIST DECLARATION

EIMS Ref	1570	Project Name	PROPOSED AFRICA OIL SOUTH AFRICA CORP BLOCK 3B/4B EXPLORATION RIGHT

Project Details

Project Name	Proposed Africa Oil South Africa Corp Block 3b/4b Exploration Right
Applicant	Africa Oil SA Corp, Ricocure (Pty) Ltd and Azinam Limited (a wholly owned subsidiary of Eco Atlantic) (the Joint Venture (JV) Partners)
Competent Authority	Department of Mineral Resources

Specialist Details

Specialist Company	CAPRICORN MARINE ENVIRONMENTAL PTY LTD			
Specialist Name	SARAH WILKINSON			
Contact details	Tel	0827289673	Cell	0827289673
	E-mail	SARAH@CAPFISH.CO.ZA		
	Postal Address	P.O BOX 50035 WATERFRONT		
	Physical Address	UNIT 15 FOREGATE SQ. FORESHORE		

General Declaration

By signing this form, I hereby declare that:

- I act as an independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting undertaking the specialist work as required, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity.
- I will comply with the Act, Regulations, and all other applicable legislation.
- I have not, and will not engage in, conflicting interest in the undertaking of the activity.
- I understand to disclose to the applicant and competent authority all material information in my possession that reasonably has or may have the potential of influencing- any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority.
- I have taken into account, to the extent possible, the matters referred to in Regulation 18 when preparing the report, plan or document.
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not.
- All the particulars furnished by me this form are true and correct.

SPECIALIST DECLARATION

EIMS Ref	1570	Project Name	PROPOSED AFRICA OIL SOUTH AFRICA CORP BLOCK 3B/4B EXPLORATION RIGHT

- I will perform all other obligations as expected from an environmental assessment practitioner in terms of the Regulations.
- I am aware of what constitutes an offence in terms of Regulation 48 and that a person convicted of an offence in terms of Regulation 48(1) is liable to the penalties as contemplated in Section 49B of the Act.

Disclosure of Vested Interest

- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remunerative for work performed in terms of the Regulations.

Undertaking Under Oath/Affirmation

By signing this form, I swear under oath/affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signatures

Specialist					
Name	SARAH WILKINSON	Signature	[signature]	Date	02 APRIL 2024
Commissioner of Oaths					
Name	NE HINANA	Signature	[signature]	Date	2024-04-03

Commissioner of Oaths Official Stamp

SOUTH AFRICAN POLICE SERVICE
TABLE BAY HARBOUR
2024 -04- 03
TABLE BAY HARBOUR
SOUTH AFRICAN POLICE SERVICE

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