PROPOSED SPECULATIVE 3D SEISMIC SURVEY WITHIN LICENCE BLOCK 1, WEST COAST, SOUTH AFRICA

SPECIALIST FISHERIES ASSESSMENT

March 2021

Prepared for the Environmental Assessment Practitioner:

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CAPRICORN MARINE ENVIRONMENTAL PTY LTD

PROPOSED SPECULATIVE 3D SEISMIC SURVEY WITHIN OFFSHORE BLOCK 1, WEST COAST, SOUTH AFRICA

Fisheries Specialist Study

15 March 2021

Expertise and Declaration of Independence

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

This specialist report was compiled for Environmental Impact Management Services (Pty) Ltd (EIMS) on behalf of Tosaco Energy (Pty) Ltd (Tosaco), for their use during Scoping and Environmental Impact Assessment (EIA) Process associated with an Exploration Right Application for Offshore Block 1 located off the West Coast of South Africa. This specialist study will form an integral component of the EIA and will help to ensure that the approach meets the current environmental management best practice in terms of sustainable development. We do hereby declare that Capricorn Marine Environmental (Pty) Ltd is financially and otherwise independent of the Applicant and EIMS.

Dave Japp

Sarah Wilkinson

EXECUTIVE SUMMARY

Tosaco Energy (Pty) Ltd (Tosaco) proposes to a 3D seismic survey within Licence Block 1, situated offshore of the West Coast of South Africa. The Licence Block is situated offshore of Alexander Bay, in the Northern Cape Province. Tosaco propose an acquisition area of ~1,000 km^2 in water depths ranging from 115 m to 180 m. It is anticipated that the 3D survey would take approximately 4 months to complete.

The proposed survey would be conducted by a dedicated vessel towing a short array of airguns as well as an array of up to 12 receiving cables 12 km in length. The seismic survey could potentially affect the operations of several fisheries sectors that operate in the vicinity of the project area through 1) noise emissions generated during seismic survey activities and; 2) temporary exclusion from fishing grounds.

Sound generated during the proposed seismic survey is expected to be in the order of 220 dB re 1 μPa at 1 m at an operating frequency range of 5 – 300 Hz. This falls within the hearing range of most fish species. For the current project, the potential impact of elevated sound levels (produced by seismic airguns) on behavioural disturbance to fish (and associated effects on commercial catch rates) may be affected up to a distance of ~1.5 km from the sound source. Based on the overlap of the affected area with fishing grounds, an overall low negative significance can be expected on the demersal longline, tuna pole-line, traditional linefish and small-scale sectors, as well as on fisheries research surveys undertaken within the area on a bi-annual basis by DFFE.

During the seismic survey, fishing vessels would be required to maintain a safe operational distance of up to 9 Nautical miles from the survey vessel. The impact of potential exclusion was assessed for each commercial sector based on the affected area of fishing ground and the relative quantities of catch reported within the proposed survey acquisition area. The impact of potential exclusion from fishing grounds was assessed to be of low negative significance to the demersal longline, tuna pole-line, traditional linefish and small-scale sectors, which show relatively low levels of fishing activity in the vicinity of the proposed seismic survey acquisition area. It is recommended that the seismic survey be timed to avoid the seasonal activity of snoek-directed coastal fishing over the period March to July. There is no impact of exclusion expected on the remaining commercial fisheries sectors viz, demeral trawl, mid-water trawl, small pelagic purse-seine, large pelagic purse-seine, west coast rock lobster, abalone ranching, netfish (beach-seine and gillnet) and the harvesting of seaweed.

Stock biomass estimate surveys by DFFE would be expected within the seismic acquisition area over the period January/February (demersal trawl), November (acoustic survey for small pelagic species) and again during May/June (a pre-recruitment biomass survey for small pelagic species). Seismic survey operations that coincide with scheduled fisheries research surveys could result in a negative impact, local in extent and of moderate magnitude. The impact on fisheries research surveys was assessed to be of overall low negative significance (i.e. where this impact would not have a direct influence on the decision to proceed with the seismic survey).

Prior to the commencement of survey activities, affected parties should be informed of the navigational co-ordinates of the proposed survey acquisition area, timing and duration of proposed activities and any implications relating to the exclusion zone that would be requested, as well as the movements of support vessels related to the project. The relevant fishing associations include the SA Tuna Association, SA Tuna Longline Association, Fresh Tuna Exporters Association, South African Hake Longline Association (SAHLLA), SA Commercial Linefish Management Association and West Coast Rock Lobster Association.

Other key stakeholders should be notified prior to commencement and on completion of the project. These include; the South African Navy Hydrographic Office (SANHO), South African Maritime Safety Association (SAMSA), Ports Authority and the Department of Agriculture, Forestry and Fisheries Vessel Monitoring, Control and Surveillance Unit in Cape Town (Vessel Monitoring System Unit)).

For the duration of the survey, a navigational warning should be broadcast to all vessels via Navigational Telex (Navtext) and Cape Town radio. In addition, it is recommended that updates of the scheduled weekly survey plan should be circulated to the operators of affected fishing vessels on a daily basis. A Fisheries Liaison Officer (FLO) should be present on board the survey vessel or support/guard vessel for the duration of the survey in order to facilitate communications between the survey and fishing vessels in the project area.

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.	**Fishery Sector**	Percentage (%) Overlap with Fishing Effort		Noise Effects on Catch Rates (airguns array)		Temporary Safety Zone around Seismic Vessel	
		Licence Block 1	3D Seismic Acquisition Area	**Pre-Mitigation**	**Residual Impact**	**Pre-Mitigation**	**Residual Impact**
1	Demersal Trawl	0.01	0	No impact	No impact	No impact	No impact
2	Mid-Water Trawl	0	0	No impact	No impact	No impact	No impact
3	Demersal Longline	0.35	<0.01	Low Negative	Low Negative	Low Negative	Low Negative
4	Small Pelagic Purse-Seine	0	0	No impact	No impact	No impact	No impact
5	Large Pelagic Longline	0	0	No impact	No impact	No impact	No impact
6	Tuna Pole-and-Line	2.5	0	Low Negative	Low Negative	Low Negative	Low Negative
7	Traditional Linefish	0.03	0	Low Negative	Low Negative	Low Negative	Low Negative
8	West Coast Rock Lobster	10.1	0	No impact	No impact	No impact	No impact
9	Abalone (Ranching)	unknown	0	No impact	No impact	No impact	No impact
10	Small-Scale Fisheries	unknown	0	Low Negative	Low Negative	Low Negative	Low Negative
11	Netfish	unknown	0	No impact	No impact	No impact	No impact
12	Seaweed (Kelp harvesting)	16.3	0	No impact	No impact	No impact	No impact
13	Fisheries Research	8.5	0.31	Low Negative	Low Negative	Low Negative	Low Negative

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ACRONYMS, ABBREVIATIONS AND UNITS

CapMarine	Capricorn Marine Environmental (Pty) Ltd
CPUE	Catch Per Unit Effort
dB	Decibel
DEFF	Department of Environment, Forestry and Fisheries
EAP	Environmental Assessment Practitioner
EMPr	Environmental Management Programme
EIA	Environmental Impact Assessment
ER	Exploration Right
EWP	Exploration Works Programme
FLO	Fisheries Liaison Officer
GRT	Gross Registered Tonnage
Hz	Hertz
ICCAT	International Convention for the Conservation of Atlantic Tunas
IOTC	Indian Ocean Tuna Commission
kg	Kilogram
m	Metres
NEMA	National Environmental Management Act 107 of 1998, as ammended
Pa	Pascal
SADSTIA	South African Deep-Sea Trawling Industry Association
SAHALLA	South African Hake Longline Association
SANHO	South African Navy Hydrographic Office
SAMLMA	South African Marine Linefish Management Association
SAPFIA	South African Pelagic Fishing Industry Association
SASMIA	South African Squid Management Industrial Association
SATLA	South African Tuna Longline Association
SECIFA	South Coast Inshore Trawl Fishing Association
t	Tonnes
TAC	Total Allowable Catch
TAE	Total Allowable Effort
ToR	Terms of Reference
VMS	Vessel Monitoring System

1 INTRODUCTION

1.1 BACKGROUND

Tosaco Energy (Tosaco) applied for an Exploration Right for offshore oil and gas exploration in Block 1, located along the West Coast of South Africa. The block is situated between Alexander Bay, extending south along the western coastline to approximately Hondeklip Bay and approximately 250 km offshore of the coast of the Northern Cape (refer to Figure 1.1).

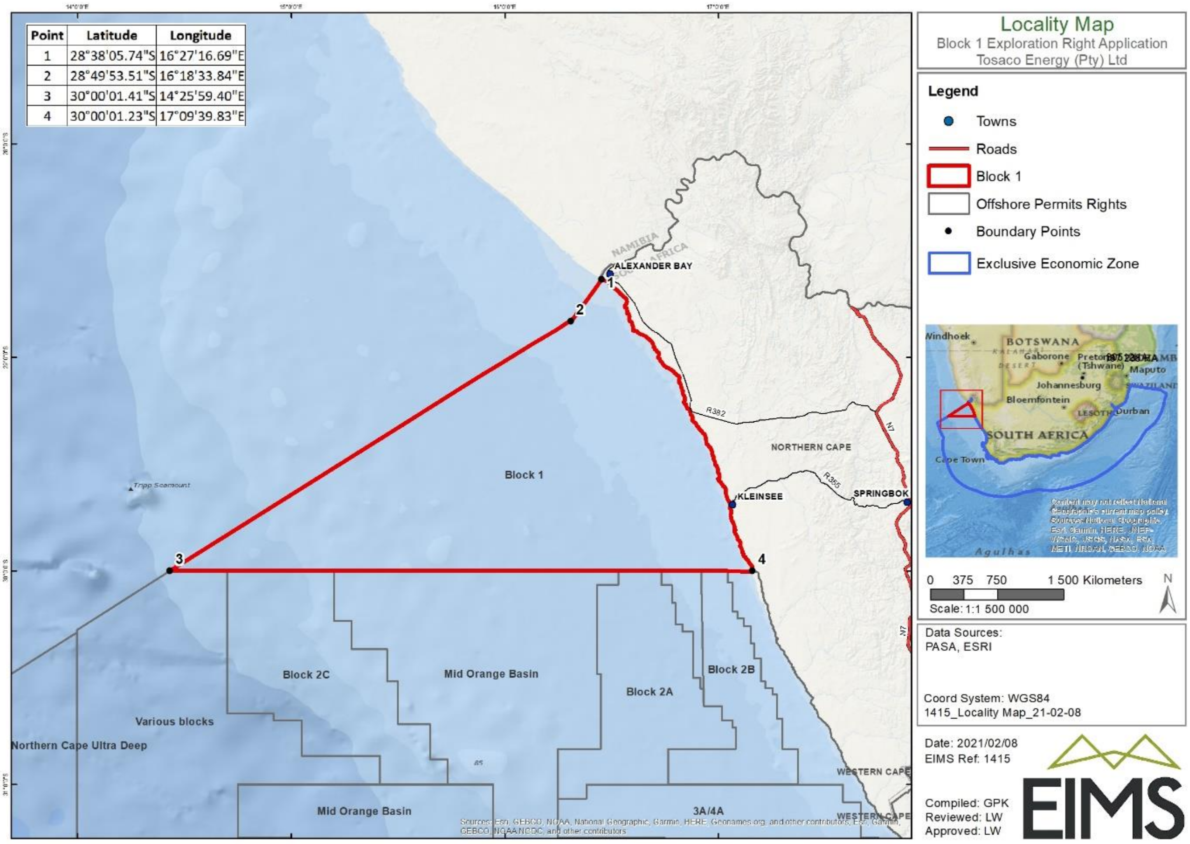


Figure 1.1: Location and Bounding Co-Ordinates of Block 1, located off the West Coast of South Africa.

The exploration will be undertaken in accordance with the Exploration Works Programme (EWP) submitted with the application for exploration right. The exploration works programme includes the following:

Year	Activity

1	• Review of all available technical data:
	  ○ Geographical Information System (GIS) data;
	  ○ Geophysical data, geological data, borehole data and log data;
	  ○ Third party technical reports;
	• Reprocessing of existing geological/geophysical data.
	• Preliminary estimation of contingent resources.
	• Preparation of conceptual design and programme of future geophysical and geological exploration and appraisal.

2	• Planning and preparation of possible seismic survey.
3	• Possible 2D and/or 3D seismic survey • Processing and interpretation of seismic data. • Evaluation and estimation of contingent resources based on new data.

In terms of the requirements of the Environmental Impact Assessment (EIA) Regulations of 2014 (as amended), published under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), the application for seismic exploration requires the undertaking of a full Scoping and EIA process. Tosaco has appointed EIMS as the Environmental Assessment Practitioner (EAP) to undertake the scoping and EIA process. Capricorn Marine Environmental (Pty) Ltd (CapMarine) has been appointed to undertake an assessment of the impact of the proposed activity on commercial fishing operations.

1.2 TERMS OF REFERENCE

The information from this study is intended to inform the EMP process through providing fisheries baseline data for the licence area 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 specific Terms of Reference (ToR) for the Fisheries Specialist Study are as follows:

- A description of the existing baseline fisheries characteristics within the Reconnaissance Permit area (distribution of fish stocks and commercial, subsistence and recreational fishing activities).
- An introduction presenting a brief background to the study and an appreciation of the requirements stated in the specific terms of reference for the study.
- Details of the approach to the study where activities performed and methods used are presented.
- The specific identified sensitivity of fishing sectors related to the proposed activity.
- Map/s superimposing the proposed survey areas on the spatial distribution of effort expended by each fishing sector.
- Calculation of proportion of fishing ground that coincides with the proposed affected area.
- Assessment of potential impacts on fisheries using prescribed impact rating methodology.
- A description of any assumptions made and any uncertainties or gaps in knowledge.
- Recommendation of mitigation measures, where appropriate.

1.3 PROJECT DESCRIPTION

Hydrocarbon deposits occur in reservoirs in sedimentary rock layers. Being lighter than water they accumulate in traps where the sedimentary layers are arched or tilted by folding or faulting of the geological layers. Marine seismic surveys are one of the primary geophysical methods for locating such deposits and are thus an indispensable component of offshore oil or gas exploration.

Seismic survey programmes comprise of data acquisition in either two-dimensional (2D) and/or three-dimensional (3D) scales, depending on information requirements. 2D surveys are typically applied to obtain regional data from widely spaced survey grids and provide a vertical profile through the subsurface, highlighting geophysical, geological information and features along the seismic-line. Infill surveys on closer grids subsequently provide more detail over specific areas of interest. In contrast, 3D seismic surveys are conducted on a very tight survey grid spacing in specific target areas identified during 2D applications and provide a cube image of the subsurface geology within the survey volume. 3D seismic acquisition is applied to prospective petroleum areas of interest to assist in fault interpretation, distribution of potential reservoirs, estimates of oil and gas in place and the location of potential exploration wells.

For this investigation Tosaco is proposing to undertake the reprocessing of approximately 5 000 km of existing 2D seismic lines taken previously in the block, as well as approximately 750 km^2 of 3D seismic data previously undertaken in the block. However, if it is determined by subsequent analysis of existing data, that acquisition of a seismic dataset utilising 3D seismic techniques might be beneficial, then an additional 3D seismic survey might be conducted over an area approximately 1 000 km^2 as shown in Figure 1.2.

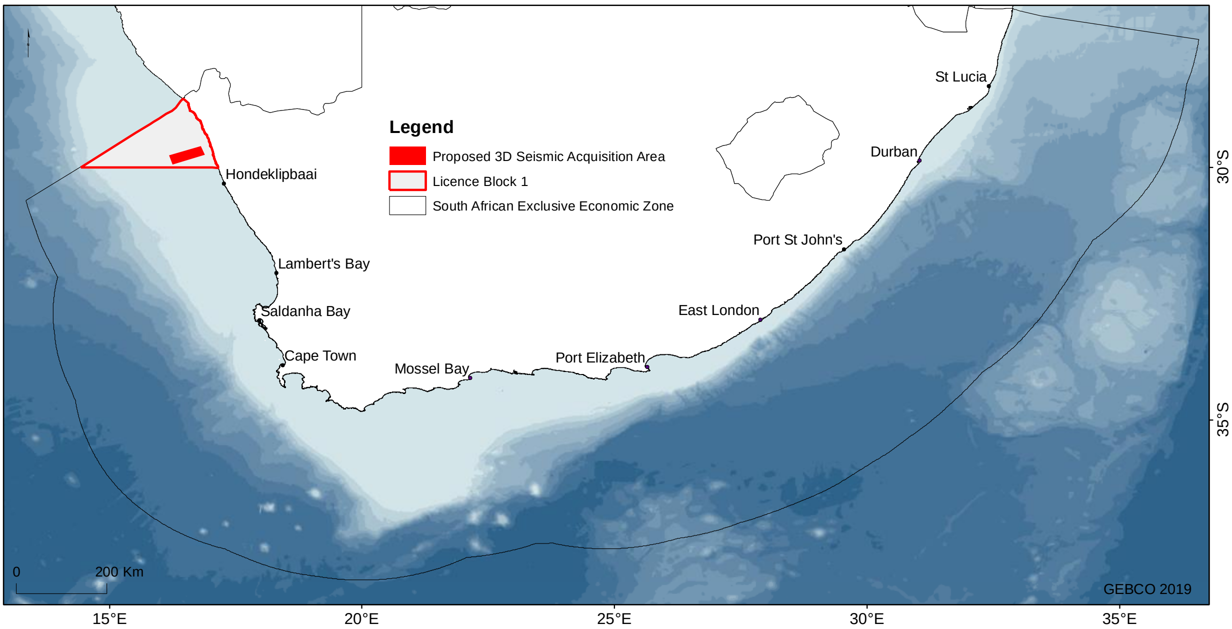


Figure 1.2: Location of Block 1 and the proposed 3D seismic survey acquisition area in relation to the South African Exclusive Economic Zone (EEZ).

The commencement of the 3D survey would depend on an Exploration Right award date and availability of seismic contractors. It is anticipated that the 3D survey would take approximately 4 months to complete. In the event that the survey cannot be completed during the months when offshore seismic surveys are allowed, the survey would be completed in the following year.

During seismic surveys high-level, low frequency sound pulses are generated by an acoustic instrument towed behind a survey vessel, just below the sea surface. The sounds are directed towards the seabed and the seismic signal is reflected by the geological interfaces below the seafloor. The reflected signals are received by an array of receivers or sets of hydrophones towed behind the vessel in a single streamer (2D) or in multiple streamers (3D) and are fed back to the recording instruments on board. The spacing between the hydrophone groups is commonly 25 m or shorter, depending on the purpose of the seismic survey. Each group contains many hydrophones, spaced less than 1 m apart. The hydrophone streamers must be towed at constant depth (6 – 10 m), with flotation usually achieved by filling the cables gel or flexible polymer foam, so that they are neutrally buoyant. To compensate for minor adjustments, Automatic Cable Levellers, or “birds” are used. The ends of the hydrophone streamers are marked with tail buoys, to warn shipping about the presence of the cable in the water. The tail buoys also act as a platform for surface positioning systems so that the cable locations can be accurately monitored. Refer to Figure 1.3 for a schematic overview of the seismic vessel towed gear configuration.

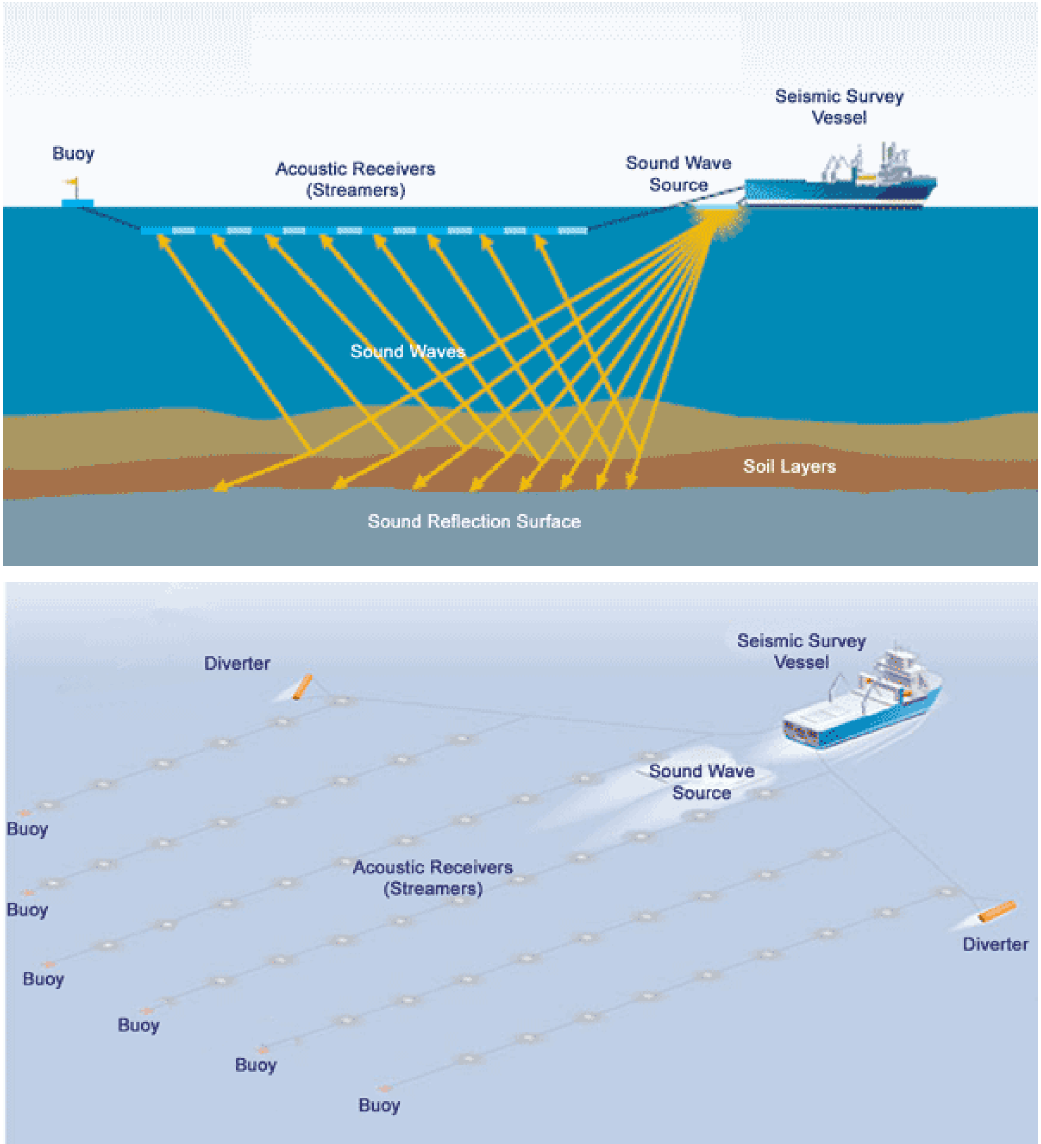


Figure 1.3: Demonstration of seismic survey operation (above) and seismic survey vessel (3D) and associated towed equipment (below) (Fish Safe, 2021).

While acquiring the seismic data, the survey vessel would travel along transects of a prescribed grid within the survey area that have been chosen to cross any known or suspected geological structure in the area. The vessel typically travels at a speed of between four and six knots (i.e. 2 to 3 metres per second) while surveying. The proposed 3D seismic survey would involve a seismic sound source (airgun array) and multiple hydrophone streamers, which would be up to 10,000 m long. The streamers would be towed at a depth of 9 m to 10 m below the surface and would not be visible, except for the tail-buoy at the terminal end of the cable. The sound source or airgun array would be towed 80 – 150 m behind the vessel at a depth of between 5 – 25 m below the surface. As the survey vessel would be restricted in manoeuvrability (a turn radius of 4.5 km is expected), other vessels should remain clear of it. A supply/chase vessel usually assists in the operation of keeping other vessels at a safe distance.

Each triggering of a sound pulse is termed a seismic shot, and these are fired at intervals of 10 – 20 seconds and at an operating pressure of between 2,000 to 2,500 psi and a volume of 3,000 to 5,000 cubic inches. Each seismic shot is usually only between 5 and 30 milliseconds in duration, and despite peak levels within each shot being high, the total energy delivered into the water is low.

Airguns have most of their energy in the 5-300 Hz frequency range, with the optimal frequency required for deep penetration seismic work being 50-80 Hz. The maximum sound pressure levels at the source of airgun arrays in use today in the seismic industry are typically around 220 dB re 1µPa at 1 m, with the majority of their produced energy being low frequency of 10-100 Hz. The location where this level of sound is attained is directly beneath the airgun array, generally near its centre, but the exact location and depth beneath the array are dependent on the detailed makeup of the array, the water depth, and the physical properties of the seafloor. However, based on analogue sound sources, sound levels for the seismic survey can notionally be expected to attenuate below 160 dB less than 1,325 m from the source array.

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 Environment, Forestry and Fisheries (Branch: Fisheries) (DEFF) record for the years 2000 to 2019. All data were referenced to a latitude and longitude position and were redisplayed on a 60x60, 10x10, 5x5 or 2x2 minute grid. Additional information was obtained from the Marine Administration System from DEFF and from the *South Africa, Namibia and Mozambique Fishing Industry Handbook 2019 (47th Edition).*

2.2 IDENTIFICATION OF IMPACTS

2.2.1 NOISE EMISSIONS

2.2.1.1 IMPACTS ON FISH

The presence and operation of the survey vessel 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. International research has shown that the noise energy generated during seismic surveys falls within the hearing range of most fish and, depending on the Sound Elevation Level (SEL), may cause mortality, physiological damage and/or behavioural responses from fish and invertebrates (Caroll et al 2017).

A review of the available literature suggests that potential impacts of seismic pulses to fish species could include physiological injury and mortality, behavioural avoidance of seismic survey areas, masking of environmental sounds and communication, and indirect impacts due to effects on predators or prey. The acoustic impacts of the proposed seismic surveys on marine fauna have been described in the marine fauna specialist report (Pulfrich, 2020). The effects of sound on marine invertebrates and fish are summarised below.

Sensitivity and hearing range is highly variable amongst fish species. Data indicates that fish possessing a swim bladder are more sensitive to impulsive sounds, such as those generated by an acoustic source, than fish without swim bladders (Popper et al., 2014). Fish species which may be affected by underwater disturbances may broadly be grouped into three categories; cartilaginous fish without gas-filled chambers or swim bladders, fish with swim bladders where hearing is independent of gas-filled chambers or swim bladders and lastly fish which are most sensitive to sound pressure through otophysic connections between pressure receptive organs and the inner ear (Carroll et al. 2017).

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)[1]. The ASA Technical Report includes noise thresholds for mortality (or potentially mortal injury) as well as degrees of impairment such as Temporary Threshold Shifts (TTS) in hearing or Permanent Threshold Shifts (PTS) in hearing. 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). Table 2.1 lists the cumulative and peak SEL at which different types of effects have been identified for each of these categories of fish (Popper et al., 2014).

Table 2.1: Guidelines for seismic airguns

Type of Animal	Mortality and potential mortal injury	Recoverable injury	TTS (Temporary threshold shift)	Masking	Behaviour
Fish: no swim bladder (particle motion detection)	>219 dB SELcum or >213 dB peak	>216 dB SELcum or >213 dB peak	>186dB SELcum	(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 SELcum or >207 dB peak	203 dB SELcum or >207 dB peak	>186dB SELcum	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low

(N)=near, (I)=intermediate, (F)=far; SEL = Sound Elevation Levels. Source: Popper *et al.* (2014)

Table 2.2: Known hearing frequency and sound production ranges of various fish taxa (Pulfrich 2020 adapted from Koper & Plön 2012; Southall et al. 2019).

Taxa	Order	Hearing frequency (kHz)	Sound production (kHz)
Shellfish	Crustaceans	0.1 – 3	
Snapping shrimp	*Alpheus/ Synalpheus* spp.		0.1 - >200
Ghost crabs	*Ocypode* spp.		0.15 – 0.8
Fish	Teleosts		0.4 – 4
Hearing specialists		0.03 - >3	
Hearing generalists		0.03 – 1	
Sharks and skates	Elasmobranchs	0.1 – 1.5	Unknown

Studies have shown that physical damage to fish caused from acoustic sources occurs only in their immediate vicinity, in distances of less than a few meters (Gausland 2003). Whilst adult fish can flee from this noise, eggs and larvae are unable to do so and therefore may be affected by an acoustic signal (refer to section 2.2.1.2 – "Impacts on plankton").

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).

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

Behavioural responses could lead to decreased catch rates if fish move out of important fishing grounds (Hirst and Rodhouse 2000).

A number of studies have reported reductions in catch rates of fish during and after seismic surveys. The observed declines in catch rates differ considerably from study to study and also according to species and gear type in the same areas and events. Estimated declines are of relatively short duration and range from no apparent reduction to an 83% reduction in bycatch in a shrimp trawl (Løkkeborg and Soldal, 1993 reported in Hirst and Rodhouse, 2000). The distance from the seismic sound source at which reductions in catch rates were measured also varied substantially from case to case ranging (when reported) from approximately 8 to 36 km. The observed duration of impacts ranged from approximately 12 hours to up to 10 days. Table 2.3 summarises catch reductions for the species Atlantic cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*) and rockfish (*Sebastes spp.*).

Table 2.3: Reduction in fish catch rates as a result of seismic survey activity (Council, A.M.C. 2014).

Species	Gear Type	Noise Level	Catch Reduction	Source
Atlantic cod (*Gadus morhua*)	Trawl	250 dB	46-69% lasting at least 5 days	Engas et al. 1993
	Longline	250 dB	17-45% lasting at least 5 days	Engas et al. 1993
	Longline	Undetermined	55-79% lasting at least 24 hours	Lokkeborg and Soldal, 1993
Haddock (*Melanogrammus aeglefinus*)	Trawl	250 dB	70-72% lasting at least 5 days	Engas et al. 1993
	Longline	250 dB	49-73% lasting at least 5 days	Engas et al. 1993
Rockfish (*Sebastes* spp.)	Longline	223 dB	52% - effect period not determined	Skalski et al. 1992

It is noteworthy that avoidance effects or behavioural alterations from seismic surveys involving many fish species do not automatically imply risk factors and thus do not necessarily cause a disturbance to the fishery (McCauley *et al.,* 2000). For example, a study conducted by Wardle et al. (2001) monitored the behaviour of fish and invertebrates on a rocky Scottish reef. Here a video system was used to observe potential responses and seismic airgun blasts were carefully calibrated to have a peak level of 210 dB re 1 µPa at 16 m from the source and 195 dB re 1 µPa at 109 m from the source. Only minor behavioural responses to seismic activity was observed. However, no animals appeared to leave the reef and more importantly, no permanent changes in the behaviour of the fish or invertebrates on the reef was observed. As a general guideline, the sound ranges of 161 to 166 dB re 1 µPa rms may be used as a suitable indicator sound pressure level at which behavioural modifications of fish start to take place (McCauley *et al.,* 2000). Based on the current project description, sound levels for the seismic survey can notionally be expected to attenuate below 160 dB less than 1,325 m from the source array. The current assessment is based on an assumption that the maximum potential zone of acoustic disturbance could extend to a distance of up to 1.5 km from the seismic acquisition area. This is based on an assumption that sound pressure levels generated during the survey would attenuate to the minimum threshold level at which behavioural disturbance on fish could be expected.

Although the effects of airgun noise on spawning behaviour of fish have not been quantified to date, it is predicted that if fish are exposed to powerful external forces on their migration paths or spawning grounds, they may be disturbed or even cease spawning altogether. The deflection from migration paths may be sufficient to disperse spawning aggregations and displace spawning geographically and temporally, thereby affecting recruitment to fish stocks. The magnitude of effect in these cases will depend on the biology of the species and the extent of the dispersion or deflection. Depending on the physical characteristics of the area, the range of the impact may extend beyond 30 km (Dalen 2007), and could thus potentially affect subsequent recruitment to fish stocks if spawning is displaced geographically or temporally. Dalen et al. (1996), however, recommended that in areas with concentrated spawning or spawning migration seismic shooting be avoided at a distance of ~50 km from these areas, particularly areas subjected to repeated, high intensity surveys (see also Gausland 2003). In Norway, areas supporting high densities of spawning fish are sometimes closed to seismic surveys as a measure both to avoid scaring away the spawning adults and to avoid direct mortality of early life stages (Boertmann et al. 2009).

Changes in spawning, migration and feeding behaviour of fishes in response to seismic shooting could indirectly affect fisheries through reduced catches resulting from changes in feeding behaviour, abundance and vertical distribution (Skalski et al. 1992; Hirst & Rodhouse 2000; Gausland 2003). Such behavioural changes could lead to decreased commercial catch rates if fish move out of important fishing grounds (Engås et al. 1996; Hirst & Rodhouse 2000; Dalen & Mæsted 2008).

2.2.1.2 IMPACTS ON PLANKTON

As the movement of phytoplankton and zooplankton is largely limited by currents, they are not able to actively avoid the seismic vessel and thus are likely to come into close contact with the sound sources. Phytoplankton are not known to be affected by seismic surveys and are unlikely to show any significant effects of exposure to airgun impulses outside of a 1 m distance (Kosheleva 1992; McCauley 1994).

Zooplankton comprises meroplankton (organisms which spend a portion of their life cycle as plankton, such as fish and invertebrate larvae and eggs) and holoplankton (organisms that remain planktonic for their entire life cycle, such as siphonophores, nudibranchs and barnacles). The abundance and spatial distribution of zooplankton is highly variable and dependent on factors such as fecundity, seasonality in production, tolerances to temperature, length of time spent in the water column, hydrodynamic processes and natural mortality. Zooplankton densities are generally low and patchily distributed. The amount of exposure to the influence of seismic airgun arrays is thus dependent on a wide range of variables. Invertebrate members of the plankton that have a gas-filled flotation aid, may be more receptive to the sounds produced by seismic airgun arrays, and the range of effects may extend further for these species than for other plankton. However, for a large seismic array, a physiological effect out to 10 m from the array is considered a generous value with known effects demonstrated to 5 m only (Kostyuchenko 1971). More recently, however, McCauley *et al.* (2017) demonstrated significant declines in zooplankton abundance within a maximum range of 1.2 km of the airguns' passage (see also Tollefson 2017). A follow-up publication by Richardson *et al.* (2017), however, queried the robustness of the McCauley *et al.* (2017) study on the grounds of insufficient sample size. Richardson *et al.* (2017) estimated that while zooplankton populations declined 22% within the survey area, biomass recovery occurred within 3 days following survey completion and any effects on zooplankton by seismic noise would endure in the very short term only. The authors stressed that impacts in areas of dynamic ocean circulation (as would be the case along the shelf edge) are likely to be even less.

Previously, McCauley (1994) concluded that when compared with total population sizes or natural mortality rates of planktonic organisms, the relative influence of seismic sound sources on these populations can be considered insignificant. The wash from ships propellers and bow waves can be expected to have a similar, if not greater, volumetric effect on plankton than the sounds generated by airgun arrays.

Due to their importance in commercial fisheries, numerous studies have been undertaken experimentally exposing the eggs and larvae of various zooplankton and ichthyoplankton species to airgun sources (reviewed in McCauley 1994 and Carroll *et al*. 2017).

2.2.2 EXCLUSION FROM FISHING GROUND

The acquisition of high quality seismic data requires that the position of the survey vessel and the array be accurately known. Seismic surveys consequently require accurate navigation of the sound source over pre-determined survey transects. This, and the fact that the array and the hydrophone streamers need to be towed in a set configuration behind the tow-ship, means that the survey operation has little manoeuvrability whilst operating. For this reason the vessel is considered to be a fixed marine feature that is to be avoided by other vessels.

Under the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972, Part A, Rule 10), a seismic survey vessel that is engaged in surveying is defined as a "vessel restricted in its ability to manoeuvre" which requires that power-driven and sailing vessels give way to a vessel restricted in her ability to manoeuvre. It is an offence for an unauthorised vessel to enter the safety zone. In addition to a statutory 500 m safety zone, a seismic contractor would request a safe operational limit (that is greater than the 500 m safety zone) that it would like other vessels to stay beyond. Typical safe operational limits for 3D surveys are illustrated in Figure 2.1.

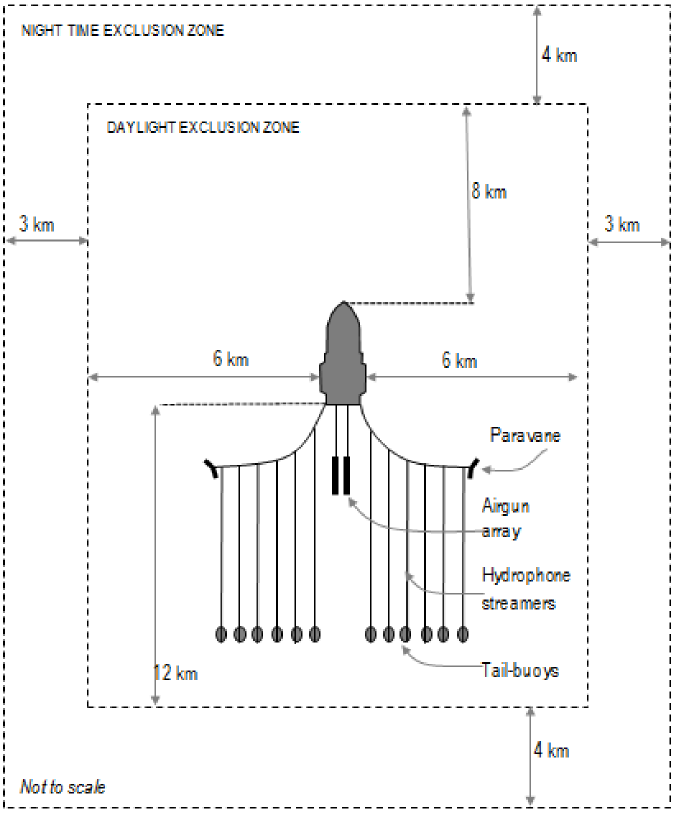


Figure 2.1: Typical Configuration and Safe Operational Limits for a 3D Seismic Survey Operation.

The dimension of the exclusion zone to other vessels would be approximately 12 km (7 Nm) ahead, 9 km (5 Nm) to either side and 16 km (9 Nm) astern of the survey vessel, resulting in a shifting exclusion area of approximately 500 km^2 within the proposed survey target area. During adverse weather conditions, the survey vessel may move outside of the boundaries of the target area and licence block. Although the acoustic source would not be active during production downtime, it is unlikely that the towed array would be retrieved during these times and an exclusion zone would still be required.

At least one chase vessel with appropriate radar and communications would be used during the seismic survey to warn vessels that are in danger of breaching the exclusion zone. The 500 m safety zone and proposed safe operational limits would be communicated to key stakeholders well in advance of the proposed seismic survey. A NAVAREA warning and coastal navigational warning would be issued via NAVTEX by the South African Navy Hydrographic Office (SANHO) for the duration of the survey operation.

The temporary exclusion of fisheries from the safety zone will effectively reduce fishing grounds, which in turn could potentially result in a loss of catch and/or displacement of fishing effort (direct negative impact). The proposed seismic survey could result in the temporary exclusion from fishing ground of any sector operating in the vicinity of the proposed seismic survey acquisition area.

2.3 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). The proposed seismic survey acquisition area was mapped and fishing catch and effort within the affected area was expressed as a percentage of the total effort and catch figures for each sector. This provided an indication of the proportion of fishing ground that could be affected by the presence of the survey vessel in relation to each fishing sector.

The EIA Team has adopted a set of conventions (provided by EIMS) for purposes of the integrated assessment of potential impacts, and the determination of impact significance. The impact significance rating methodology is guided by the requirements of the NEMA EIA Regulations, 2014. For each impact, the Nature, Extent, Duration, Magnitude, and Reversibility were described. These criteria were used to determine the Consequence of the impact. The Consequence was related to the probability/ likelihood of the impact occurring. This determined the Environmental rRsk. In addition other factors, including cumulative impacts, public concern, and potential for irreplaceable loss of resources, were used to determine a prioritisation factor which was applied to the Environmental Risk to determine the overall Significance of each of the impacts identified. The methodology reference for this assessment is included in Appendix 1.

A key objective of an EIA is to identify and define environmentally and technically acceptable and cost effective measures to manage and mitigate potential impacts. Mitigation measures are developed to avoid, reduce, remedy or compensate for potential negative impacts, and to enhance potential environmental benefits. The priority is to first apply mitigation measures to the source of the impact (i.e. to avoid or reduce the magnitude of the impact from the associated project activity), and then to address the resultant effect to the resource/receptor *via* abatement or compensatory measures or offsets (i.e. to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude). Once mitigation measures are declared, the next step in the impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation measures.

2.4 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 official governmental record of fisheries data was used to display fishing catch and effort relative to the proposed project area. These data are derived from logbooks that are completed by skippers, and it is assumed that there will be a proportion of erroneous data due to mistakes in the capturing of these data into electronic format. The proportion of erroneous data is estimated to be up to 10% of the total dataset and would be primarily related to the accurate recording or transcription of the fishing position (latitude and longitude). Where obvious errors in the reporting of fishing positions were identified these were excluded from the analysis.

- In assessing the impact of the proposed exclusion zone on fishing operations, calculations of potential loss of catch were based on the assumption that fisheries would be excluded from the entire target survey area (inclusive of the additional exclusion area surrounding the survey vessel where this extends beyond the boundary of the target survey area) for the entire duration of the survey. In practice, the exclusion area would be a moving footprint of approximately 500 km^2 extending around the vessel (based on the required safety clearances shown in Figure 2.1: Typical Configuration and Safe Operational Limits for a 3D Seismic Survey Operation.
-). Our approach is likely to be an overestimate of the potential impact on fishing operations which in reality could continue within certain portions of the Licence Block.
- The acoustic impact has been considered to affect the entire survey acquisition area (inclusive of a buffer of 1.5 km of acoustic disturbance around the acquisition area) at all times. We have not factored in the transitory nature of the acoustic impact i.e. that the sound source moves in space and time as the survey progresses within the target area. Our calculations of potential reduction of catch are therefore likely to be overestimates.
- The effects of seismic sound on the CPUE of fish and invertebrates have been drawn from the findings of international studies. To date there have been no studies focused directly on the species found locally. Although the results from international studies are likely also to be representative for local species, current gaps in knowledge on the topic lead to uncertainty when attempting to accurately quantify the potential loss of catch for each type of fishery. Research into the effects of seismic sound on marine fauna is ongoing.

3 DESCRIPTION OF RECEIVING ENVIRONMENT: FISHERIES BASELINE

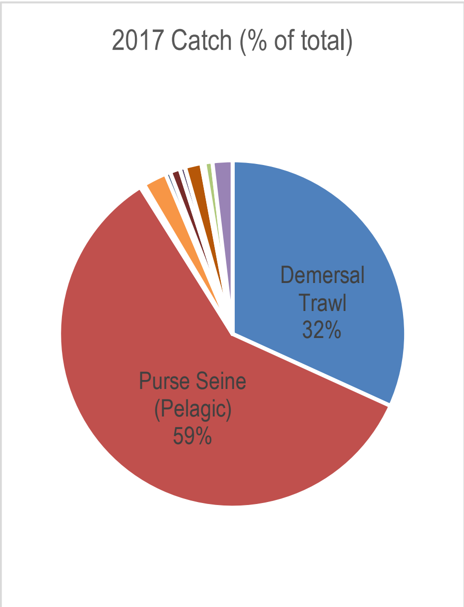
3.1 OVERVIEW OF FISHERIES SECTORS

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

Approximately 14 different commercial fisheries sectors currently operate within South African waters. 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. The primary fisheries in terms of economic value and overall tonnage of landings are the demersal (bottom) trawl and long-line fisheries targeting the Cape hakes (*Merluccius paradoxus* and *M. capensis*) and the pelagic-directed purse-seine fishery targeting pilchard (*Sardinops sagax)*, anchovy (*Engraulis encrasicolus*) and red-eye round herring (*Etrumeus whitheadii*). Highly migratory tuna and tuna-like species are caught on the high seas and seasonally within the South African waters by the pelagic long-line and pole fisheries. Targeted species include albacore (*Thunnus alalunga*), bigeye tuna (*T. obesus*), yellowfin tuna (*T. albacares*) and swordfish

(*Xiphias gladius*). The traditional line fishery targets a large assemblage of species close to shore including snoek (*Thyrsites atun*), Cape bream (*Pachymetopon blochii)*, geelbek (*Atractoscion aequidens)*, kob (*Argyrosomus japonicus)*, yellowtail (*Seriola lalandi)* and other reef fish. Crustacean fisheries comprise a trap and hoop net fishery targeting West Coast rock lobster (*Jasus lalandii*), a line trap fishery targeting the South Coast rock lobster (*Palinurus gilchristi*) and a trawl fishery based solely on the East Coast targeting penaeid prawns, langoustines (*Metanephrops andamanicus* and *Nephropsis stewarti*), deep-water rock lobster (*Palinurus delagoae*) and red crab (*Chaceon macphersoni*). Other fisheries include a mid-water trawl fishery targeting horse mackerel (*Trachurus trachurus capensis*) predominantly on the Agulhas Bank (South Coast) and a hand-jig fishery targeting chokka squid (*Loligo vulgaris reynaudii*) exclusively on the South Coast. In addition to commercial sectors, recreational fishing occurs along the coastline comprising shore angling and small, open boats generally less than 10 m in length. The commercial and recreational fisheries are reported to catch over 250 marine species, although fewer than 5% of these are actively targeted by commercial fisheries, which comprise 90% of the landed catch.

Most commercial fish landings must take place at designated fishing harbours. For the larger industrial vessels targeting hake, only the major ports of Saldanha Bay, Cape Town, Mossel Bay and Port Elizabeth are used. On the West Coast, St. Helena Bay and Saldanha Bay are the main landing sites for the small pelagic fleets. These ports also have significant infrastructure for the processing of anchovy into fishmeal as well as the canning of sardine. Smaller fishing harbours on the West / South-West Coast include Port Nolloth, Hondeklip, Laaiplek, Hout Bay and Gansbaai harbours. On the East Coast, Durban and Richards Bay are deployment ports for the crustacean trawl and large pelagic longline sectors. There are more than 230 small-scale fishing communities on the South African coastline (DAFF, 2016). Small-scale fisheries commonly use boats but occur mainly close to the shore. Recreational fisheries comprise shore-based, estuarine and boat-based line fisheries as well as spearfishing and net fisheries, including cast, drag and hoop net techniques.



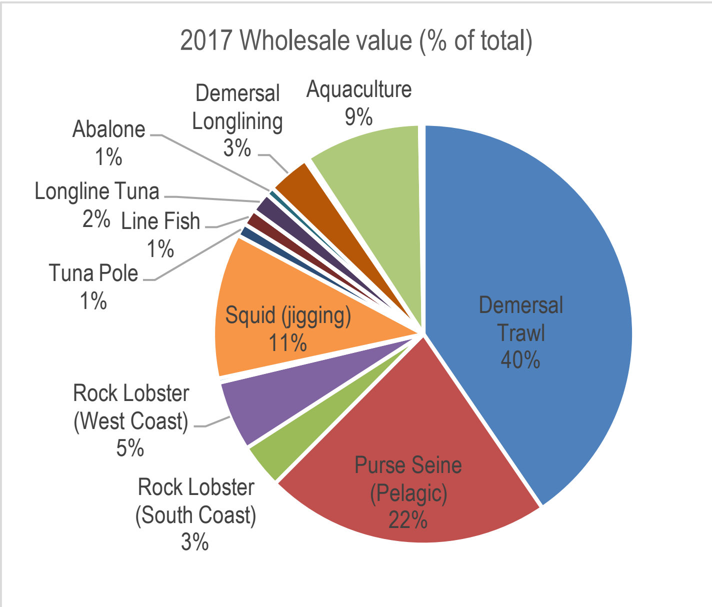


Figure 3.1: Pie chart showing percentage of landings by weight (left) and wholesale value (right) of each commercial fishery sector as a contribution to the total landings and value for all commercial fisheries sectors combined (2017). Source: DEFF, 2019.

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)	313476	313476	2164224	22.0
Demersal trawl (offshore)	50 (45)	163743	98200	3891978	39.5
Demersal trawl (inshore)	18 (31)	4452	2736	90104	0.9
Mid-water trawl	34 (6)				
Demersal long-line	146 (64)	8113	8113	319228	3.2
Large pelagic long-line	30 (31)	2541	2541	154199	1.6
Tuna pole	170 (128)	2399	2399	97583	1.0
Linefish	422 (450)	4931	4931	122096	1.2
Longline shark demersal		72	72	1566	0.0
South coast rock lobster	13 (12)	699	451	*337912*	3.4
West coast rock lobster	240 (105)	1238	1238	*531659*	5.4
Crustacean trawl	6 (5)	310	310	32012	0.3
Squid jig	92 (138)	11578	11578	1099910	11.2
Miscellaneous nets	190 (N/a)	1502	1502	25589	0.3
Oysters	146 pickers	42	42	3300	0.0
Seaweeds	14 (N/a)	9877	6874	27095	0.3
Abalone	N/a (N/a)	86	86	*61920*	0.6
Aquaculture		3907	3907	881042	9.0
Total		**528966**	**458456**	**9841417**	**100**

Table 3.2: South African offshore commercial fishing sectors, landings, number of rights holders, wholesale catch value and target species (DEFF, 2019).

Sector	Areas of Operation	Main Ports in Priority	Target Species
Small pelagic purse-seine	West, South Coast	St Helena Bay, Saldanha, Hout Bay, Gansbaai, Mossel Bay	Anchovy (*Engraulis encrasicolus*), sardine (*Sardinops sagax*), Redeye round herring (*Etrumeus whiteheadi*)
Demersal trawl (offshore)	West, South Coast	Cape Town, Saldanha, Mossel Bay, Port Elizabeth	Deepwater hake (*Merluccius paradoxus*), shallow-water hake (*Merluccius capensis*)
Demersal trawl (inshore)	South Coast	Cape Town, Saldanha, Mossel Bay	East coast sole (*Austroglossus pectoralis*), shallow-water hake (*Merluccius capensis*), juvenile horse mackerel (*Trachurus capensis*)
Mid-water trawl	West, South Coast	Cape Town, Port Elizabeth	Adult horse mackerel (*Trachurus capensis*)
Demersal long-line	West, South Coast	Cape Town, Saldanha, Mossel Bay, Port Elizabeth, Gansbaai	Shallow-water hake (*Merluccius capensis*)
Large pelagic long-line	West, South, East Coast	Cape Town, Durban, Richards Bay, Port Elizabeth	Yellowfin tuna (*T. albacares*), big eye tuna (*T. obesus*), Swordfish (*Xiphius gladius),* southern bluefin tuna (*T. maccoyii*)

Sector	Areas of Operation	Main Ports in Priority	Target Species
Tuna pole	West, South Coast	Cape Town, Saldanha	Albacore tuna (*T. alalunga*)
Linefish	West, South, East Coast	All ports, harbours and beaches around the coast	Snoek (*Thyrsites atun*), Cape bream (*Pachymetopon blochii)*, geelbek (*Atractoscion aequidens)*, kob (*Argyrosomus japonicus)*, yellowtail (*Seriola lalandi),* Sparidae, Serranidae, Carangidae, Scombridae, Sciaenidae
South coast rock lobster	South Coast	Cape Town, Port Elizabeth	*Palinurus gilchristi*
West coast rock lobster	West Coast	Hout Bay, Kalk Bay, St Helena	*Jasus lalandii*
Crustacean trawl	East Coast	Durban, Richards Bay	Tiger prawn (*Panaeus monodon*), white prawn (*Fenneropenaeus indicus*), brown prawn (*Metapenaeus monoceros*), pink prawn (*Haliporoides triarthrus*)
Squid jig	South Coast	Port Elizabeth, Port St Francis	Squid/chokka (*Loligo vulgaris reynaudii)*
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*

3.2 SPAWNING AND RECRUITMENT OF FISH STOCKS

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

The principal commercial fish species undergo a critical migration pattern in the Agulhas and Benguela ecosystems. Adults spawn on the central Agulhas Bank in spring (September to November) and the spawn moves southwards with the Agulhas current before drifting northwards in the Benguela current across the shelf. As the eggs drift, hatching takes place followed by larval development. Settlement of larvae occurs in the inshore areas, in particular the bays that are used as nurseries – this takes place from October through to March. Juveniles shoal and then begin a southward migration – it is at this stage that anchovy and sardine are targeted by the small pelagic purse seine fishery. Demersal species such as hake migrate offshore into deeper water.

A variety of pelagic species, including anchovy, pilchard, and horse mackerel, are reported to spawn east of Cape Agulhas between the shelf-edge upwelling and the cold-water ridge, where copepod availability is highest (Crawford 1980; Hutchings 1994; Roel & Armstrong 1991; Hutchings et al. 2002). The eggs and larvae spawned in this area are thought to largely remain on the Agulhas Bank, although some may be carried to the West Coast or be lost to the Agulhas Current retroflection (Hutchings 1994; Duncombe Rae et al. 1992; Hutchings et al. 2002). Pilchards also spawn on the Agulhas Bank

(Crawford 1980), with adults moving eastwards and northwards after spawning. Round herring are also reported to spawn along the South Coast (Roel & Armstrong 1991). Demersal species that spawn along the South Coast include the cape hakes and kingklip. Spawning of the shallow-water hake occurs primarily over the shelf (<200 m) whereas that by the deep-water hake occurs off the shelf. Similarly, kingklip spawn off the shelf edge to the south of St Francis and Algoa Bays (Shelton 1986; Hutchings 1994).

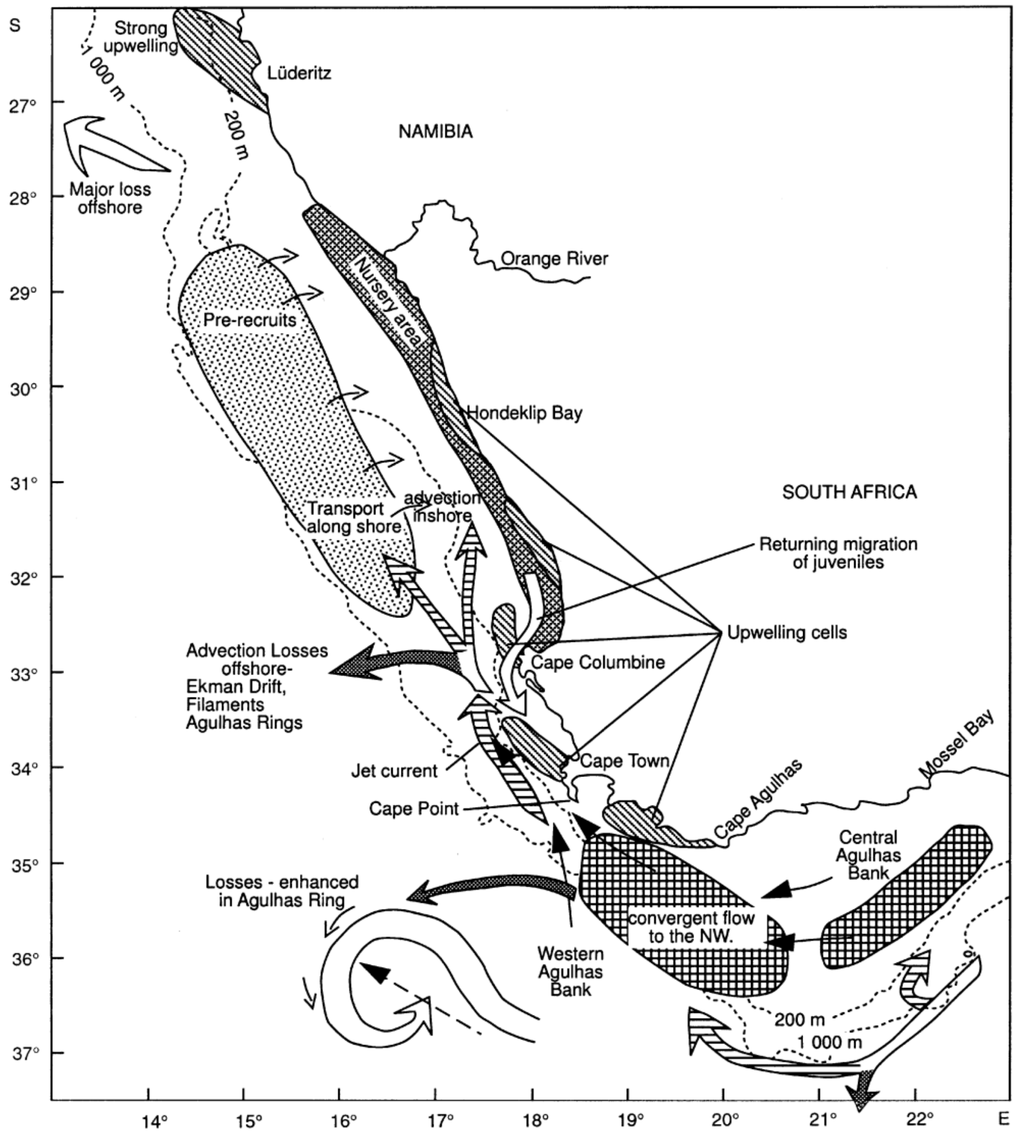


Figure 3.2: Generalised figure of the main fish recruiting process for species caught on the West Coast of South Africa (after Hutchings et al., 2002). Figure shows the West Coast nursery area and the western/central Agulhas Bank spawning grounds. Light stippled area on the West Coast marks the main recruiting area for the small pelagic fishery and dark stippled area on the Agulhas Bank marks the main spawning grounds for small pelagic fish.

Squid (*Loligo* spp.) spawn principally in the inshore waters (<50 m) between Knysna and Port Elizabeth. Their distribution and abundance are highly 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). Larvae and juveniles are carried offshore and westwards (via the Benguela jet) to feed and mature, before returning to the spawning grounds to complete their lifecycle (Olyott et al. 2007).

The inshore area of the Agulhas Bank, especially between the cool water ridge and the shore, serves as an important nursery area for numerous linefish species (e.g. elf *Pomatomus saltatrix*, leervis *Lichia amia*, geelbek *Atractoscion aequidens*, carpenter *Argyrozona argyrozona*) (Wallace et al. 1984; Smale et al. 1994). A significant proportion of these eggs and larvae originate from spawning grounds along the east coast, as adults undertake spawning migrations along the South Coast into KwaZulu-Natal waters (van der Elst 1976, 1981; Griffiths 1987; Garratt 1988; Beckley & van Ballegooyen 1992). The eggs and larvae are subsequently dispersed southwards by the Agulhas Current, with juveniles occurring on the inshore Agulhas Bank, using the area between the cold-water ridge and the shore as nursery grounds (van der Elst 1976, 1981; Garratt 1988). In the case of the carpenter, a high proportion of the reproductive output comes from the central Agulhas Bank and the Tsitsikamma Marine Protected Area (MPA), and two separate nursery grounds appear to exist, one near Port Elizabeth and a second off the deep reefs off Cape Agulhas, with older fish spreading eastwards and westwards (van der Lingen et al. 2006).

3.3 COMMERCIAL FISHING SECTORS

3.3.1 DEMERSAL TRAWL

The primary fisheries in terms of highest economic value are the demersal (bottom) trawl and long-line fisheries targeting the Cape hakes (*Merluccius paradoxus* and *M. capensis*). Secondary species include a large assemblage of demersal fish of which monkfish (*Lophius vomerinus*), kingklip (*Genypterus capensis*) and snoek (*Thyrsites atun*) are the most commercially important. The demersal trawl fishery comprises an offshore and inshore fleet, which differ primarily in terms of vessel capacity and the areas in which they operate. The wholesale value of catch landed by the inshore and offshore demersal trawl sectors, combined, during 2017 was R3.982 Billion, or 40.5% of the total value of all fisheries combined. Nominal catch for both sectors combined amounted to 145 088 tons during 2018.

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

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

Otter trawling is the main trawling method used in the South African hake fishery. This method of trawling makes use of trawl doors (also known as otter boards) that are dragged along the seafloor ahead of the net, maintaining the horizontal net opening. Bottom contact is made by the footrope and by long cables and bridles between the doors and the footrope. Behind the trawl doors are bridles connecting the doors to the wings of the net (to the ends of the footrope and headrope). A headline, bearing floats and the weighted footrope (that may include rope, steel wire, chains, rubber discs, spacers, bobbins or weights) maintain the vertical net opening. The “belly”, “wings” and the “cod-end” (the part of the net that retains the catch) may contact the seabed (see Figure 3.3). The configuration of trawling gear is similar for both offshore and inshore vessels however inshore vessels are smaller and less powerful than those operating within the offshore sector. The offshore fleet is segregated into wetfish and freezer vessels which differ in terms of the capacity for the processing of fish at sea and in terms of vessel size and capacity. While freezer vessels may work in an area for up to a month at a time, wetfish vessels may only remain in an area for about a week before returning to port. Wetfish vessels range between 24 m and 56 m in length while freezer vessels are usually larger, ranging up to 90 m in length. Inshore vessels range in length from 15 m to 40 m. Trips average three to five days in length and all catch is stored on ice.

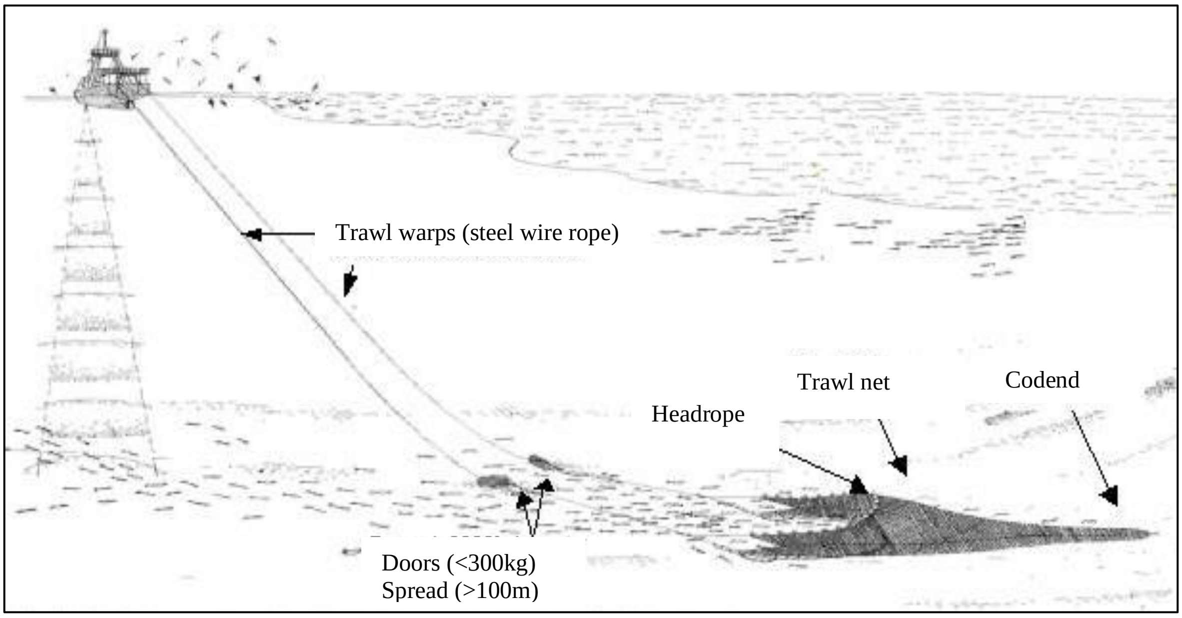


Figure 3.3: Typical gear configuration used by offshore demersal trawlers targeting hake.

The activity of the fishery is restricted by permit condition to operating within the confines of a historical “footprint” – an area of approximately 57 300 km^2 and 17 000 km^2 for the offshore and inshore fleets, respectively. Figure 3.4 shows an overview of the spatial distribution of fishing activity within the EEZ and in relation to Licence Block 1 and the proposed seismic acquisition area.

Figure 3.5 shows the demersal trawling activity at a reporting resolution of ~14 km^2 in relation to Licence Block 1 and the proposed seismic acquisition area. The licence block coincides with the northerly extent of the demersal trawl footprint where a small amount of fishing activity has been reported offshore of the 200 m bathymetric contour. Over the period 2008 to 2016, an average of 14 hours of trawling time was expended within the licence block yielding 6.7 tonnes of hake. This is equivalent to 0.01% of the overall effort and catch reported nationally by the sector.

A Namibian-registered fleet of demersal trawl vessels operate on the Namibian side of the maritime border at a depth range of 200 m to 1000 m. As such, fishing activity can be expected along the boundary of Licence Block 1, as this extends along the maritime border.

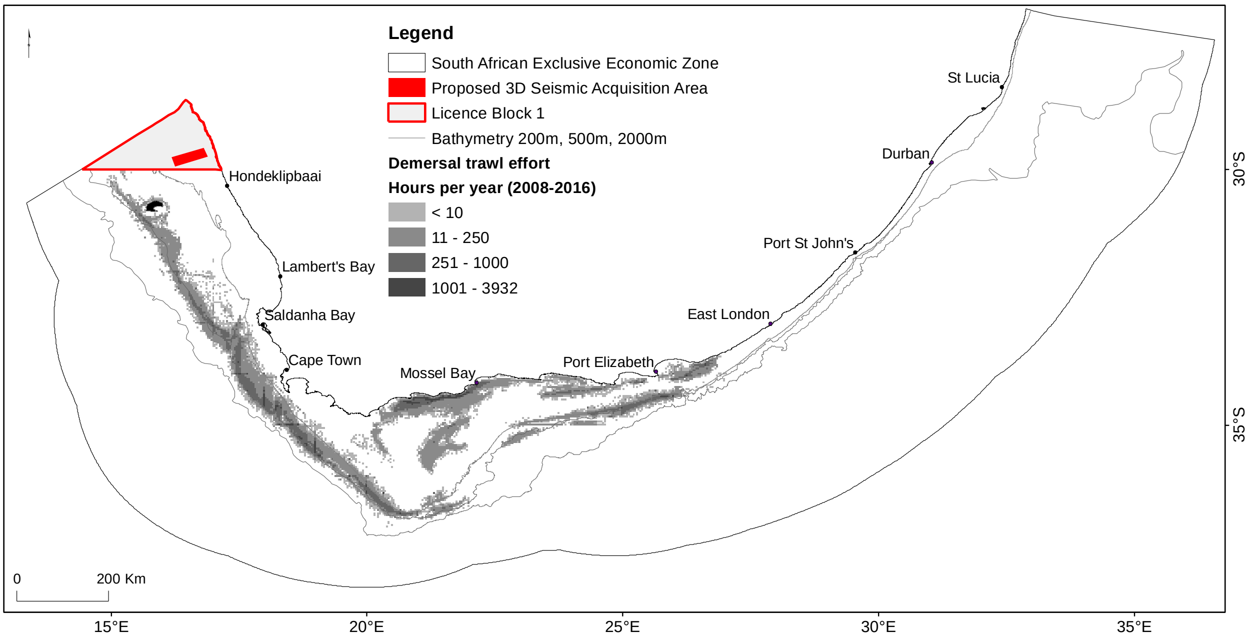


Figure 3.4: Overview of the spatial distribution of fishing effort expended by the demersal trawl sector within the South African EEZ and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area.

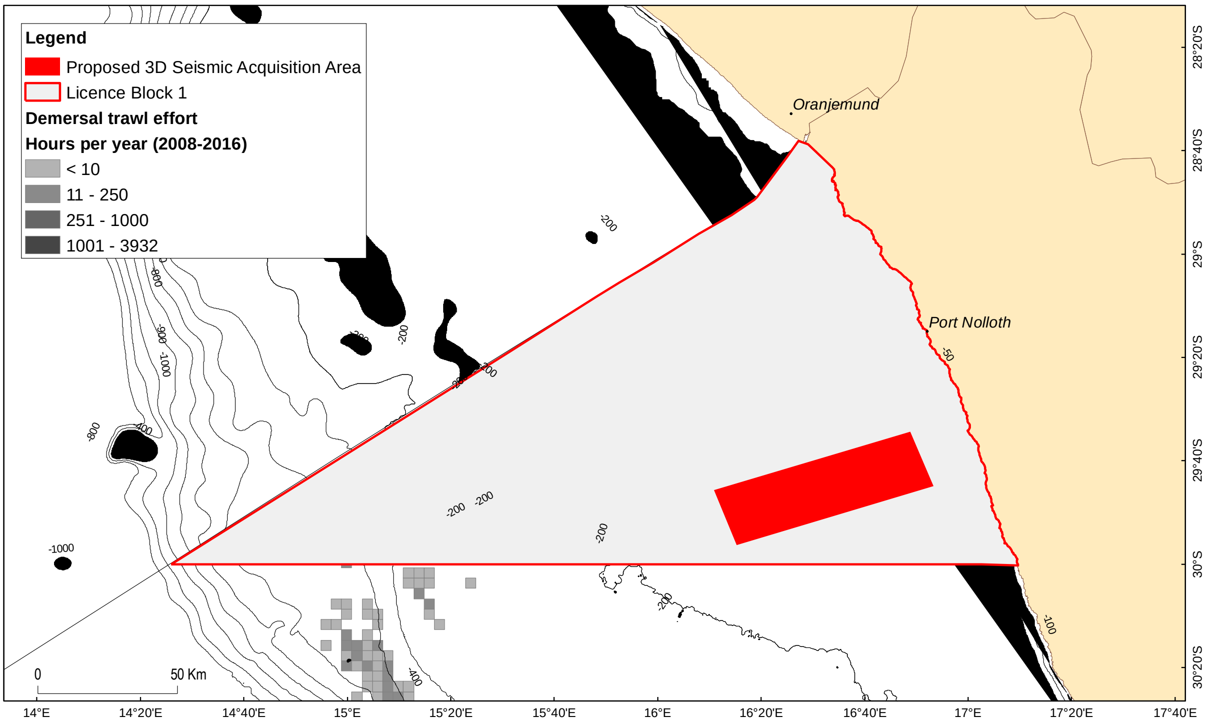


Figure 3.5: Spatial distribution of fishing effort expended by the demersal trawl sector in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area. Effort is shown as the number of fishing hours reported at a gridded resolution of 2x2 minutes (each grid block covers an area of ~14 km^2).

3.3.2 MID-WATER TRAWL

This sector included six vessels and 34 rights holders which target adult horse mackerel (*Trachurus trachurus capensis*) of which a total catch of 19 555 tons were landed in 2019. Mid-water 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, mid-water trawl gear does occasionally come into contact with the seafloor. Mid-water trawling gear configuration is similar to that of demersal trawlers, except that the net is manoeuvred vertically through the water column (refer to Figure 3.6 for a schematic diagram of gear configuration). Several demersal trawlers are able to undertake mid-water trawling by switching gear and operating under dual rights, but currently the FMV *Desert Diamond* is the only dedicated mid-water trawler and is the largest registered South African commercial fishing vessel. The *Desert Diamond* is 120 m in length and has a Gross Registered Tonnage (GRT) of 8 000 t. The towed gear may extend up to 1 km astern of the vessel and comprises trawl warps, net and cod end. Trawl warps are between 32 mm and 38 mm in diameter. The trawl doors (3.5 t each) maintain the net opening which ranges from 120 to 130 m in width and from 40 m to 80 m in height. Weights in front of, and along the ground-rope provide for vertical opening of the trawl. The cable transmitting acoustic signal from the net sounder might also provide a lifting force that maximizes the vertical trawl opening. To reduce the resistance of the gear and achieve a large opening, the front part of the trawls are usually made from very large rhombic or hexagonal meshes. The use of nearly parallel ropes instead of meshes in the front part is also a common design. Once the gear is deployed, the net is towed for several hours at a speed of 4.8 to 6.8 knots predominantly parallel with the shelf break.

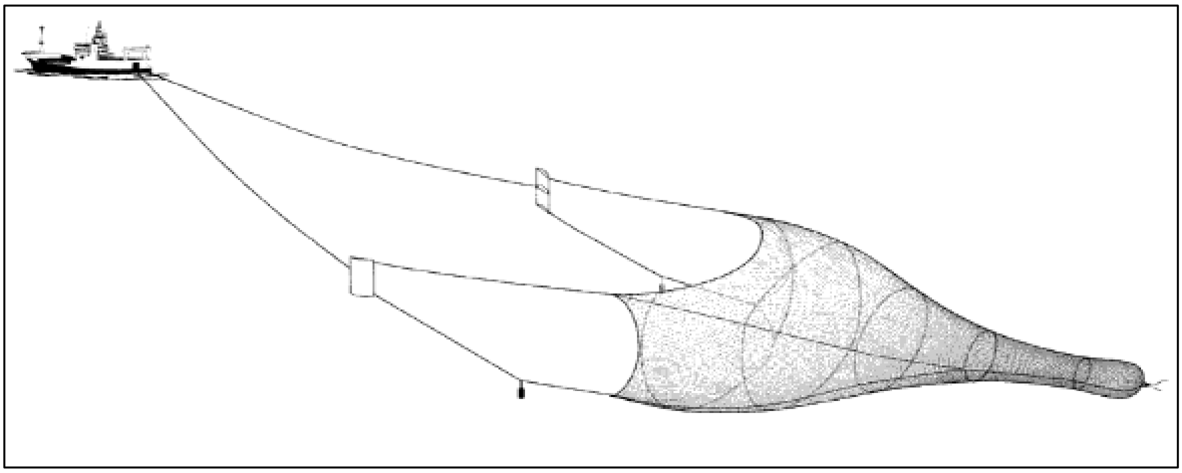


Figure 3.6: Schematic diagram showing the typical gear configuration of a mid-water trawler.

The fishery operates predominantly on the edge of the Agulhas Bank, where shoals are found in commercial abundance. Fishing grounds off the South Coast are situated along the shelf break and three dominant areas can be defined. The first lies between 22 °E and 23 °E at a distance of approximately 70 nm offshore from Mossel Bay and the second extends from 24 °E to 27 °E at a distance of approximately 30 nm offshore. The third area lies to the south of the Agulhas Bank 21 °E and 22 °E. These grounds range in depth from 100 m to 400 m and isolated trawls are occasionally recorded up to 650 m. From 2017, DEFF has permitted experimental fishing to take place westward of 20°E.

Figure 3.7 shows the spatial extent of grounds fished by mid-water trawlers within the EEZ and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area. The licence block is situated approximately 330 km from grounds fished by the sector and there is no overlap of the proposed survey activities with the operational area of the fishery.

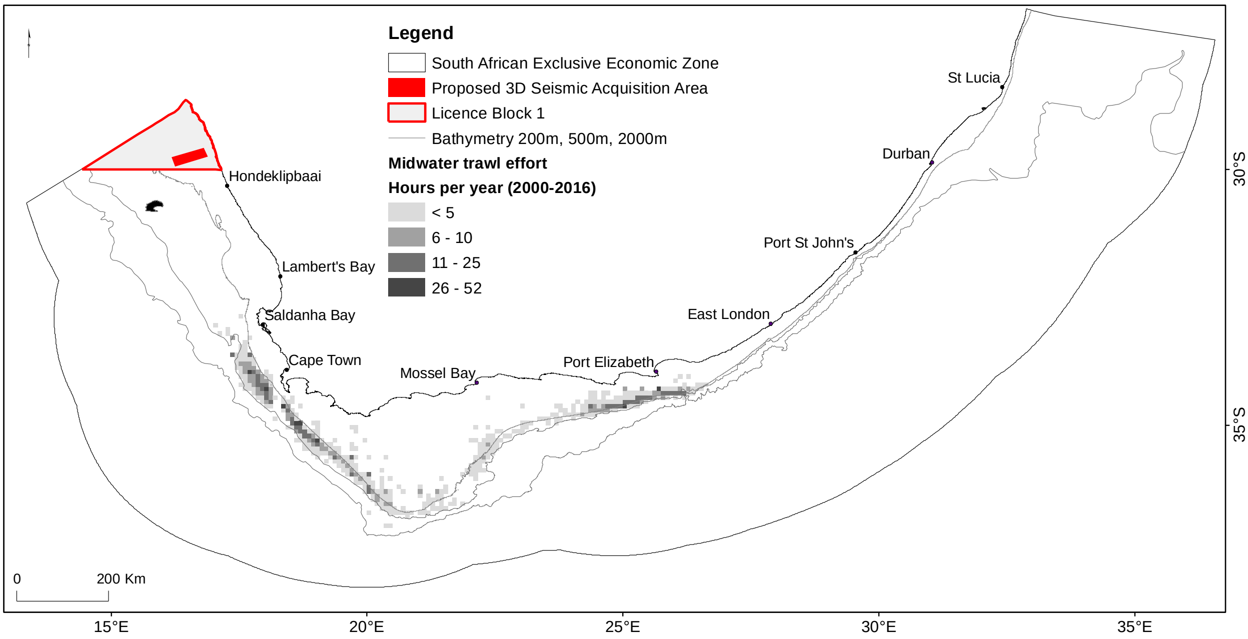


Figure 3.7: Overview of the spatial distribution of fishing effort expended by the mid-water trawl sector targeting horse mackerel within the South African EEZ and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area.

3.3.3 DEMERSAL LONGLINE

Like the demersal trawl fishery, the target species of the longline fishery is the Cape hakes, with a small non-targeted commercial by-catch that includes kingklip. In 2017, 8113 tons of catch was landed with a wholesale value of R319.2 Million, or 3.2% of the total value of all fisheries combined. Landings of 8 230 tons were reported in 2018.

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 3.8.

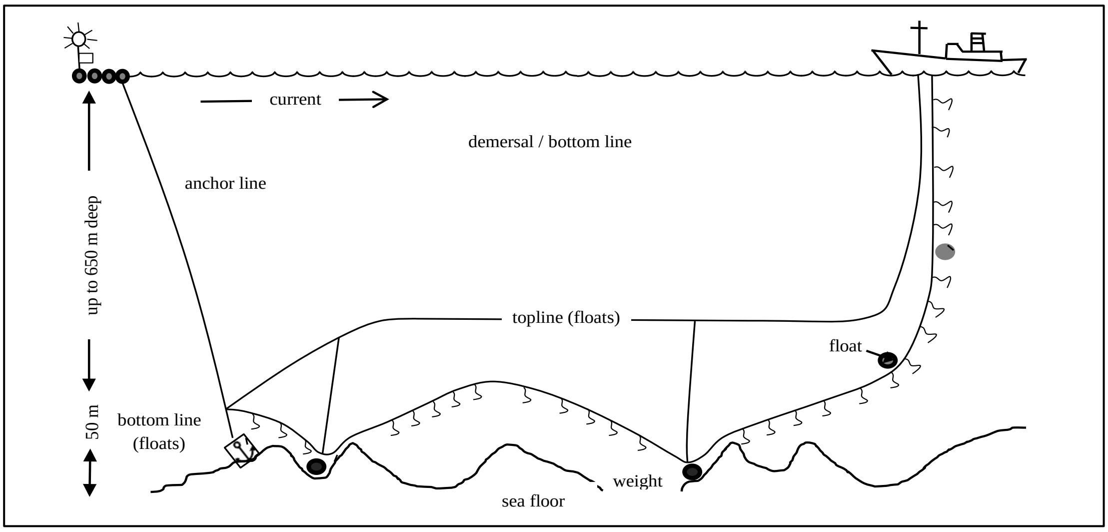


Figure 3.8: Typical configuration of demersal longline gear used in the South African hake-directed fishery (after Japp, 1989).

Currently 64 hake-directed vessels are active within the fishery, most of which operate from the harbours of Cape Town and Hout Bay. Fishing grounds are similar to those targeted by the hake-directed trawl fleet. The hake longline footprint extends down the west coast from approximately 150 km offshore of Port Nolloth (15°E, 29°S). It lies inshore to the south of St Helena Bay moving offshore once again as it skirts the Agulhas Bank to the south of the country (21°E, 37°S). Along the South Coast the footprint moves inshore again towards Mossel Bay. The eastern extent of the footprint lies at approximately (26°E, 34.5°S). Lines are set parallel to bathymetric contours, along the shelf edge up to the 1 000 m depth contour in places. The more patchy nature of effort in the north western extents of the footprint and the eastern edge of the Agulhas Bank may be attributed to proximity to fishing harbours. Figure 3.9 shows the spatial extent of demersal longline grounds within the South African EEZ and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area.

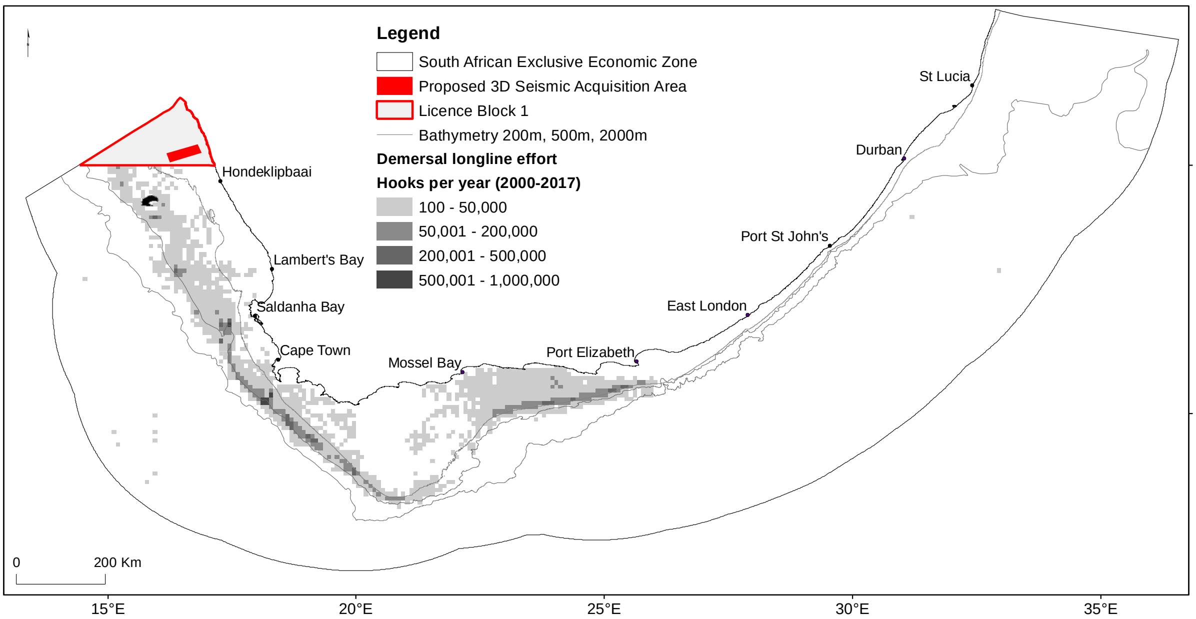


Figure 3.9: An overview of the spatial distribution of fishing effort expended within the South African EEZ by the demersal longline sector and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area.

Figure 3.10 shows the spatial distribution of demersal longline fishing areas at a reporting resolution of ~85 km^2 in relation to Licence Block 1 and the proposed seismic acquisition area. The licence block coincides with longline fishing grounds offshore of the 200 m bathymetric contour. Over the period 2000 to 2017, an average of 120,000 hooks per year were set within the licence block yielding 22.3 tonnes of hake. This is equivalent to 0.35% of the overall effort and 0.27% of the overall catch reported nationally by the sector. Incidental reports of fishing have been reported within 15 km of the proposed seismic survey acquisition area.

A Namibian-registered fleet of demersal longline vessels operate on the Namibian side of the maritime border at a depth range of 200 m to about 500 m. As such, fishing activity can be expected along the boundary of Licence Block 1, as this extends along the maritime border.

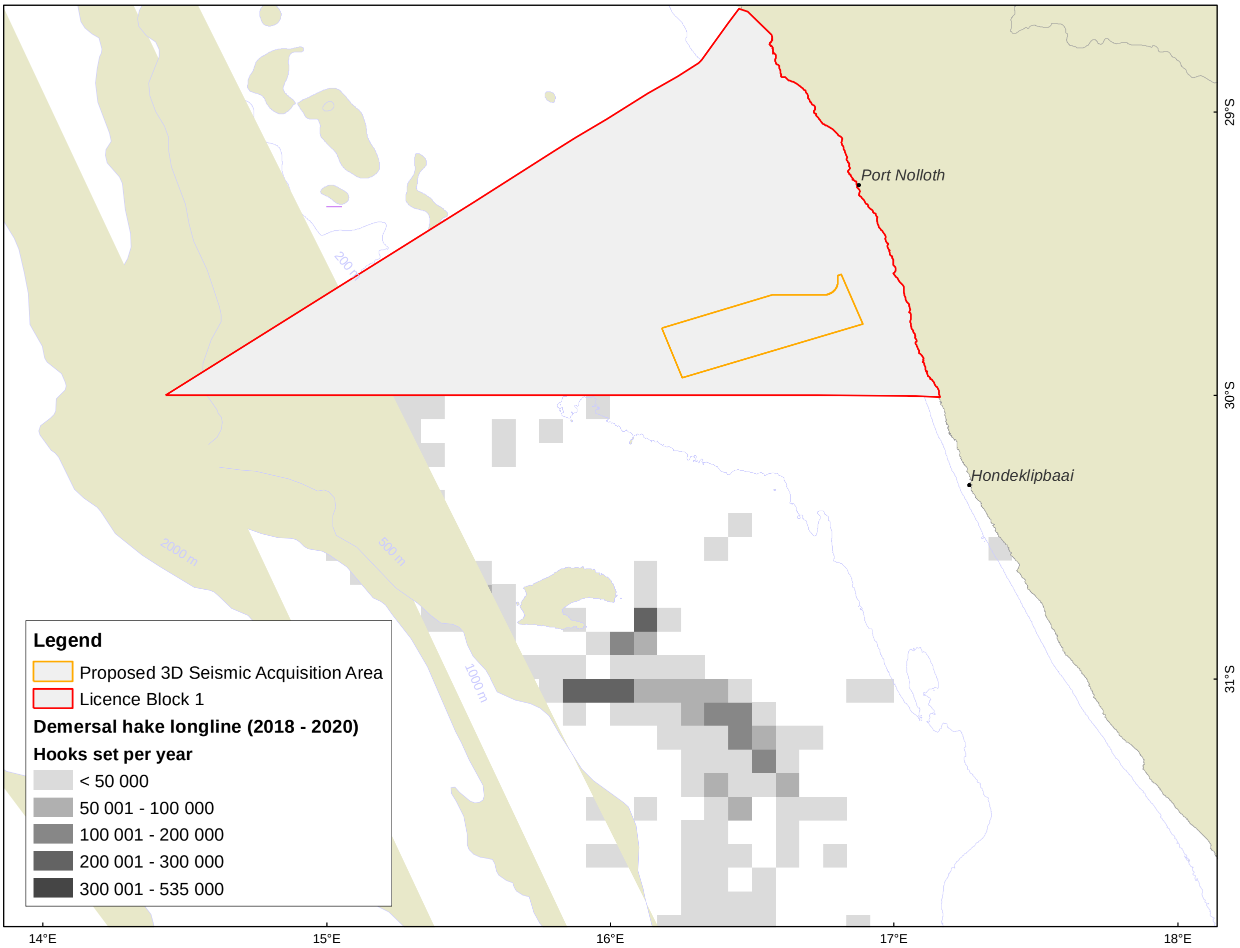


Figure 3.10: Spatial distribution of fishing effort expended by the longline sector targeting demersal fish species in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area. Effort is shown as the number of hooks set at a gridded resolution of 5x 5 minutes (each grid block covers an area of approximately 85 km^2).

3.3.4 SMALL PELAGIC PURSE-SEINE

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

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

The fleet consists of approximately 100 wooden, glass-reinforced plastic and steel-hulled vessels ranging in length from 11m to 48 m. The targeted species are surface-shoaling and once a shoal has been located the vessel will steam around it and encircle it with a large net, extending to a depth of 60 m to 90 m (Figure 3.11). Netting walls surround aggregated fish, preventing them from diving downwards. These are surface nets framed by lines: a float line on top and lead line at the bottom. Once the shoal has been encircled the net is pursed, hauled in and the fish pumped on board into the hold of the vessel. It is important to note that after the net is deployed, the vessel has no ability to manoeuvre until the net has been fully recovered on board and this may take up to 1.5 hours. Vessels usually operate overnight and return to offload their catch the following day.

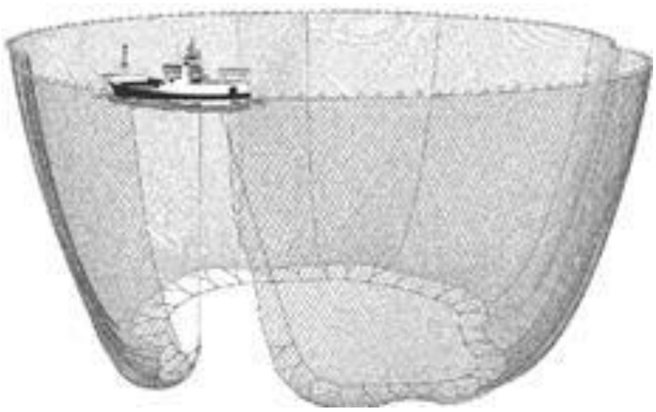


Figure 3.11: Schematic diagram showing typical configuration and deployment of a small pelagic purse-seine for targeting anchovy and sardine as used in South African waters.

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

Figure 3.12 shows the spatial extent of fishing grounds within the South African EEZ and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area. There is no overlap of fishing grounds, which are situated at least 150 km south of the licence area.

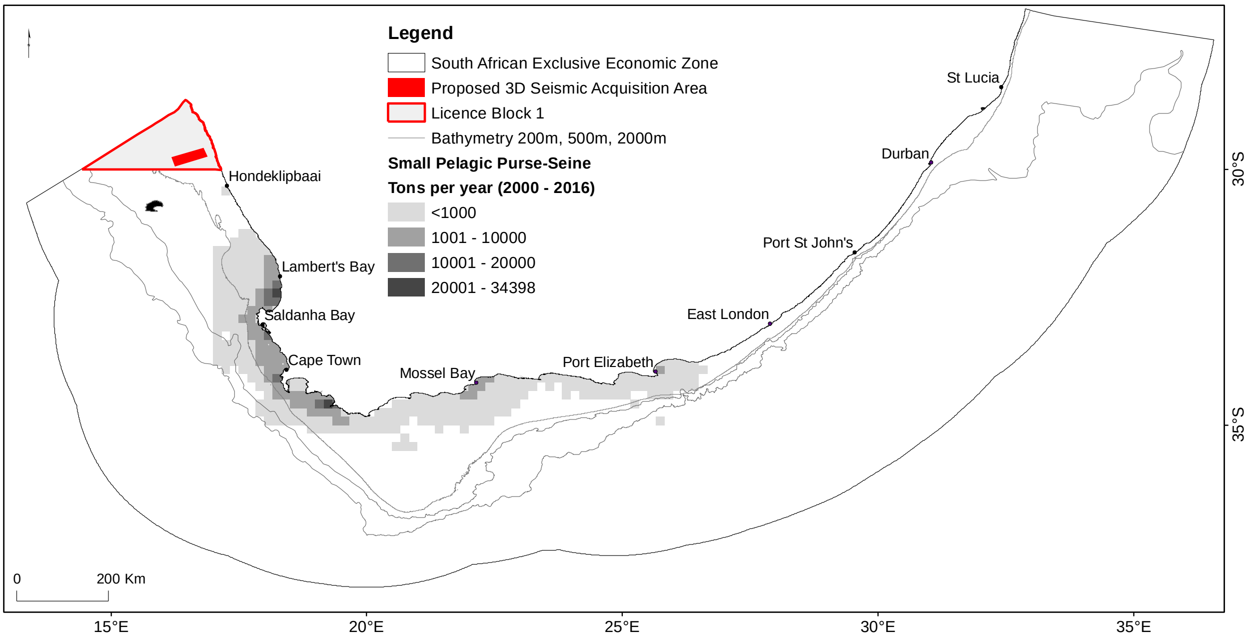


Figure 3.12: An overview of the spatial distribution of catch reported by the purse-seine sector targeting small pelagic species in the South African EEZ and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area.

3.3.5 LARGE PELAGIC LONGLINE

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

Gear consists of monofilament mainlines of between 25 km and 100 km in length which are suspended from surface buoys and marked at each end. As gear floats close to the water surface it would present a potential obstruction to surface navigation as well as a snagging risk to the gear array towed by the seismic survey vessel. The main fishing line is suspended about 20 m below the water surface via dropper lines connecting it to surface buoys at regular intervals. Up to 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 3.13 below.

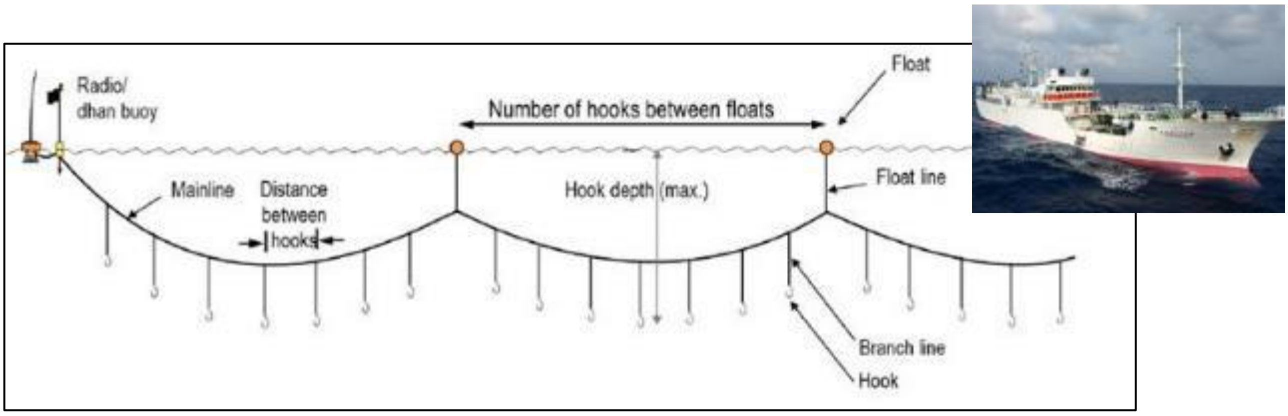


Figure 3.13: Schematic diagram showing typical configuration of long-line gear targeting pelagic species (left), and photograph of typical high seas longline vessel (upper right).

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

The fishery operates year-round with a relative increase in effort during winter and spring. Catch per unit effort (CPUE) variations are driven both by the spatial and temporal distribution of the target species and by fishing gear specifications. Variability in environmental factors such as oceanic thermal structure and dissolved oxygen can lead to behavioural changes in the target species, which may in turn influence CPUE (Punsly and Nakano, 1992). During the period 2000 to 2016, the sector landed an average catch of 4 527 tonnes and set 3.55 million hooks per year. Total catch and effort figures reported by the fishery for the years 2000 to 2018 are shown in Figure 3.14. Eighteen vessels were active in 2018.

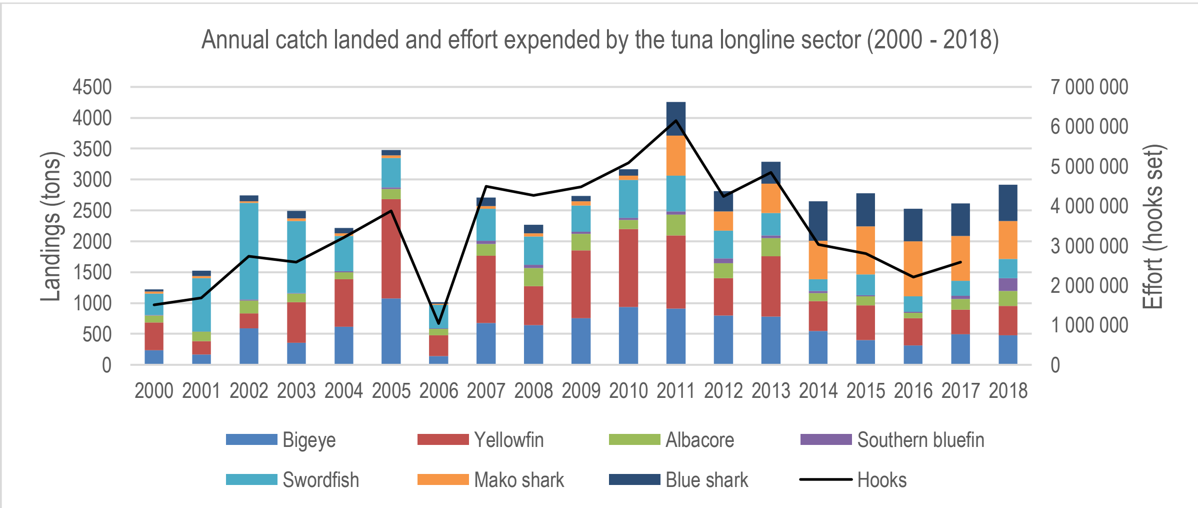


Figure 3.14: Inter-annual variation of catch landed and effort expended by the large pelagic longline sector in South African waters as reported to the two regional management organisations, ICCAT and IOTC (2000 - 2018).

Rights Holders in the large pelagic long-line fishery are required to complete daily logs of catches, specifying catch locations, number of hooks, time of setting and hauling, bait used, number and estimated weight of retained species, and data on bycatch. The fishery operates extensively within the South African EEZ, primarily along the continental shelf break and further offshore. Fishing effort is shown in Figure 3.15 at a grid resolution of 1 x 1 degree. As fishing activity is centred off the shelf break, there is no direct overlap of fishing operations with Licence Block 1 or the proposed seismic acquisition area. Fishing activity can be expected adjacent to the licence block offshore of the 500 m bathymetric contour.

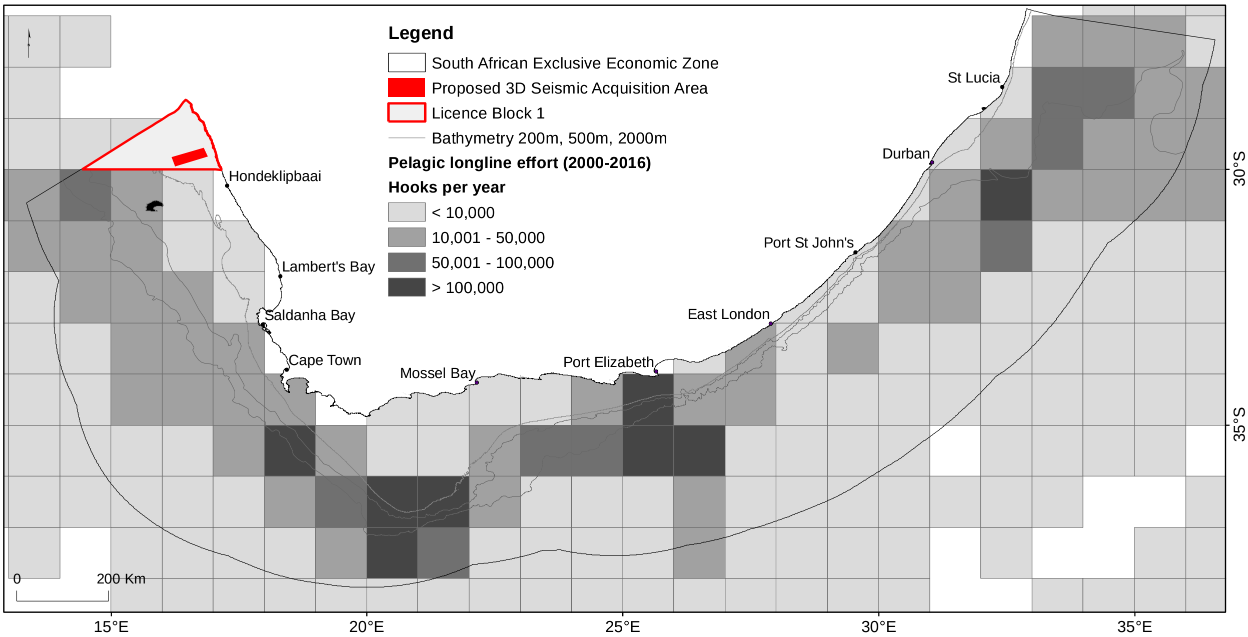


Figure 3.15: An overview of the spatial distribution of fishing effort expended by the longline sector targeting large pelagic fish species in the South African EEZ and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area. Effort is shown at a 1° grid resolution (60 x 60 nautical minutes).

3.3.6 TUNA POLE (POLE-AND-LINE)

Poling for tuna is predominantly based on the southern Atlantic longfin tuna stock also referred to as albacore (*T. alalunga*). Other catch species include yellowfin tuna, bigeye tuna, skipjack tuna (*Katsuwonus pelamis*). The fishery is seasonal with vessels active predominantly between November and May and peak catches recorded from November to January. Due to the seasonality of tuna in South Africa's waters the tuna pole fishery is also allowed access to snoek (*Thyrsites atun*) and yellowtail (*Seriola lalandi*). Access to these additional species has caused conflict with the traditional linefish sector.

Landings of albacore for 2018 amounted to 2471 tons, with a wholesale value of R124 Million, or 1.2% of the total value of all fisheries combined. A historical time series of catch and effort reported by the South African sector operating within the Atlantic region is shown in Table 3.3. The total effort of 3751 catch days within the ICCAT convention area in 2018 represents an increase by 23% compared to 2017.

Table 3.3: Total number of fishing days (effort), active vessels and total catch (t) of the main species caught by tuna pole vessels in the ICCAT region (West of 20E), 2008 – 2018 (ICCAT, 2019).

	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

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

Vessels are typically small (an average length of 16 m but ranging up to 25 m). Catch is stored on ice, refrigerated sea water or frozen at sea and the storage method often determines the range of the vessel. Trip durations average between four and five days, depending on catch rates and the distance of the fishing grounds from port. Vessels drift whilst attracting and catching shoals of pelagic tunas. Sonars and echo sounders are used to locate schools of tuna. Once a school is located, water is sprayed outwards from high-pressure nozzles to simulate small baitfish aggregating near the water surface. Live bait is then used to entice the tuna to the surface (chumming). Tuna swimming near the surface are caught with hand-held fishing poles. The ends of the poles are fitted with a short length of fishing line leading to a hook. In order to land heavier fish, lines may be strung from the ends of the poles to overhead blocks to increase lifting power (see Figure 3.16).

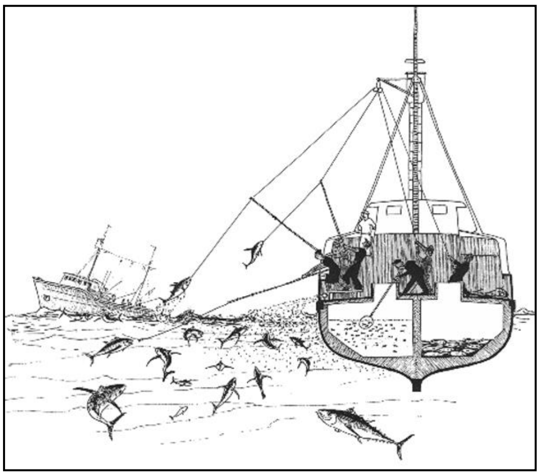


Figure 3.16: Schematic diagram of pole and line operation (Source: www.fao.org/fishery).

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 3.17 shows the location of fishing activity in relation to Licence Block 1 and the proposed seismic survey acquisition area. Fishing activity for tuna occurs along the entire West Coast beyond the 200 m bathymetric contour, along the shelf break with favoured fishing grounds including areas north of Cape Columbine and between 60 km and 120 km offshore of Saldanha Bay. Snoek-directed fishing activity is coastal in nature. Fishing records received from DEFF for the reporting period 2007 to 2019 indicate that tuna-directed fishing does not take place within the licence block; however, a significant amount of snoek-directed activity occurs inshore of the 100 m depth contour. Over the period 2017 to 2019, an average of 63 fishing events were reported having taken place within the licence block yielding 187 tonnes of snoek. This is equivalent to 2.5% of the overall effort expended by the pole-and-line sector and 27% of the snoek catch landed by the sector. Fishing activity within the block is seasonal with all fishing reported within the period March to July inclusive.

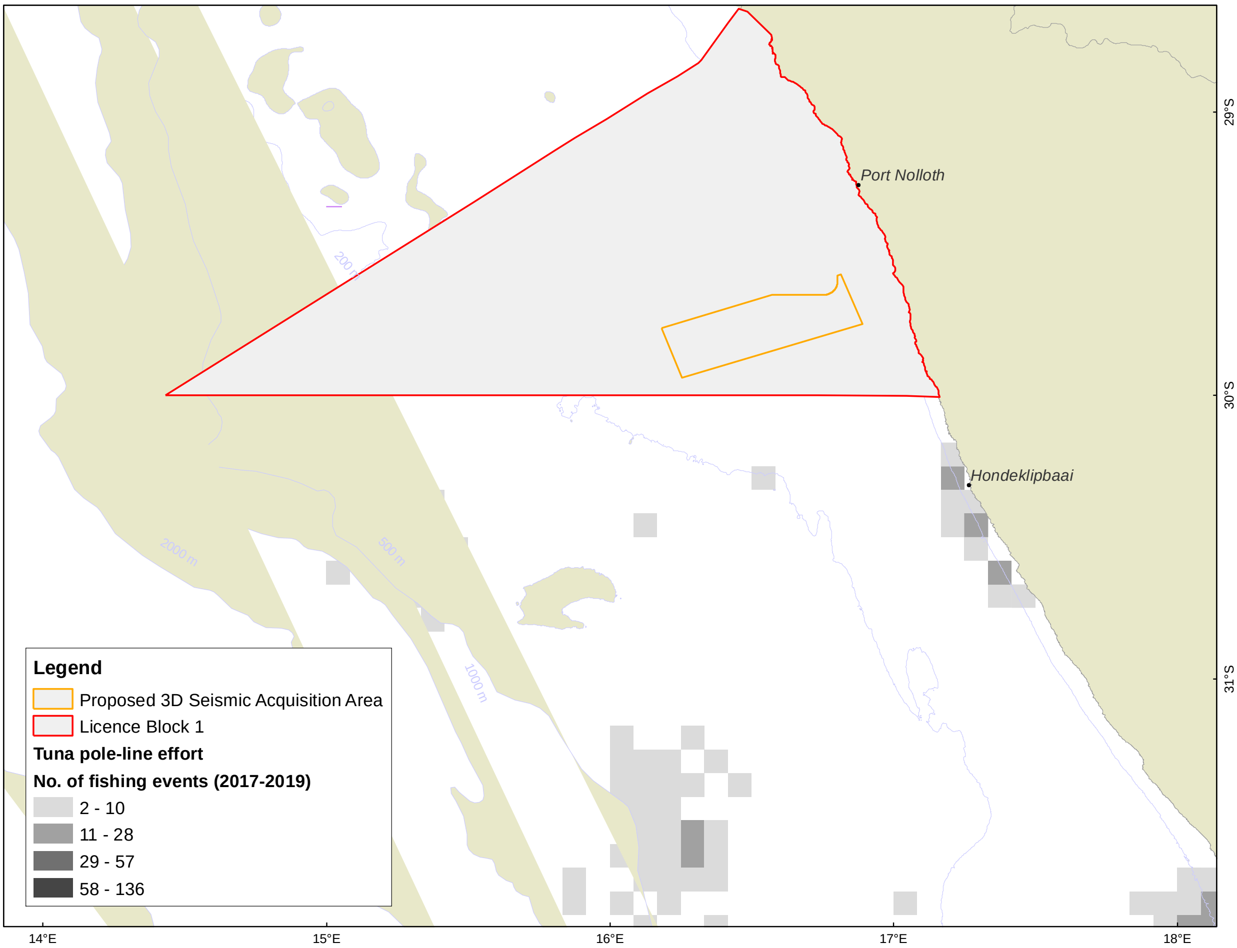


Figure 3.17: An overview of the spatial distribution of fishing effort expended by the pole-and-line sector targeting pelagic tuna and snoek in relation to Licence Block 1 and the proposed 3D seismic survey acquisition.

3.3.7 TRADITIONAL LINEFISH

The traditional line fishery is the country's third most important fishery in terms of tonnage landed and economic value. It is a long-standing, nearshore fishery based on a large assemblage of different species using hook and line, but excludes the use of longlines. Within the Western Cape the predominant catch species is snoek (*Thyrsites atun*) while other species such as Cape bream (hottentot) (*Pachymetopon blochii*), geelbek (*Atractoscion aequidens*), kob (*Argyrosomus japonicus)* and yellowtail (*Seriola lalandi)* are also important. Towards the East Coast the number of catch species increases and includes resident reef fish (Sparidae and Serranidae), pelagic migrants (Carangidae and Scombridae) and demersal migrants (Sciaenidae and Sparidae). In 2017, the wholesale value of catch was reported as R122.1 million. Table 3.4 lists the catch of important linefish species for the years 2010 to 2018.

Table 3.4: Annual catch of linefish species (t) from 2010 to 2018 (DEFF, 2019).

	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

The traditional line fishery is a boat-based activity and has since December 2000 consisted of 3450 crew operating from 455 commercial vessels. The number of rights holders is 425 (valid rights until 31 December 2020). For the 2019/2020 fishing season, 395 vessels and 3007 crew was apportioned to commercial fishing, whilst 60 vessels and 443 crew was apportioned to small-scale fishing (refer to Section 3.3.10). DEFF proposed an increase in the apportionment of TAE to small-scale fishing from 13% to 50% commencing in 2021 in order to boost economic possibilities for coastal communities.

Crew use hand line or rod-and-reel to target approximately 200 species of marine fish along the full 3 000 km coastline, of which 50 species may be regarded as economically important. To distinguish between line fishing and long lining, line fishers are restricted to a maximum of 10 hooks per line. Target species include resident reef-fish, coastal migrants and nomadic species. Annual catches prior to the reduction of the commercial effort were estimated at 16 000 tons for the traditional commercial line fishery. Almost all of the traditional linefish 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 3.5 lists the annual Total Allowable Effort (TAE) and activated effort per linefish 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. 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.

Table 3.5: Annual total allowable effort (TAE) and activated commercial linefish effort per management zone from 2007 to 2019 (DEFF, 2020).

Total TAE boats (fishers). Upper limit: 455 boats or 3450 crew			Zone A: Port Nolloth to Cape Infanta		Zone B: Cape Infanta to Port St Johns		Zone C: KwaZulu-Natal	
Allocation	455 (3182)		301 (2136)		103 (692)		51 (354)	
Year	Allocated	Activated	Allocated	Activated	Allocated	Activated	Allocated	Activated
2007	455	353	301	231	103	85	51	37
2008	455	372	301	239	103	82	51	51
2009	455	344	300	222	104	78	51	44
2010	455	335	298	210	105	82	51	43
2011	455	328	298	207	105	75	51	46
2012	455	296	298	192	105	62	51	42
2013	455	289	301	189	103	62	51	38
2014**	455	399	340	293	64	58	51	48
2015**	455	356	340	291	64	61	51	45
2016**	455	278	340	274	64	59	51	45
2017**	455	329	340	232	64	60	51	37
2018**	455	324	340	232	64	50	51	42
2019**	455	306	340	218	64	50	51	38

** In the finalisation of the 2013 commercial Traditional Linefish appeals, the effort apportioned for the small-scale fisheries sector was allocated to the commercial sector. All the small-scale Rights were considered to be activated on allocation

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.

Figure 3.18 shows the spatial extent of traditional linefish grounds at a national scale and Figure 3.19 shows reported catch in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area. Within Licence Block 1, fishing effort is coastal, with vessels operating in waters shallower than 100 m and in proximity to Port Nolloth. Records over the period 2017 to 2019 show that the fishing activity within this area is seasonal – March to September. Fishing effort within the block amounted to an average of 1037 hours per year yielding 57.8 tonnes of snoek (3.32% of total snoek landings by the sector and 0.03% of the total landings of all species by the sector). There was no fishing effort reported within the proposed seismic survey acquisition area[2]. However, due to the potential inaccuracies of reported fishing positions by this sector, the current assessment is based on an assumption that the proposed survey area is within the maximum range (75 km) of vessels launching from Port Nolloth and Hondeklipbaai. Therefore there is a low probability that vessels would operate within the inshore section of the proposed survey area.

[2] DFFE database shows the closest fishing position situated 35 km to the north of the north-western extent of the proposed acquisition area.

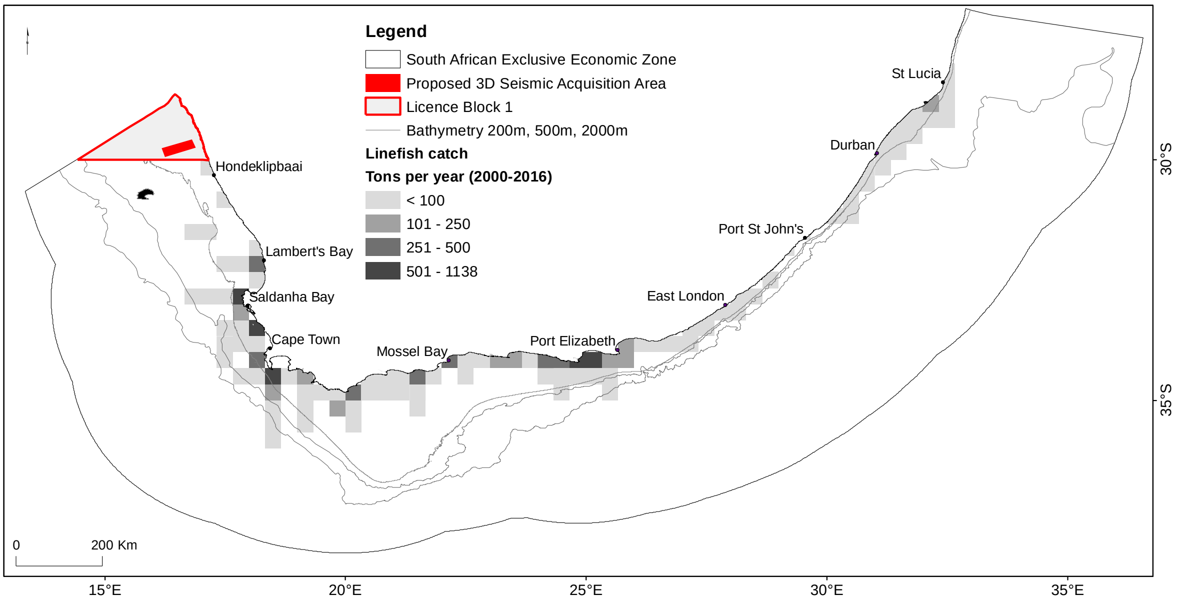


Figure 3.18: An overview of the spatial distribution of catch taken by the line-fish sector in the South African EEZ and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area.

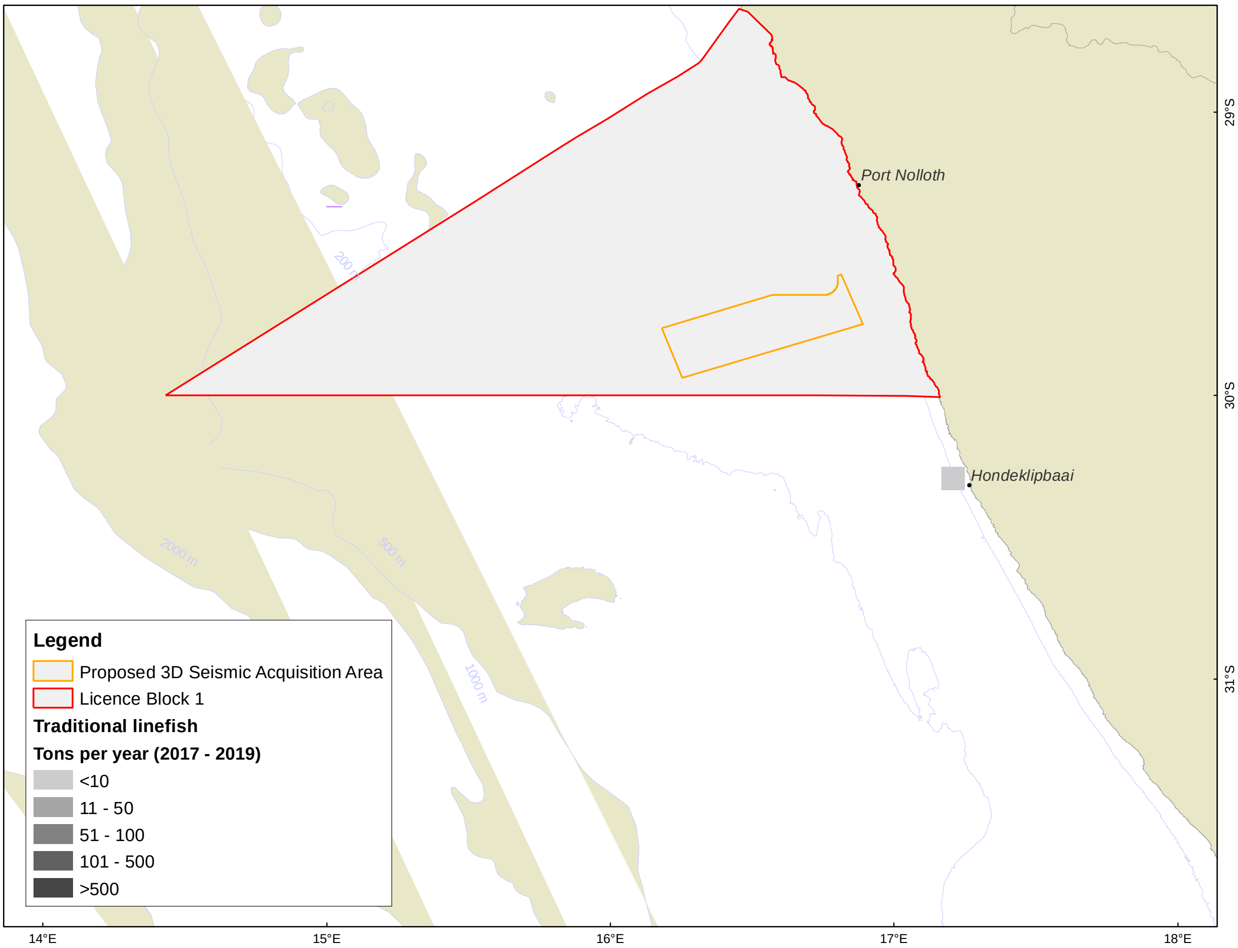


Figure 3.19: An overview of the spatial distribution of catch taken by the line-fish sector in in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area.

3.3.8 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 2020/21 TAC was set at 837 tonnes[3] and apportionment of TAC by sub-sector is listed in Table 3.6. Annual TAC and average monthly landings over the period 2006 to 2020 are shown in Figures 3.20 and Figure 3.21, respectively.

Table 3.6: Apportionment of TAC of rock lobster by sub-sector (DEFF, 2020).

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

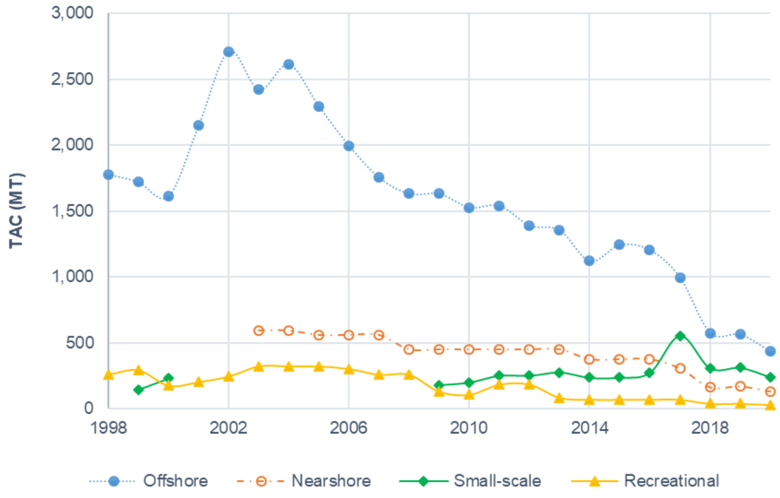


Figure 3.20: Graph showing the total allowable catch (TAC) of west coast rock lobster.

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

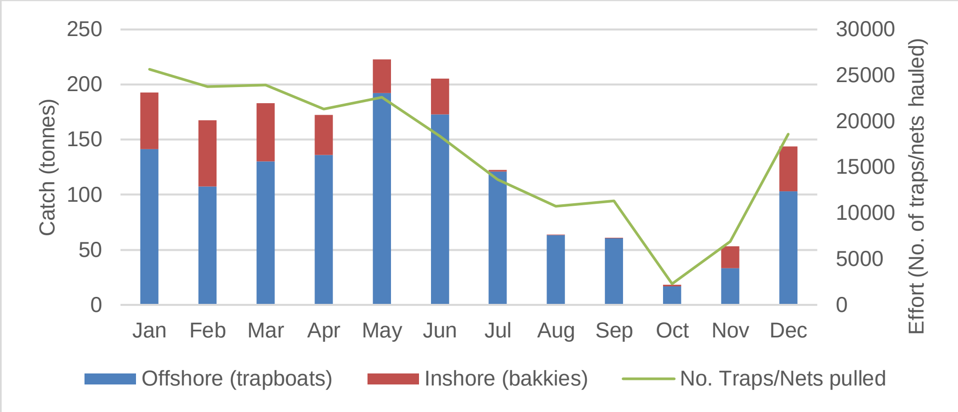


Figure 3.21: Graph showing the average monthly catch (tonnes) and effort (number of traps hauled) reported by the offshore (trapboat) and inshore (bakkie) rock lobster sectors over the period 2006 to 2020.

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 2020/21 fishing season per sector and zone are shown in Table 3.7.

Table 3.7: Start and end dates for the fishing season 2020/21 by management zone (DEFF, 2020).

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

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

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

The delineation of management zones is shown in Figure 3.22. 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. A historical time-series of TACs and landings is listed in Table 3.8.

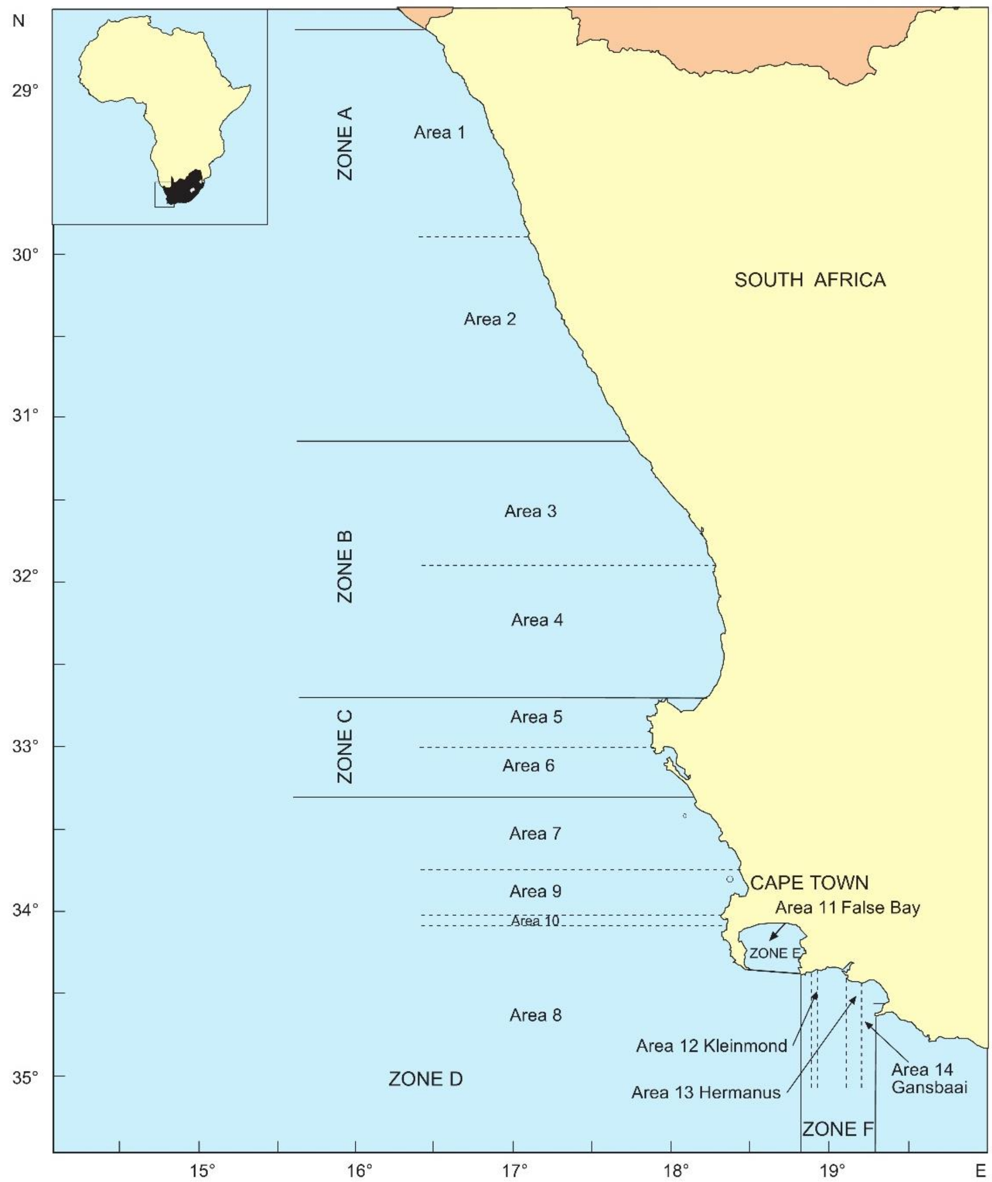


Figure 3.22: West Coast rock lobster fishing zones and areas. The five super-areas are: areas1–2, corresponding to zone A; areas 3–4, to zone B; areas 5–6, to zone C; area 7, being the northernmost area within zone D; and area 8+, comprising area 8 of zone D as well as zones E and F.

Figure 3.23 and Figure 3.24 show rock lobster catch by management zone for the commercial offshore and inshore sectors, respectively, in relation to Licence Block 1 and the proposed 3D seismic survey area. The licence block is situated offshore of rock lobster management area 1 (situated in the vicinity of Port Nolloth) and management area 2 (vicinity of Hondeklip Bay). Over the period 2005 to 2020, there was no fishing activity reported by the offshore sector within management areas 1 and 2. Over the same period the inshore sector reported an annual average of 4500 nets set and 11.8 tonnes of lobster caught within management areas 1 and 2. The amount of catch and effort reported within the area amounted to 3.6% and 10.1%, respectively, of the total national landings and overall effort expended by the inshore fleet. A fleet of small dinghies/bakkies operate within the area targeting lobster at discrete suitable reef areas along the shore at a water depth of up to 15 m. Fishing activity could be expected approximately 17 km shoreward of the seismic acquisition area and fishing grounds do not overlap the proposed seismic acquisition area. Management areas 1 and 2 have a seasonal operational window from 15 October to 15 February.

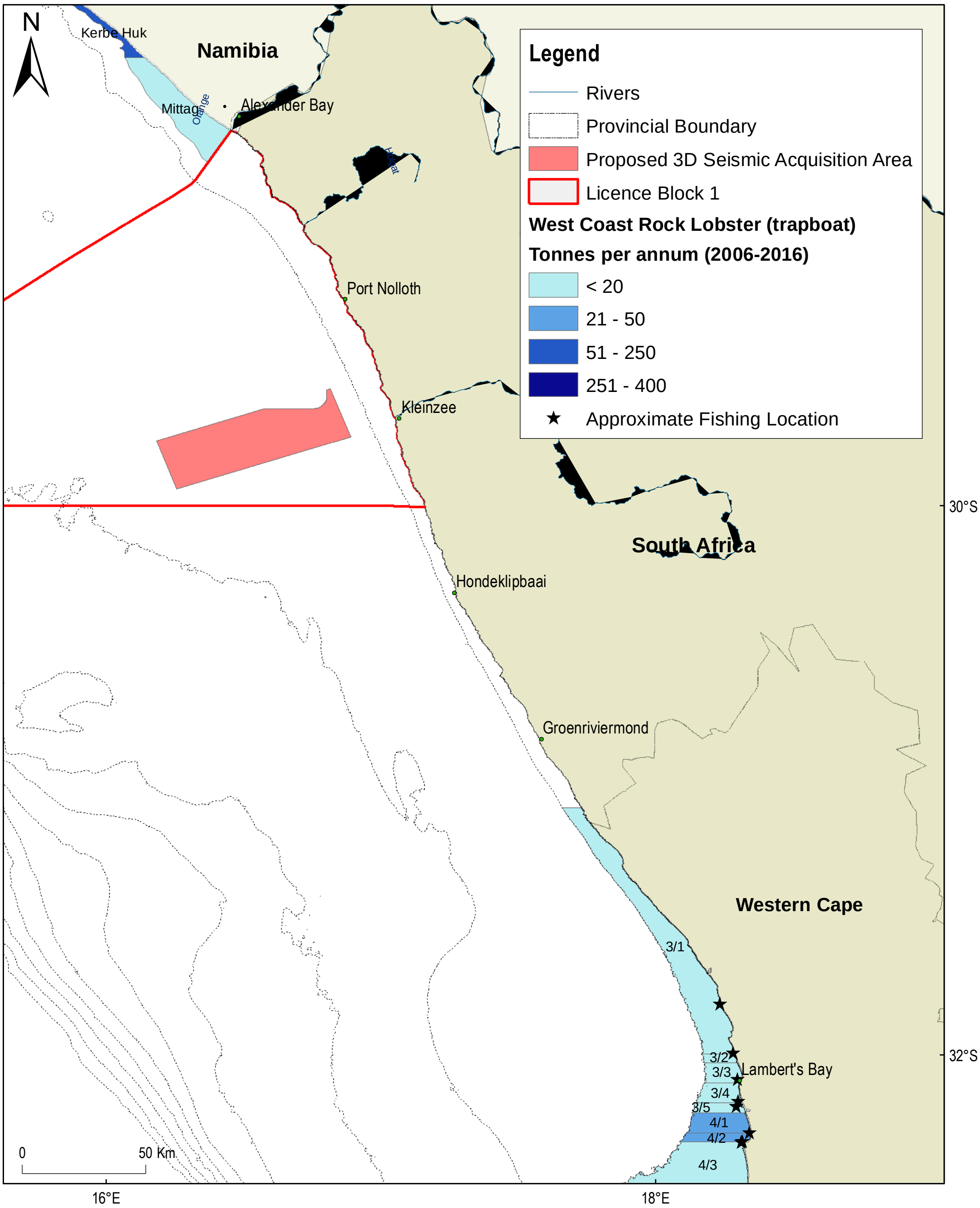


Figure 3.203: An overview of the spatial distribution of fishing effort expended by the west coast rock lobster offshore (trapboat) sector in relation to Licence Block 1 and the proposed seismic survey acquisition area. Lobster management zones are demarcated and labelled.

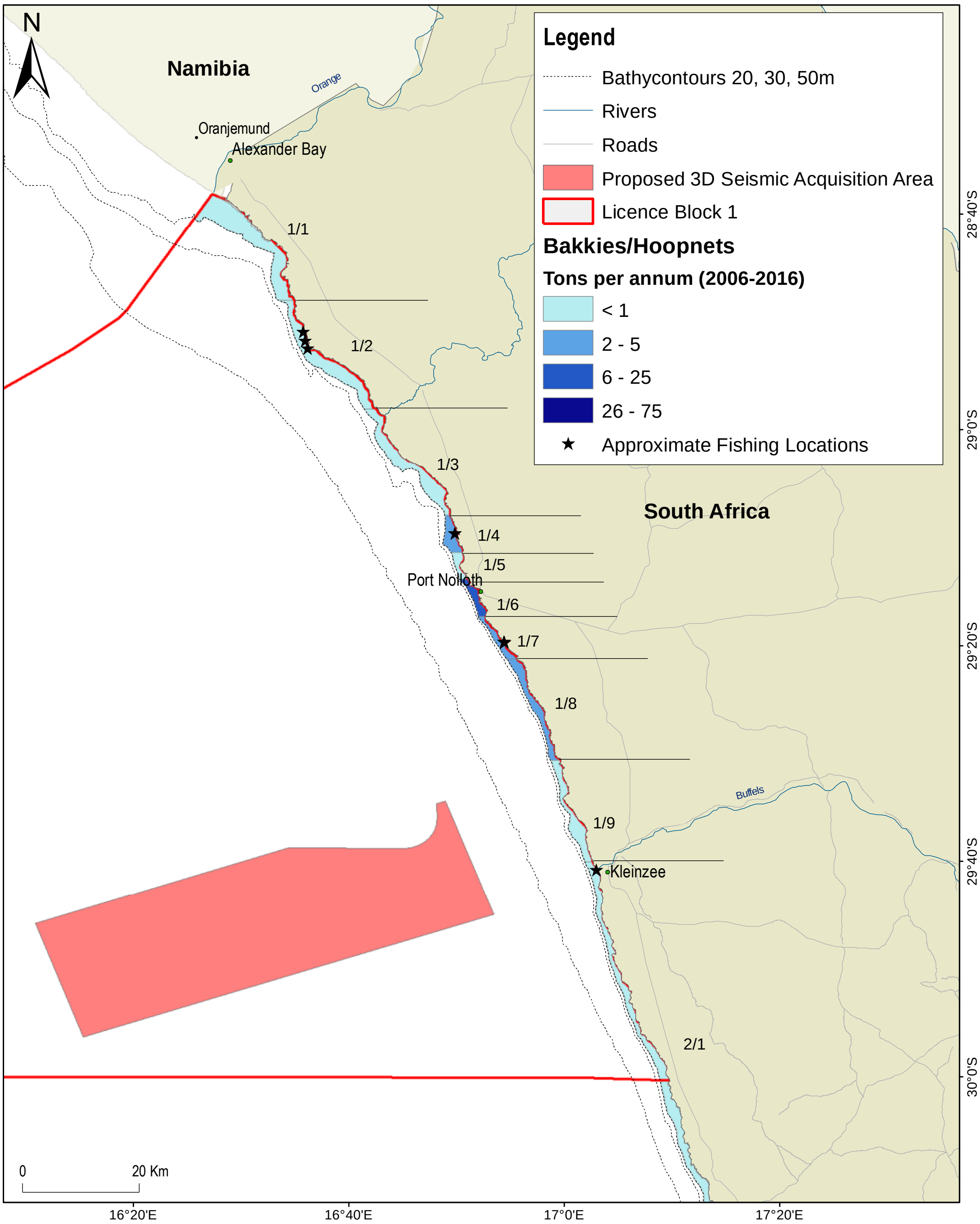


Figure 3.214: An overview of the spatial distribution of fishing effort expended by the west coast rock lobster inshore (bakkies/hoopnets) sector in relation to Licence Block 1 and the proposed seismic survey acquisition area. Lobster management zones are demarcated and labelled.

Table 3.8: 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[3]
1998/99	2 300	1780			258	2051
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[4]	69	1564
2017/18	1 924	994	305	554[5]	69	1355

[1] No Interim Relief allocated
[2] Interim Relief accommodated under Recreational allocation
[3] Total catch by all sectors
[4] Includes 39 t allocated to N Cape small-scale fishers (SSF)
[5] Includes 248.7 t allocated to SSF Offshore and 70.4 t to SSF Nearshore

3.3.9 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).

The commercial (diver) fishery for abalone started in the late 1940s and catches were initially unregulated, reaching a peak of close to 3 000 tonnes in 1965. By 1970, catches had declined rapidly, although the fishery remained stable, with a total annual catch of around 700 tonnes, until the mid-1990s, after which there were continuous declines in commercial catches (DAFF, 2016). The continued high levels of illegal fishing and declines in the resource led to the introduction of diving prohibitions in selected areas and the closure of the commercial fishery in 2008. The fishery was subsequently reopened in 2010, with TAC allocations of 150 tonnes. Latest published figures of abalone landings are 89.6 tonnes (2016/17). Historically, the resource was most abundant in the region between Cape Columbine and Quoin Point (refer to Figure 3.25). Along the East Coast, the resource was considered to be discontinuous and sparsely distributed and as a result no commercial fishery for abalone was implemented there.

Figure 3.225: Distribution of abalone (insert) and abalone fishing Zones A–G (Source DAFF, 2016).

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 areas (ranching) (Anchor Environmental, 2012). The potential to increase this to 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 (refer to Figure 3.25).

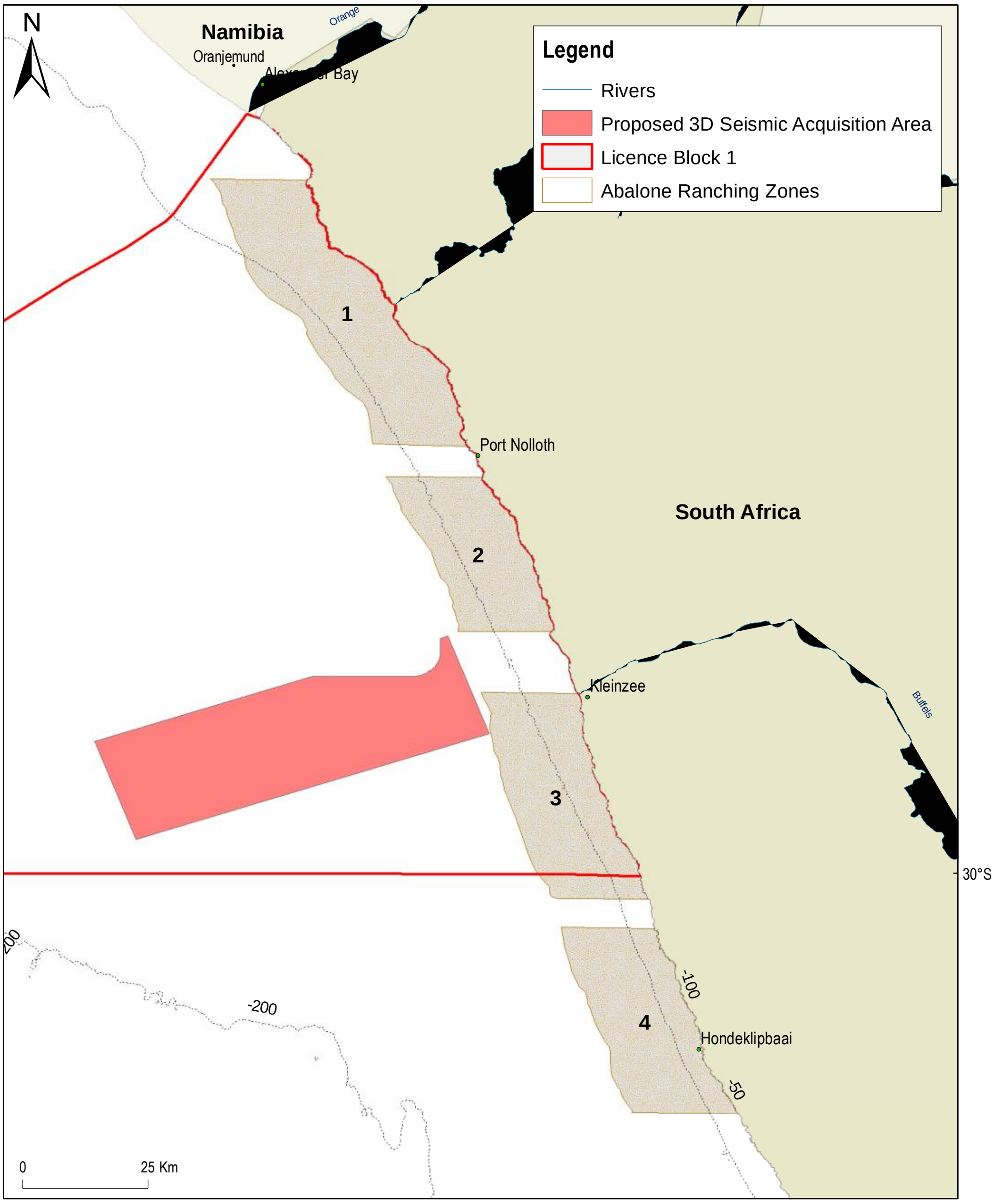


Figure 3.236: An overview of the spatial distribution of abalone ranching concession areas in relation to Licence Block 1 and the proposed seismic acquisition area.

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. Zones 1, 2 and 3 are situated within Licence Block 1 and Zone 3 is located inshore of the proposed seismic acquisition area (refer to Figure 3.26). As the maximum depth of seeding is considered to be approximately 10 m, the proposed seismic acquisition area would not coincide with seeding areas within Zone 3.

3.3.10 SMALL-SCALE FISHERIES

The term small-scale is usually used to distinguish between capital intensive commercial fisheries and low technology, labour intensive fishing activities (Sowman, 2006). Small-scale fishers fish to meet food and basic livelihood needs, and may also directly be involved in fishing for commercial purposes. These fishers traditionally operate on nearshore fishing grounds, using traditional, low technology or passive fishing gear 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[4].

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. Small scale fisheries 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.

South Africa is implementing a Small-Scale Fisheries policy (SSF) – this is in process and was gazetted in May 2019 under the Marine Living Resources Act, 1998 (Act No. 18 of 1998). A small-scale fishing right is the right to catch different species of fish in the near shore. These rights are allocated to communities and not to individuals in terms of the SSF. Applicants for small-scale fishing rights must have a historical involvement in traditional fishing operations, including the catching, processing or marketing of fish for a cumulative period of at least 10 years. They also need to show a historical dependence on deriving the major part of their livelihood from traditional fishing operations. More than 270 communities have registered an Expressions of Interest (EOI) with the Department. The location of these coastal communities and the number of fishers per community are shown in Figure 3.27.

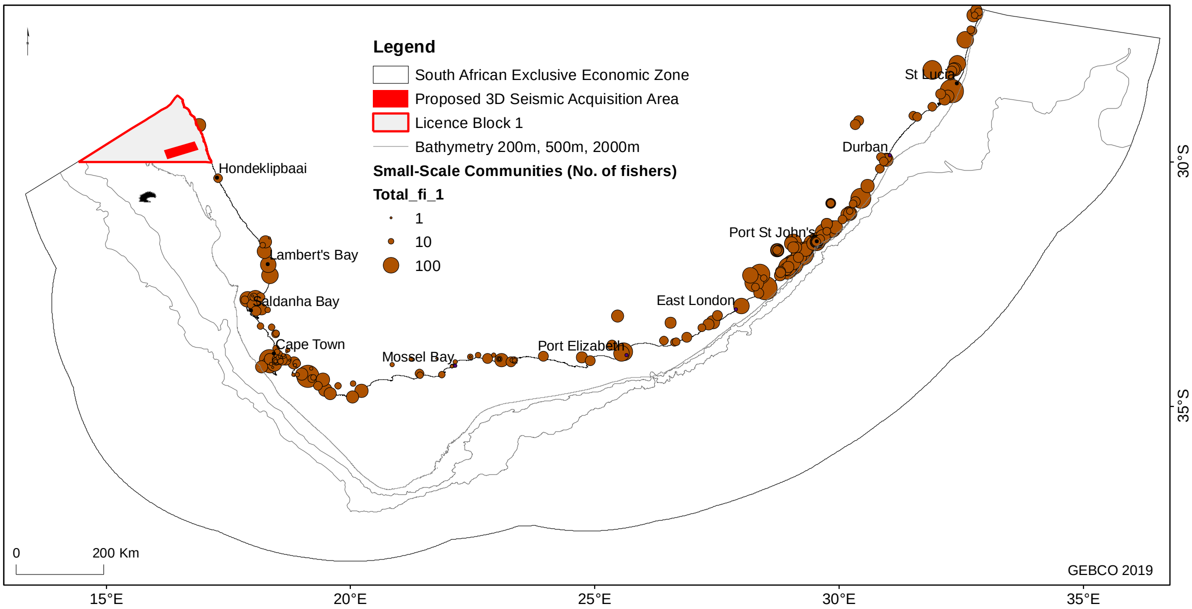


Figure 3.24: Overview of spatial distribution of small-scale fishing communities and number of participants per community along the South African coastline and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area.

[4] 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.

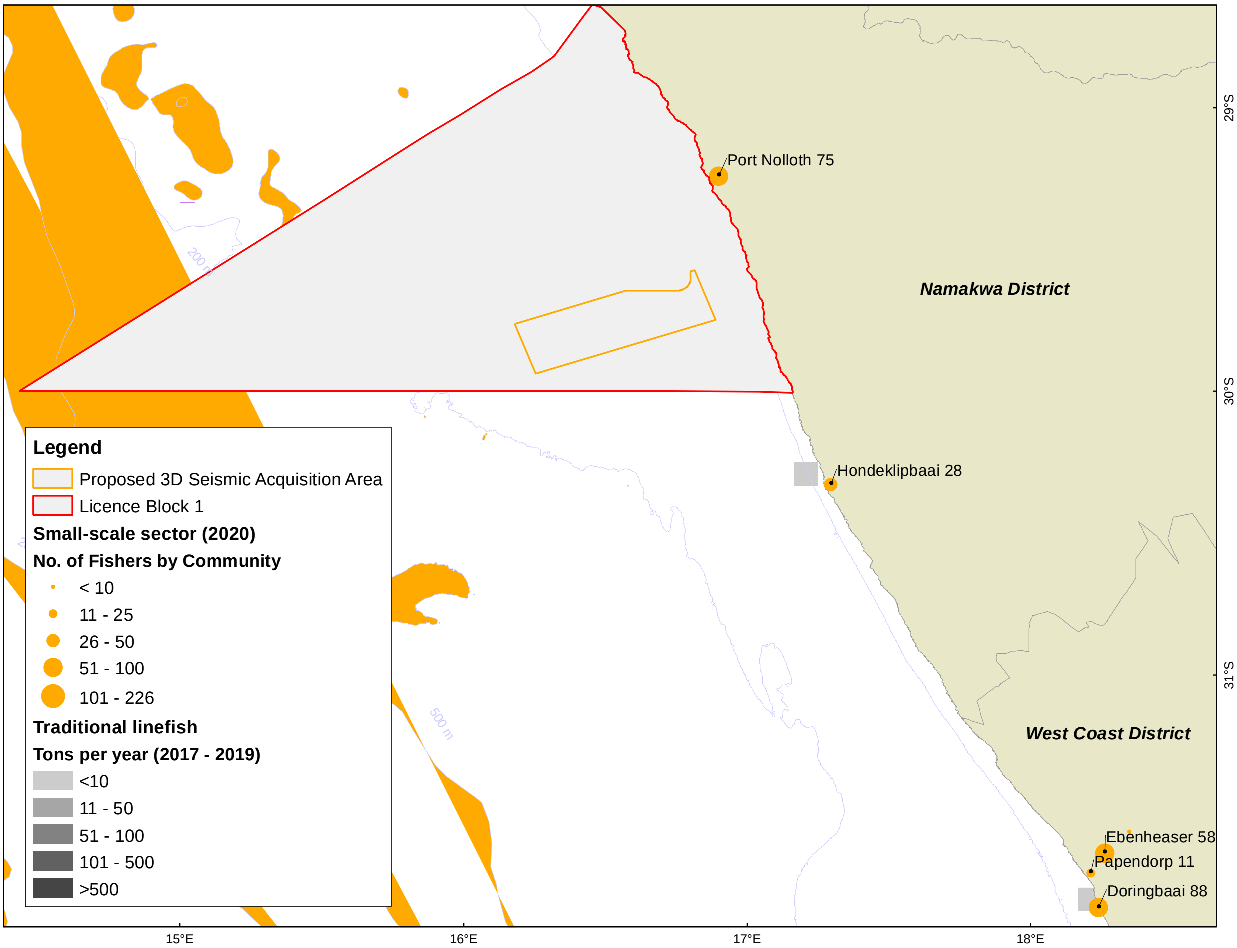


Figure 3.25: Location of small-scale fishing communities and number of participants per community in the Namakwa municipal district, adjacent to Licence Block 1 and the proposed 3D seismic survey acquisition area.

The small-scale fisheries policy proposes that certain areas on the coast be prioritized and demarcated as small-scale fishing areas. In some areas access rights could be reserved exclusively for use by small-scale fishers. The community, once they are registered as a community-based legal entity, could apply for the demarcation of these areas. The policy also requires a multi-species approach to allocating rights, which will entail allocation of rights for a basket of species that may be harvested or caught within particular designated areas. DFFE recommends five basket areas: 1. Basket Area A – The Namibian border to Cape of Good Hope – 57 different resources 2. Basket Area B – Cape of Good Hope to Cape Infanta – 109 different resources 3. Basket Area C – Cape Infanta to Tsitsikamma – 107 different resources 4. Basket Area D – Tsitsikamma to the Pondoland MPA – 138 different resources 5. Basket Area E – Pondoland MPA to the Mozambican border – 127 different resources.

The fishing sectors that could be directly affected are: 1) traditional line fish; 2) squid; 3) white mussel and oysters and 4) hake handline. While most of these sectors are nearshore (within 3 nm of the coast), the fisheries that operate further offshore may be affected by this ongoing process. These include hake handline and squid, which will be subjected to the ongoing Fishery Rights Allocation Process (referred to as “FRAP”).

The SSF is to be implemented along the coast in series of community “co-operatives”. DFFE has split SFF by communities into district municipalities and local municipalities.

- In the Northern Cape, communities are grouped into the Namakwa district, comprising the Richtersveld and Kamiesberg local municipalities and there are 103 registered fishers between Port Nolloth and Hondeklipbaai (see Figure 3.28).
- 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 2 748 fishers registered in the province.
- In the Eastern Cape, the districts are 1) Nelson Mandela Bay, 2) Sarah Baartman, 3) Buffalo City, 4) Amathole, 5) O.R. Tambo and 6) Alfred Nzo. There are 5 154 fishers registered in the province.
- KwaZulu-Natal has 2 008 registered small-scale fishers divided by district into 1) Ugu, 2) Ethekwini Metropolitan, 3) Ilembe, 4) King Shwetshayo/Uthungula, and 5) Umkhanyakude.

Small-scale fishermen along the Northern Cape and Western Cape coastlines are typically involved in the traditional line (refer to Section 3.3.7), West Coast rock lobster (Section 3.3.8) and abalone fisheries, whereas communities on the South Coast would be involved in traditional line, squid jig and oyster harvesting. The above-mentioned fisheries off the West Coast are unlikely to range beyond 3 nm (5.6 km) from the coastline; thus, inshore of the proposed survey area. However, there is a low probability that snoek-directed fishing effort reported under the traditional linefish sector could range up to a maximum of 75 km from Port Nolloth launch site thus in range of the inshore extent of the proposed survey area.

3.3.11 BEACH-SEINE AND GILLNET FISHERIES (NETFISH)

There are a number of active beach-seine and gillnet operators throughout South Africa (collectively referred to as the “netfish” sector). Initial estimates indicate that there are at least 7 000 fishermen active in fisheries using beach-seine and gillnets, mostly (86%) along the West and South coasts. These fishermen utilize 1 373 registered and 458 illegal nets and report an average catch of about 1 600 tons annually, constituting 60% harders (also known as mullet, *Liza richardsonii*), 10% St Joseph shark (*Callorhinchus capensis*) and 30% "bycatch" species such as galjoen (*Dichistius capensis*), yellowtail (*Seriola lalandii*) and white steenbras (*Lithognathus lithognathus*). Catch-per-unit-effort declines eastwards from 294 and 115 kg·net-day^{-1} for the beach-seine and 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 3.9 for the number of rights issued and Figure 3.29 for the fishing areas). The number of Rights Holders for 2014 was listed as 28 for beach-seine and 162 for gill-net (DAFF, 2014a). 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.

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). There are currently three rights issued for Area A (Port Nolloth) and no rights issued for Area B (Hondeklipbaai).

The gillnet fishery operates from Yzerfontein to Port Nolloth on the West Coast. Surface-set gillnets (targeting mullet) are restricted in size to 75 m x 5 m and bottom-set gillnets (targeting St Joseph shark) are restricted to 75 m x 2.5 m (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 and ranges up to a maximum of 15 off St Helena Bay. Of a total of 162 right holders, four operate within Area A (Port Nolloth) and two operate within Area B (Hondeklipbaai).

Table 3.9: 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

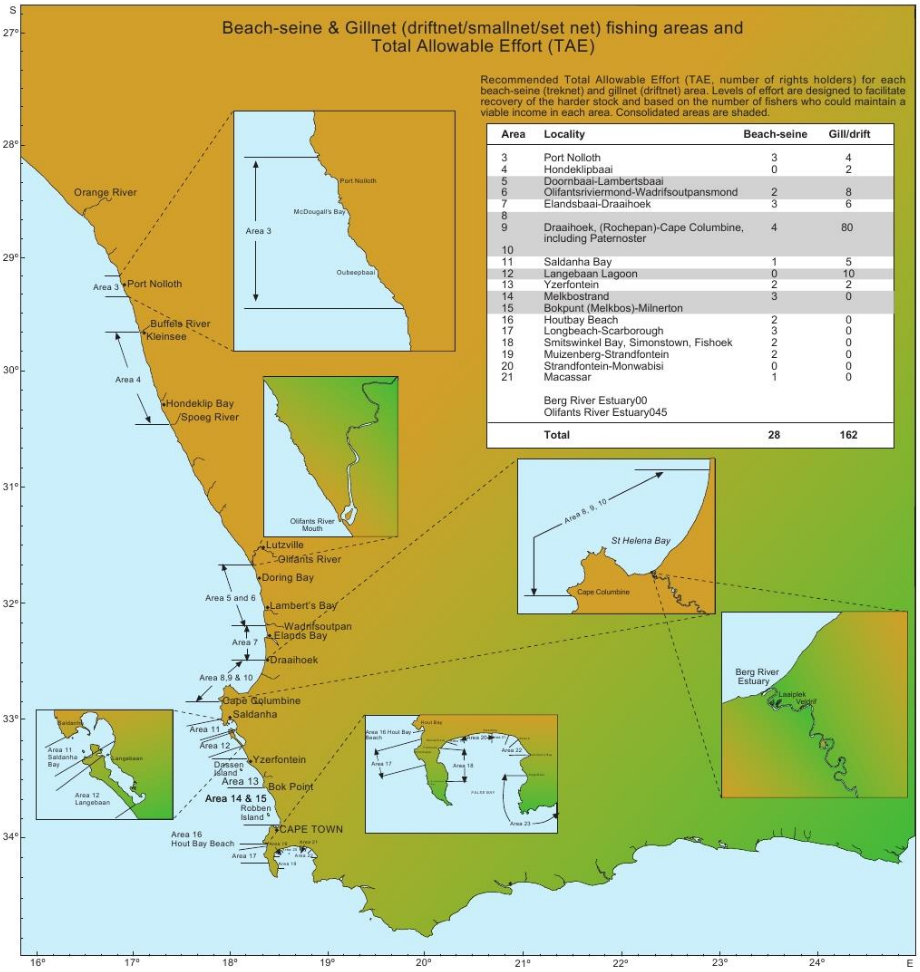


Figure 3.26: Beach-seine and gillnet fishing areas and TAE (DAFF, 2014)

Licence Block 1 is situated offshore of management area B, however the range of gillnets (50 m) and that of beach-seine activity (20 m) is not likely to directly overlap with the seismic acquisition area which is situated in waters deeper than 100 m. Figure 3.30 shows the expected range of gillnet fishing activity in relation to the seismic acquisition area.

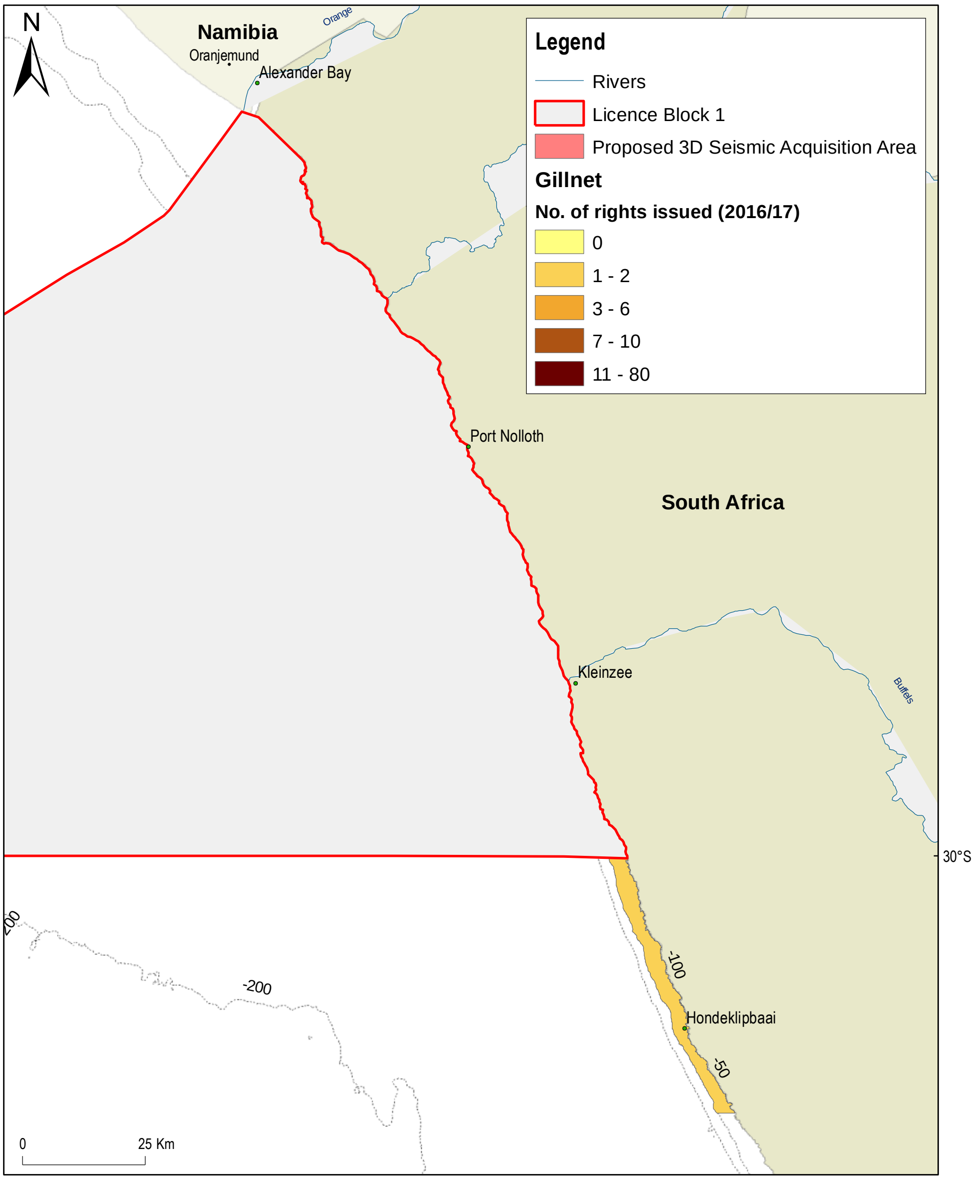


Figure 3.30: Number of rights issued for gillnet fishing areas A (Port Nolloth) and B (Hondeklipbaai) to a maximum fishing depth of 50 m (DAFF, 2016/17) in relation to Licence Block 1 and the proposed seismic acquisition area.

3.3.12 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 Port Nolloth and Port St Johns into 23 harvesting areas. Figure 3.31 shows licence block 1 in relation to management areas 15 and 16, which are situated offshore of Port Nolloth and Hondeklipbaai.

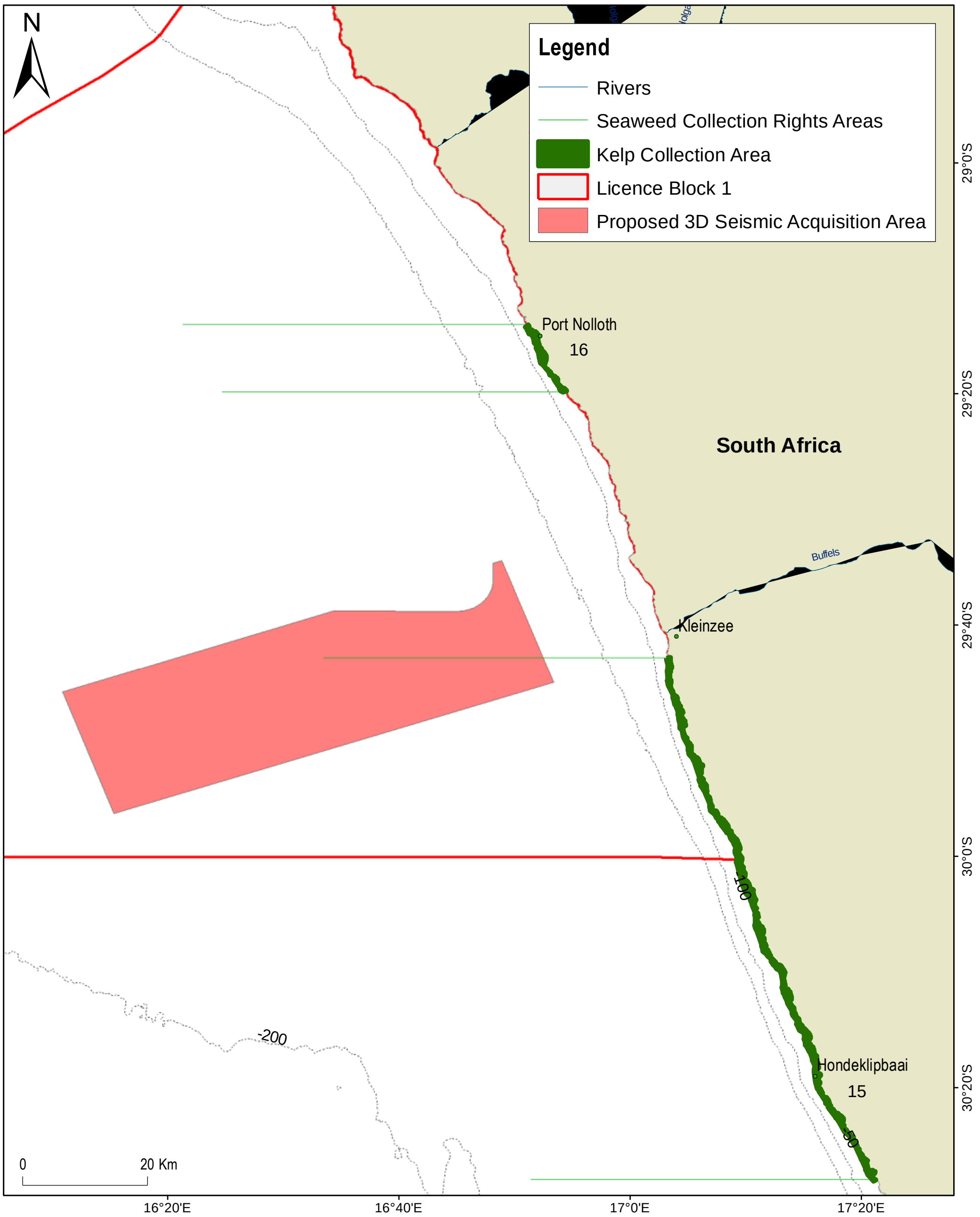


Figure 3.31: Location of seaweed rights areas in relation to licence block 1 and the proposed seismic survey acquisition area.

Permit conditions stipulate that within these areas kelp may be harvested using a diver deployed from a boat or the shore. The acquisition area 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. Over the period 2000 to 2017, an average of 40.33 tonnes per annum of dry harvested kelp (beach cast) and 34.67 tons per annum of wet harvested kelp were reported within collection area 15. An average of 37 tonnes per annum of dry harvested kelp and 37.33 tonnes of wet harvested kelp were reported within collection area 16. Amounts harvested within these collection areas amounts to approximately 16.3% of the total kelp harvests, nationally.

3.3.13 FISHERIES RESEARCH

Swept-area trawl surveys of demersal fish resources are carried out twice a year by DAFF in order to assess stock abundance. Results from these surveys are used to set the annual TACs for demersal fisheries. First started in 1985, the West Coast survey extends from Cape Agulhas (20°E) to the Namibian maritime boarder and takes place over the duration of approximately one month during January/February. The survey of the Southeast coast (20°E – 27°E longitude) takes place in April/May. Following a stratified, random design, bottom trawls are conducted to assess the biomass, abundance and distribution of hake, horse mackerel, squid and other demersal trawl species on the shelf and upper slope of the South African coast. Trawl positions are randomly selected to cover specific depth strata that range from the coast to the 1 000 m isobath. On occasion, trawls are targeted in waters deeper than 1 000 m. Figure 3.32 shows the distribution of research trawls undertaken in relation to licence block 1 and the proposed 3D seismic survey acquisition area. Research trawls take place across the spatial extent of the licence block and the proposed seismic acquisition area. Approximately 8.5% and 0.31% of the total number of research trawls were reported within the licence block and seismic acquisition area, respectively. The surveys in the area take place usually over the period January to March.

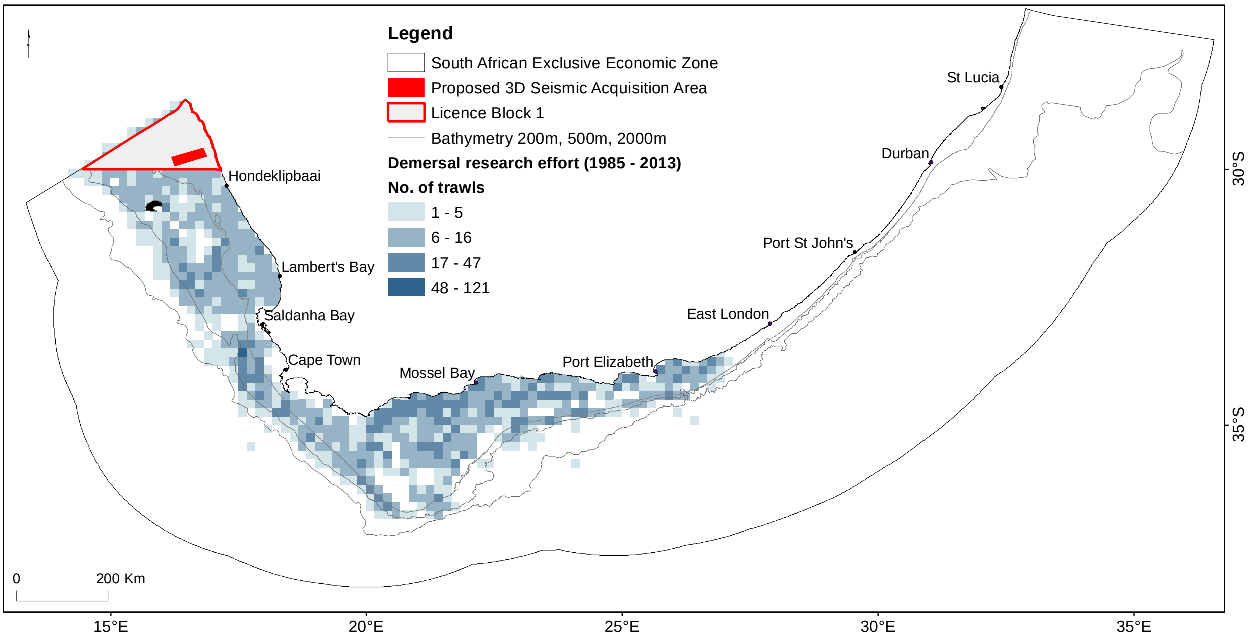


Figure 3.27: Spatial distribution of trawling effort expended during research surveys undertaken by DFFE to ascertain biomass of demersal fish species.

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. During these surveys the survey vessels travel pre-determined transects (perpendicular to bathymetric contours) running offshore from the coastline to approximately the 200 m isobath. The surveys are designed to cover an extensive area from the Orange River on the West Coast to Port Alfred on the East Coast and the DFFE survey vessel progresses systematically from the Northern border Southwards, around Cape Agulhas and on towards the east. Figure 3.33 shows the research effort undertaken between 1988 and 2013 in respect to Licence Block 1 and the proposed 3D survey acquisition area. Figure 3.34 shows the transects completed during the November 2020 and May 2021 research surveys for the recruitment and spawner biomass of small pelagic species. Two survey transects were undertaken across the proposed seismic survey acquisition area and nine transects across the extent of the licence block.

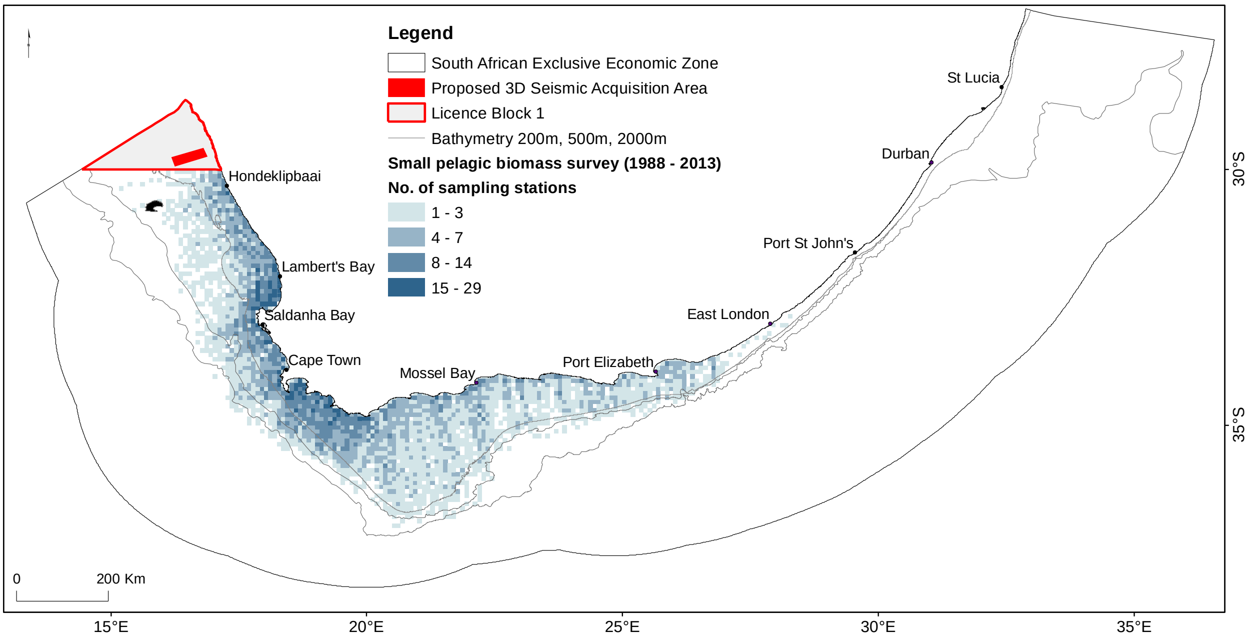


Figure 3.28: Spatial distribution sampling stations for acoustic surveys of the biomass of small pelagic species (1988 – 2013).

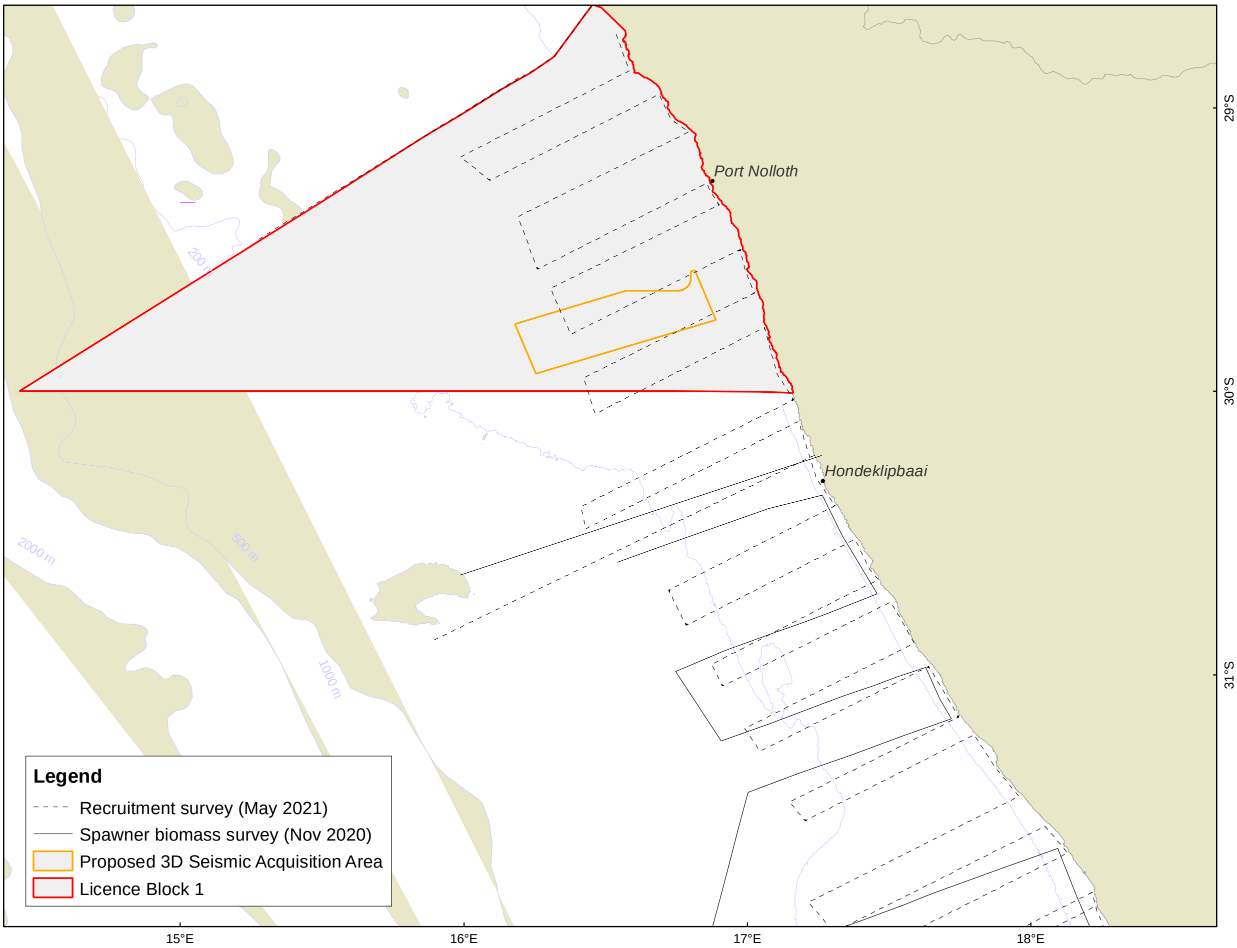


Figure 3.29: Spatial distribution of survey transects completed during the DFFE research surveys for small pelagic species (May 2021 and November 2020) in relation to Licence Block 1 and the proposed 3D seismic survey area.

3.4 SUMMARY TABLE OF SEASONALITY OF CATCHES FOR COMMERCIAL FISHING SECTORS

The seasonality of each of the main commercial fishing sectors that operate within the South Africa EEZ is indicated in Table 3.7 – also presented is the relative intensity of fishing effort on a month-by-month basis.

Table 3.7: Summary table showing seasonal variation in fishing effort expended by each of the main commercial fisheries sectors operating off the West Coast of South Africa.

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

*Areas 8 and 11 only; # Area 8 only

4 IMPACT ASSESSMENT

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

Under the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972, Part A, Rule 10), a seismic survey vessel that is engaged in surveying is defined as a “vessel restricted in its ability to manoeuvre” which requires that power-driven and sailing vessels give way to a vessel restricted in her ability to manoeuvre. Furthermore, under the Marine Traffic Act, 1981 (No. 2 of 1981), a vessel used for the purpose of exploiting the seabed falls under the definition of an “offshore installation” and as such it is protected by a 500 m safety zone. It is an offence for an unauthorised vessel to enter the safety zone. In addition to a statutory 500 m safety zone, a seismic contractor would request a safe operational limit (that is greater than the 500 m safety zone) that it would like other vessels to stay beyond. Safety clearances for seismic surveys are usually 9 Nm to the stern and 5 Nm to either side of the vessel. The temporary exclusion of fisheries from the safety zone will effectively reduce fishing grounds, which in turn could potentially result in a loss of catch and/or displacement of fishing effort (direct negative impact).

An overview of the South African fishing industry and a description of each commercial sector is presented in Sections 3.1 and 3.3, respectively. The affected fisheries sectors have been identified based on the extent of overlap of fishing grounds with the proposed seismic acquisition area.

4.1.1 DEMERSAL TRAWL

Demersal trawlers operate within Licence Block 1 offshore of the 200 m bathymetric contour. Although there is minimal fishing activity that takes place within the licence block (0.01% of overall national effort and catch), there is no overlap of the proposed seismic survey acquisition area with the trawl fishing grounds. The acquisition area is situated 80 km inshore of the closest trawling locations. As such there is no impact expected from the presence of the seismic survey vessel on exclusion of fishing operations.

4.1.2 MID-WATER TRAWL

The licence block is situated approximately 330 km from grounds fished by the sector and there is no overlap of Licence Block 1 or the proposed survey acquisition area with the operational area of the fishery. As such there is no impact expected from the presence of the seismic survey vessel on exclusion of fishing operations.

4.1.3 DEMERSAL LONGLINE

Demersal longline vessels operate within the licence block between the 200 m and 500 m bathymetric contours. Over the period 2000 to 2017, 0.35% of the overall effort and 0.27% of the overall catch were reported within the licence block. Incidental fishing activity has been reported within 5 km of the seismic survey acquisition area, but the probability of fishing activity taking place within the survey area itself is considered to be unlikely.

The impact is considered to be local in extent (i.e. the area within 5 km of the survey acquisition area) and immediate in duration (limited to the duration of the survey i.e. 4 months). The magnitude (or intensity) of the impact on the sector is expected to be moderate (where normal operations will need to be modified). This rating is based on the proportion of fishing effort and catch within the affected area relative to total effort and catch reported by the sector. The probability of the impact materialising is considered to be improbable (<25%). Based on the above ratings, the overall significance of the impact is assessed to be LOW NEGATIVE (Refer to Table 4.1).

4.1.4 SMALL PELAGIC PURSE-SEINE

Licence Block 1 is situated at least 150 km north of the closest grounds fished by the small pelagic purse-seine fleet. As such there is no impact expected from the presence of the seismic survey vessel on exclusion of fishing operations.

4.1.5 LARGE PELAGIC LONGLINE

Pelagic longline vessels operate extensively within the South African EEZ, primarily along the continental shelf break and further offshore. Fishing activity can be expected offshore of the 500 m bathymetric contour and into deeper water. There is no expected overlap of fishing operations with Licence Block 1 or the proposed seismic acquisition area and no impact of exclusion of fishing operations during the proposed seismic survey.

4.1.6 POLE-AND-LINE

Vessels registered under the pole-and-line sector target either albacore in favoured areas off the shelf break, or they target snoek and yellowtail in coastal waters. Fishing records received from DFFE for the reporting period 2007 to 2019 indicate that tuna-directed fishing does not take place within the licence block; however, a significant amount of snoek-directed activity occurs inshore of the 100 m depth contour. Approximately 2.5% of the overall effort expended by the sector and 27% of the snoek catch landed by the sector was reported within the licence block. Fishing activity within the block is seasonal with all fishing reported within the period March to July inclusive. Vessels could be expected to operate in close proximity to the proposed seismic acquisition area, within 6 km of the inshore extent of the seismic acquisition area. Vessels may therefore be affected by the navigational safety zone around the survey vessel, especially if the survey design requires the survey vessel to conduct line changes (vessel turns) into shallow waters.

The impact is considered to be local in extent (i.e. the area within 5 km of the survey acquisition area) and immediate in duration (limited to the duration of the survey i.e. 4 months). The magnitude (or intensity) of the impact on the sector is expected to be moderate (where normal operations will need to be modified). This rating is based on the proportion of fishing effort and catch within the affected area relative to total effort and catch reported by the sector. The probability of the impact materialising is considered to be medium (>50% and <75%). Based on the above ratings, the overall significance of the impact is assessed to be LOW NEGATIVE (refer to Table 4.1).

4.1.7 TRADITIONAL LINEFISH

Within Licence Block 1, linefish vessels operate in coastal waters (water depths shallower than 100 m) and in close proximity to Port Nolloth and Hondeklipbaai (generally within 15 km of the vessel launch site). Fishing activity in this area is seasonal (March to September) and predominantly snoek-directed. Over the period 2017 to 2019, 3.32% of the total snoek landings reported by the sector were caught within the licence block. There was no fishing effort reported within the proposed seismic survey acquisition area itself[5]. However, due to the potential inaccuracies of reported fishing positions by this sector, the current assessment assumes that the proposed survey area is within the maximum range (75 km) of vessels launching from Port Nolloth and Hondeklipbaai. Therefore there is a low probability (<25%) that vessels would operate in the vicinity of the inshore section of the proposed survey area. Vessels may therefore be affected by the navigational safety zone around the survey vessel, especially if the survey design requires the survey vessel to conduct line changes (vessel turns) into shallow waters.

The impact is considered to be local in extent (i.e. the area within 5 km of the survey acquisition area) and immediate in duration (limited to the duration of the survey i.e. 4 months). The magnitude (or intensity) of the impact on the sector is expected to be low to moderate (where normal operations will need to be modified). The impact of temporary exclusion of fishing operations is assessed to be of LOW NEGATIVE significance (refer to Table 4.1).

4.1.8 WEST COAST ROCK LOBSTER

Rock lobster is targeted within Licence Block 1 by a fleet of small dinghies (“bakkies”) operating under the inshore commercial rock lobster sector. Lobster is caught using hoop nets at discrete suitable reef areas along the shore at a water depth of up to approximately 15 m. The licence block is situated offshore of rock lobster management area 1 (situated in the vicinity of Port Nolloth) and management area 2 (vicinity of Hondeklip Bay). The amount of catch and effort reported within the area amounted to 3.6% and 10.1%, respectively, of the total national landings and overall effort expended by the inshore fleet. Fishing activity by the inshore sector could be expected approximately 17 km shoreward of the seismic acquisition area. Management areas 1 and 2 have a seasonal operational window from 15

[5] Most activity would be expected within 15 km of the launch sites at Port Nolloth and Hondeklipbaai.

October to 15 February. Over the period 2005 to 2020, there was no fishing activity reported by the offshore sector within management areas 1 and 2. There is no expected impact of exclusion to fishing posed by the proposed seismic survey on either the inshore or offshore rock lobster trap fisheries.

4.1.9 ABALONE RANCHING

The natural distributional range of abalone extends from St Helena Bay in the Western Cape to Port St Johns on the east coast. Translocation of abalone along roughly 50 km of the Namaqualand coast in the Northern Cape has been made possible through the issuing of "Abalone Ranching Rights" by DFFE. This involves the seeding of four designated areas (concession zones), situated between Alexander Bay and Hondeklipbaai, using cultured abalone spat which are harvested upon reaching a marketable size. Zones 1, 2 and 3 are situated within Licence Block 1 and Zone 3 is located inshore of the proposed seismic acquisition area. As the maximum depth of seeding is considered to be approximately 10 m (subtidal rocky reefs), the proposed seismic acquisition area would not coincide with seeding areas within Zone 3 and there is no impact of exclusion expected on the fishery.

4.1.10 SMALL-SCALE FISHERIES

Certain areas on the coast are prioritized and demarcated by DFFE as small-scale fishing areas. Small-scale fishermen along the Northern Cape coast are typically involved in the traditional line and west coast rock lobster fisheries (refer to sections 4.2.7 and 4.2.8). Approximately 10 000 small-scale fishers have been identified around the South African coastline, 103 of which are registered at the Port Nolloth and Hondeklipbaai fishing communities. The small scale fishery rights cover the nearshore area (defined in section 19 of the MLRA as being within close proximity of shoreline). These in reality are unlikely to extend beyond 3 nm from the coast. However, based on a precautionary approach, the current assessment assumes that linefish operations could be within range of the nearshore extent of the proposed seismic survey area. The impact of temporary exclusion to small scale fishing operations is expected to be of overall LOW NEGATIVE significance (refer to Section 4.1.4 and Table 4.1).

4.1.11 NETFISH

The beach-seine fishery operates primarily on the West Coast of South Africa between False Bay and Port Nolloth. Fishing effort is coastal and net depth may not exceed 10 m. There are currently three beach-seine fishing rights issued for Area A (Port Nolloth) and no rights issued for Area B (Hondeklipbaai). The gillnet fishery operates from Yzerfontein to Port Nolloth on the West Coast. Surface-set gillnets (targeting mullet) and bottom-set gillnets (targeting St Joseph shark) and are set in waters shallower than 50 m. Of a total of 162 right holders, four operate within Area A (Port Nolloth) and two operate within Area B (Hondeklipbaai). Licence Block 1 is situated offshore of management areas A and B, however the range of gillnets (50 m) and that of beach-seine activity (10 m) is not likely to directly overlap with the seismic acquisition area which is situated in waters deeper than 100 m. There is no impact of exclusion expected on the beach-seine or gillnet fisheries, which are situated at least 12 km from the 50 m depth contour within Area B. However, should the survey vessel need to perform turns between survey lines inshore of the proposed seismic acquisition area, gillnets may be encountered in shallow waters within 5 km of Kleinzee.

4.1.12 SEAWEED

The South African coastline is divided between Port Nolloth and Port St Johns into 23 harvesting areas for seaweed. In the Northern and Western Cape, the industry is currently based on the collection of beach-cast kelps and harvesting of fresh kelps. Collection of kelp is undertaken within Licence Block 1 within management areas 15 and 16, which are situated offshore of Port Nolloth and Hondeklipbaai. Permit conditions stipulate that within these areas kelp may be harvested using a diver deployed from a boat or the shore. The acquisition area is not expected to coincide with the depth range at which divers could harvest kelp. There is no impact of exclusion expected on the fishery.

4.1.13 FISHERIES RESEARCH

Research trawls are undertaken by DFFE to establish the stock status of key commercial species. These research cruised are undertaken on a bi-annual basis across stratified depth ranges from the coastline up to approximately the 1000 m bathymetric contour. As such, they cover the entire extent of the licence block and the proposed seismic acquisition area. Approximately 8.5% and 0.31% of the total number of demersal research trawls were reported within the licence block and seismic acquisition area, respectively. The demersal research survey would be expected to take place within this area over the period January/February whereas the acoustic survey for small pelagic species would be expected to operate within the area during November and again during May/June (a pre-recruitment biomass survey for small pelagic species).

The impact is considered to be local in extent (i.e. the area within 5 km of the survey acquisition area) and immediate in duration (limited to the duration of the survey i.e. 4 months). The magnitude (or intensity) of the impact on the sector is expected to be moderate (where normal operations will need to be modified). This rating is based on the proportion of fishing effort and catch within the affected area relative to total effort and catch reported by the sector. The probability of the impact materialising is considered to be medium (>50% and <75%). Based on the above ratings, the overall significance of the impact is assessed to be low negative.

Table 4.1: Impact of Exclusion from Fishing Ground.

1	IMPACT OF EXCLUSION OF FISHING OPERATIONS	
	PRE-MITIGATION IMPACT	RESIDUAL IMPACT
NATURE OF IMPACT	LIKELY TO RESULT IN A NEGATIVE IMPACT	LIKELY TO RESULT IN A NEGATIVE IMPACT
INTENSITY	LOW: LINEFISH, SMALL-SCALE MODERATE: TUNA POLE-LINE, DEMERSAL LONGLINE	LOW: LINEFISH, SMALL-SCALE MODERATE: TUNA POLE-LINE, DEMERSAL LONGLINE
EXTENT	LOCAL	
DURATION	IMMEDIATE	IMMEDIATE
REVERSIBILITY	IMPACT IS REVERSIBLE WITHOUT ANY TIME AND COST	
PROBABILTY	IMPROBABLE: DEMERSAL LONGLINE LOW PROBABILITY: LINEFISH, SMALL-SCALE MEDIUM PROBABILITY: TUNA POLE-LINE	
CUMULATIVE IMPACT	LOW	
LOSS OF RESOURCES	LOW	
ENVIRONMENTAL SIGNIFICANCE	LOW NEGATIVE	

4.2 NOISE EMISSIONS DURING SEISMIC SURVEY

As a general guideline, the sound ranges of 161 to 166 dB re 1 µPa rms may be used as a suitable indicator sound pressure level at which behavioural modifications of fish start to take place (McCauley *et al.,* 2000). Based on the current project description, sound levels for the seismic survey can notionally be expected to attenuate below 160 dB less than 1,325 m from the source array. The current assessment is based on an assumption that the maximum potential zone of acoustic disturbance could extend to a distance of up to 1.5 km from the seismic acquisition area. This is based on an assumption that sound pressure levels generated during the survey would attenuate to the minimum threshold level at which behavioural disturbance on fish could be expected.

The spatial extent of the impact of airgun noise emissions on catch rates is expected to be localised. The effects are considered to be of immediate duration (for duration of survey ~4 months) and of low to moderate magnitude (intensity). The impact is considered to be highly reversible – any disturbance of behaviour that may occur as a result of survey noise would be temporary. The impact of sound produced during the proposed survey is assessed to be of LOW NEGATIVE significance to the demersal longline, tuna pole-line, traditional linefish and small-scale sectors (refer to Table 4.2). There is no impact expected on the demersal trawl, midwater trawl, small pelagic purse-seine, large pelagic purse-seine, west coast rock lobster, abalone, netfish and seaweed sectors.

Potential impacts of seismic pulses on plankton and fish eggs and larvae would include mortality or physiological injury in the immediate vicinity of the airgun sound source, and potentially within a maximum range of 1.2 km of the airgun passage (Pulfrich, 2020). Impacts will thus be of high intensity at close range. The impact of seismic airgun operations on the recruitment of fish stocks is assessed to be of overall low negative significance.

At the start of winter every year, juveniles of most small pelagic shoaling species recruit into coastal waters in large numbers between the Orange River and Cape Columbine. They recruit in the pelagic stage, across broad stretches of the shelf, to utilise the shallow shelf region as nursery grounds before gradually moving southwards in the inshore southerly flowing surface current, towards the major spawning grounds east of Cape Point.

Two species that migrate along the West Coast following the shoals of small pelagic species are snoek and chub mackerel. Their appearance along the West and South-West coasts are highly seasonal. Snoek migrating along the southern African West Coast reach the area between St Helena Bay and the Cape Peninsula between May and August. They spawn in these waters between July and October before moving offshore and commencing their return northward migration (Payne & Crawford 1989). Chub mackerel similarly migrate along the southern African West Coast reaching South-Western Cape waters between April and August. They move inshore in June and July to spawn before starting the return northwards offshore migration later in the year.

Table 4.2: Impact of Sound on Catch Rates.

2	IMPACT OF SEISMIC AIRGUN SOUND ON FISHING OPERATIONS	
	PRE-MITIGATION IMPACT	RESIDUAL IMPACT
NATURE OF IMPACT	LIKELY TO RESULT IN A NEGATIVE IMPACT	LIKELY TO RESULT IN A NEGATIVE IMPACT
INTENSITY	LOW: LINEFISH, SMALL-SCALE MODERATE: TUNA POLE-LINE, DEMERSAL LONGLINE	LOW: LINEFISH, SMALL-SCALE MODERATE: TUNA POLE-LINE, DEMERSAL LONGLINE
EXTENT	LOCAL	
DURATION	IMMEDIATE	IMMEDIATE
REVERSIBILITY	IMPACT IS REVERSIBLE WITHOUT ANY TIME AND COST	

2	IMPACT OF SEISMIC AIRGUN SOUND ON FISHING OPERATIONS	
	PRE-MITIGATION IMPACT	RESIDUAL IMPACT
PROBABILTY	IMPROBABLE: DEMERSAL LONGLINE LOW PROBABILITY: LINEFISH, SMALL-SCALE MEDIUM PROBABILITY: TUNA POLE-LINE	
CUMULATIVE IMPACT	LOW	
LOSS OF RESOURCES	LOW	
ENVIRONMENTAL SIGNIFICANCE	LOW NEGATIVE	

5 CONCLUSIONS AND RECOMMENDATIONS

The sources of potential impacts on the fishing industry were identified as 1) noise emissions generated during survey activities and 2) temporary exclusion during survey activities. The summary table below (Table 5.1) lists the overall significance of each of the identified project impacts before and after the implementation of mitigation measures listed in Table 5.2.

Sound generated during the proposed seismic survey is expected to be in the order of 220 dB re 1 μPa at 1 m at an operating frequency range of 5 – 300 Hz. This falls within the hearing range of most fish species. The potential impacts on fish of sound produced by seismic airguns may include, amongst other effects, physiological injury/mortality, behavioural avoidance and reduced reproductive success. These impacts were assessed to be of overall very low significance, after mitigation, for pelagic and demersal fish species and of overall insignificance for cephalopods and crustaceans. These results were used to inform the assessment of potential effects of reduced catch rates as a result of behavioural avoidance of fish in response to elevated sound levels. The effects on catch rates vary by species and gear-type, as well as the oceanographic variables that affect the attenuation of noise from the sound source. Based on the current project description, sound levels for the seismic survey can notionally be expected to attenuate below 160 dB less than 1,325 m from the source array. The current assessment is based on an assumption that the maximum potential zone of acoustic disturbance could extend to a distance of up to 1.5 km from the seismic acquisition area. This is based on an assumption that sound pressure levels generated during the survey would attenuate to the minimum threshold level at which behavioural disturbance on fish could be expected. For the demersal trawl, midwater trawl, small pelagic purse-seine, west coast rock lobster and netfish sectors, there is no impact expected. However, in the case of the demersal longline, tuna pole-and-line, traditional linefish and fisheries research sectors, the spread of sound into fishing grounds may affect catch rates and the impact on these sectors has been assessed to be of low negative significance.

During the seismic survey, fishing vessels would be required to maintain a safe operational distance of up to 9 Nautical miles from the survey vessel. The impact of potential exclusion was assessed for each commercial sector based on the affected area of fishing ground and the relative quantities of catch reported within the proposed survey acquisition area. The impact of potential exclusion from fishing grounds was assessed to be of low negative significance to the demersal longline, tuna pole-line, traditional linefish and small-scale sectors, which show relatively low levels of fishing activity in the vicinity of the proposed seismic survey acquisition area. It is recommended that the seismic survey be timed to avoid the seasonal activity of snoek-directed coastal fishing over the period March to July. There is no impact of exclusion expected on the remaining commercial fisheries sectors viz, demeral trawl, mid-water trawl, small pelagic purse-seine, large pelagic purse-seine, west coast rock lobster, abalone ranching, netfish (beach-seine and gillnet) and the harvesting of seaweed.

Stock biomass estimate surveys by DFFE would be expected within the seismic acquisition area over the period January/February (demersal trawl), November (acoustic survey for small pelagic species) and again during May/June (a pre-recruitment biomass survey for small pelagic species). Seismic survey operations that coincide with scheduled fisheries research surveys could result in a negative impact, local in extent and of moderate magnitude. The impact on fisheries research surveys was assessed to be of overall low negative significance (i.e. where this impact would not have a direct influence on the decision to proceed with the seismic survey).

Table 5.1 Summary of the impacts on fisheries of each of the identified project activities.

Fishery Sector	Percentage (%) Overlap with Fishing Effort		Noise Effects on Catch Rates (airguns array)		Temporary Safety Zone around Seismic Vessel	
	Licence Block 1	3D Seismic Acquisition Area	**Pre-Mitigation**	**Residual Impact**	**Pre-Mitigation**	**Residual Impact**
Demersal Trawl	0.01	0	No impact	No impact	No impact	No impact
Mid-Water Trawl	0	0	No impact	No impact	No impact	No impact
Demersal Longline	0.35	<0.01	Low Negative	Low Negative	Low Negative	Low Negative
Small Pelagic Purse-Seine	0	0	No impact	No impact	No impact	No impact
Large Pelagic Longline	0	0	No impact	No impact	No impact	No impact
Tuna Pole-Line	2.5	0	Low Negative	Low Negative	Low Negative	Low Negative
Traditional Linefish	0.03	0	Low Negative	Low Negative	Low Negative	Low Negative
West Coast Rock Lobster	10.1	0	No impact	No impact	No impact	No impact
Abalone (Ranching)	unknown	0	No impact	No impact	No impact	No impact
Small-Scale Fisheries	unknown	0	Low Negative	Low Negative	Low Negative	Low Negative
Netfish	unknown	0	No impact	No impact	No impact	No impact
Seaweed (Kelp harvesting)	16.3	0	No impact	No impact	No impact	No impact
Fisheries Research	8.5	0.31	Low Negative	Low Negative	Low Negative	Low Negative

Table 5.2 Summary table of proposed mitigation measures.

No.	Mitigation measure	Classification
1	At least three weeks prior to the commencement of survey activities, the following key stakeholders should be consulted and informed of the proposed survey programme (including navigational co-ordinates of location, timing and duration of proposed activities) and the likely implications thereof (specifically the exclusion and safety zone around the survey vessels): Fishing industry associations: SA Tuna Association; SA Tuna Longline Association, Fresh Tuna Exporters Association, South African Deepsea Trawling Industry Association (SADSTIA), South African Hake Longline Association (SAHLLA), SA Commercial Linefish Association and West Coast Rock Lobster Association. Other key stakeholders: SANHO, South African Maritime Safety Association, Ports Authority and the Department of Agriculture, Forestry and Fisheries Vessel Monitoring, Control and Surveillance Unit in Cape Town. These stakeholders should again be notified at the completion of the project when the survey and support vessels are off location.	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 activity. Distribute a Notice to Mariners prior to the commencement of the survey operations. The Notice to Mariners should give notice of (1) the co-ordinates of the survey area, (2) an indication of the proposed survey timeframes, (3) the dimensions of the towed gear array and dimensions of the safety zone around the survey vessel, and (4) provide details on the movements of support vessels servicing the project. This	Avoid / reduce at source

No.	Mitigation measure	Classification
	Notice to Mariners should be distributed timeously to fishing companies and directly onto vessels where possible.	
3	An experienced Fisheries Liaison Officer (FLO) should be placed on board the survey or guard vessel to facilitate communications with fishing vessels in the vicinity of the survey areas.	Abate on site
4	Timing: The tuna pole-and-line sector targets snoek seasonally in the vicinity of the proposed seismic survey acquisition area. If possible, time the survey to avoid peak fishing activity during March to July. Demersal research surveys are undertaken within the licence area and proposed seismic survey area over the period January/February. An acoustic survey for small pelagic species is carried out in the area during November and again during May/June by DFFE.	Avoid / reduce at source
5	As far as possible, avoid vessel turns in shallow waters east of the proposed seismic acquisition area.	Avoid/ reduce at source
6	The lighting on the survey and support vessels should be managed to ensure that they are sufficiently illuminated to be visible to fishing vessels, as well as ensure that it is reduced to a minimum compatible with safe operations.	Abate on site
7	Notify any fishing vessels at a radar range of 12 nm from the vessel via radio regarding the safety requirements around the survey vessel.	Abate on site
8	Implement a grievance mechanism in case of disruption to fishing or navigation.	Abate off site

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APPENDIX 1: ASSESSMENT CONVENTIONS

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 3.

Table 3: 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 4.

Table 4: 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 5: 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 6.

Table 6: 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 7: 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 7. 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 8).

Table 8: 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 9: Environmental Significance Rating

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

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

APPENDIX 2: CURRICULUM VITAE

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

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

Date of Birth: 20 June 1979

Nationality: South African / British

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

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

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

Key Experience:

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

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

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

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

NAMIBIAN EXPERIENCE : Selected projects undertaken over the past five years

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

Courses and Symposia :

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

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

Publications:

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

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

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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

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Education:

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

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

Relevant Professional Experience (selected)

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

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

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

ADDITIONAL INFORMATION

Major Projects - Summary

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

Aquaculture-Specific

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

Fishery Economics and Governance :

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

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

Other Projects Completed :

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

Marine Stewardship Council :

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

Lecturing and Document Preparation:

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

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