Appendix C2 – Fisheries Assessment

BASIC ASSESSMENT FOR A PROSPECTING RIGHT APPLICATION FOR OFFSHORE SEA AREAS 4C & 5C, EXCLUDING THE NAMAQUA FOSSIL FOREST MARINE PROTECTED AREA, WEST COAST, SOUTH AFRICA

SPECIALIST FISHERIES ASSESSMENT

January 2023

Prepared for the Environmental Assessment Practitioner:

SLR Consulting (South Africa) (Pty) Ltd

On behalf of the client:

De Beers Consolidated Mines (Pty) Limited

CAPRICORN MARINE ENVIRONMENTAL PTY LTD

BASIC ASSESSMENT FOR A PROSPECTING RIGHT APPLICATION FOR OFFSHORE SEA AREAS 4C & 5C, EXCLUDING THE NAMAQUA FOSSIL FOREST MARINE PROTECTED AREA, WEST COAST, SOUTH AFRICA

Fisheries Specialist Study

19 January 2023

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 SLR Consulting (South Africa) (Pty) Ltd on behalf of De Beers Consolidated Mines (Pty) Limited for their use in preparing a Basic Impact Assessment for proposed offshore prospecting operations in Sea Areas 4C and 5C off the West Coast of South Africa. I do hereby declare that Capricorn Marine Environmental (Pty) Ltd is financially and otherwise independent of the Applicant and SLR.

Dave Japp

Sarah Wilkinson

EXECUTIVE SUMMARY

De Beers Marine (Pty) Ltd (DBM), as the marine operator of De Beers Consolidated Mines (Pty) Limited, is proposing to undertake prospecting operations within Sea Areas 4C and 5C. Before these activities can be undertaken, authorisation is required in terms of the National Environmental Management Act (NEMA), 1998 (No. 107 of 1998), as amended, and a Prospecting Right has to be obtained in terms of the Mineral and Petroleum Resources Development Act (MPRDA), 2002 (Act 28 of 2002). SLR Consulting (South Africa) (Pty) Ltd (SLR) has been appointed to undertake the necessary application processes and in turn have asked Capricorn Marine Environmental (Pty) Ltd to provide a specialist report on potential impacts of the proposed prospecting operations on commercial fisheries in the area.

Phase 1 entails exploration sampling (e.g. coring and / or wide spaced sampling) in target features of interest, enabling refinement of the definition of the target features. Geophysical survey may also be undertaken. Should the result of the survey(s) / exploration sampling indicate potential exists, then further follow-up sampling and infill survey may be undertaken to establish the distribution of the diamondiferous material. During Phase 1 of the project, various exploration geophysical tools may be used including swathe bathymetry systems, sub-bottom profilers, side-scan sonars, and electrical, magnetic and Electro-Magnetic systems. The geophysical systems could be deployed from various platforms such as towed systems, vessel mounted, pole mounted, Autonomous Underwater Vehicles (AUV) or Autonomous Surface Vehicles (ASV). Phase 2 consists of a techno-economic assessment, which is a desktop study and therefore does not form part of this report.

Several aspects of the proposed activities were identified as posing a potential risk to the fishing industry and these risks were assessed with respect to each commercial fishing sector operational off the West Coast of South Africa. The following project-related impacts were identified: 1) temporary safety zone around survey and sampling vessels and impact of exclusion of fishing operations; 2) discharge of sediment into the marine environment and the resulting impact of the sediment plume on fish stock recruitment and 3) noise emissions during geophysical survey and acoustic impacts on fish stocks.

Various types of survey equipment alternatives have been proposed for the current project, some of which produce an acoustic signal that would fall within the hearing range of fish and crustaceans. The noise emissions from the geophysical sources are mid- to high-frequency and highly directional, spreading as a fan from the sound source. The anticipated radius of influence would thus be significantly less than that for a deeper penetration, low frequency seismic airgun array typically used during petroleum exploration activities. Based on the proximity of fishing grounds of each of the sectors in relation to the prospecting application area, the significance of the impact is considered to be very low for the pole-and-line, traditional linefish, west coast rock lobster (nearshore), small-scale and netfish sectors, as well as on fisheries research surveys undertaken within the area twice a year by DFFE. The impact was assessed to be of negligible significance for the demersal trawl and demersal longline sectors. No mitigation measures are possible, or considered necessary for the proposed prospecting activities.

During the project activities, fishing vessels would be required to maintain a safe operational distance of 1.5 nautical miles from the survey vessel and 500 m from the sampling 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 prospecting application area. The impact magnitude was assessed based on a combination of the intensity, duration and extent of the impact. Magnitude was assigned to the pre-mitigation impact (i.e. before additional mitigation measures are applied, and residual impacts after additional mitigation is applied. Thereafter the impact significance rating was determined as a function of the magnitude of the impact and the sensitivity of the fishery.

The impact of exclusion from fishing grounds was assessed to be of overall negligible significance to the pole-and-line, traditional linefish and small-scale sectors. There is no impact of exclusion expected on the remaining commercial fisheries sectors viz, demersal trawl, mid-water trawl, demersal longline, 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 prospecting application 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). Survey and sampling operations that coincide with scheduled fisheries research surveys could result in a negative impact, local in extent and of very low magnitude and significance. The most effective means of mitigation would be to ensure that the proposed prospecting activities do not coincide with the research surveys. It is recommended that prior to the commencement of the proposed activities, De Beers consult with the managers of the DFFE research survey programmes to discuss their respective programmes and the possibility of altering the prospecting programme in order to minimises or avoid disruptions to both parties, where required.

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.

Fishery Sector	Discharge of Sediment		Noise Effects on Catch Rates		Temporary Safety Zone	
	Pre-Mitigation	Residual Impact	Pre-Mitigation	Residual Impact	Pre-Mitigation	Residual Impact
Demersal Trawl	Negligible	Negligible	Negligible	Negligible	No impact	No impact
Mid-Water Trawl	No impact	No impact	No impact	No impact	No impact	No impact
Demersal Longline	Negligible	Negligible	Negligible	Negligible	No impact	No impact
Small Pelagic Purse-Seine	Negligible	Negligible	No impact	No impact	No impact	No impact
Large Pelagic Longline	No impact	No impact	No impact	No impact	No impact	No impact
Pole-and-Line	Negligible	Negligible	Very low	Very low	Negligible	Negligible
Traditional Linefish	Negligible	Negligible	Very low	Very low	Negligible	Negligible
West Coast Rock Lobster	Very Low	Very Low	Very low	Very low	No impact	No impact
Abalone (Ranching)	Negligible	Negligible	No impact	No impact	No impact	No impact
Small-Scale Fisheries	Negligible	Negligible	Very low	Very low	Negligible	Negligible
Netfish	Very low	Very low	Very low	Very low	No impact	No impact
Seaweed (Kelp harvesting)	Negligible	Negligible	No impact	No impact	No impact	No impact
Fisheries Research	Negligible	Negligible	Very low	Very low	Very low	No impact

A process of notification and information-sharing should be followed with the relevant fishing industry associations including the SA Tuna Association; SA Tuna Longline Association, South African Deepsea Trawling Industry Association (SADSTIA), South African Hake Longline Association (SAHLLA), West Coast Rock Lobster Association, South African Linefish Associations (various) and SA Marine Linefish Management Association (SAMLMA). 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 Environment, Forestry and Fisheries Vessel Monitoring, Control and Surveillance Unit in Cape Town (Vessel Monitoring System Unit).

The required safety zones around the sampling vessels should be communicated via the issuing of Daily Navigational Warnings for the duration of the sampling operations through the South African Naval Hydrographic Office.

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ACRONYMS, ABBREVIATIONS AND UNITS

CapMarine	Capricorn Marine Environmental (Pty) Ltd
CPUE	Catch Per Unit Effort
dB	Decibel
DBCM	De Beers Consolidated Mines
DBM	De Beers Marine
DFFE	Department of Forestry, Fisheries and Environment
EAP	Environmental Assessment Practitioner
EMPr	Environmental Management Programme
EIA	Environmental Impact Assessment
FLO	Fisheries Liaison Officer
GRT	Gross Registered Tonnage
Hz	Hertz
ICCAT	International Convention for the Conservation of Atlantic Tunas
IOTC	Indian Ocean Tuna Commission
kg	Kilogram
kHz	Kilohertz
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
t	Tonnes
TAC	Total Allowable Catch
TAE	Total Allowable Effort
ToR	Terms of Reference
VMS	Vessel Monitoring System

1 INTRODUCTION

1.1 BACKGROUND

De Beers Marine (Pty) Ltd (DBM), as the marine operator of De Beers Consolidated Mines (Pty) Limited (DBCM), is proposing to undertake prospecting operations for target minerals within Sea Areas 4C and 5C. Before these activities can be undertaken, authorisation is required in terms of the National Environmental Management Act (NEMA), 1998 (No. 107 of 1998), as amended, and a Prospecting Right has to be obtained in terms of the Mineral and Petroleum Resources Development Act (MPRDA), 2002 (Act 28 of 2002).

SLR Consulting (South Africa) (Pty) Ltd (SLR) has been appointed to undertake the necessary application processes in terms of the NEMA, as amended, and in turn have asked Capricorn Marine Environmental (Pty) Ltd to provide a specialist report on potential impacts of the proposed operations on commercial and small-scale fisheries in the area.

The proposed prospecting activities would be undertaken within the Sea Areas 4C and 5C, located off the West Coast of South Africa (see Figure 1.1). The Prospecting Right area excludes the Namaqua Fossil Forest Marine Protected Area located in Sea Area 4C. The co-ordinates of the boundary points of Sea Areas 4C and 5C are provided in Table 1.2 below.

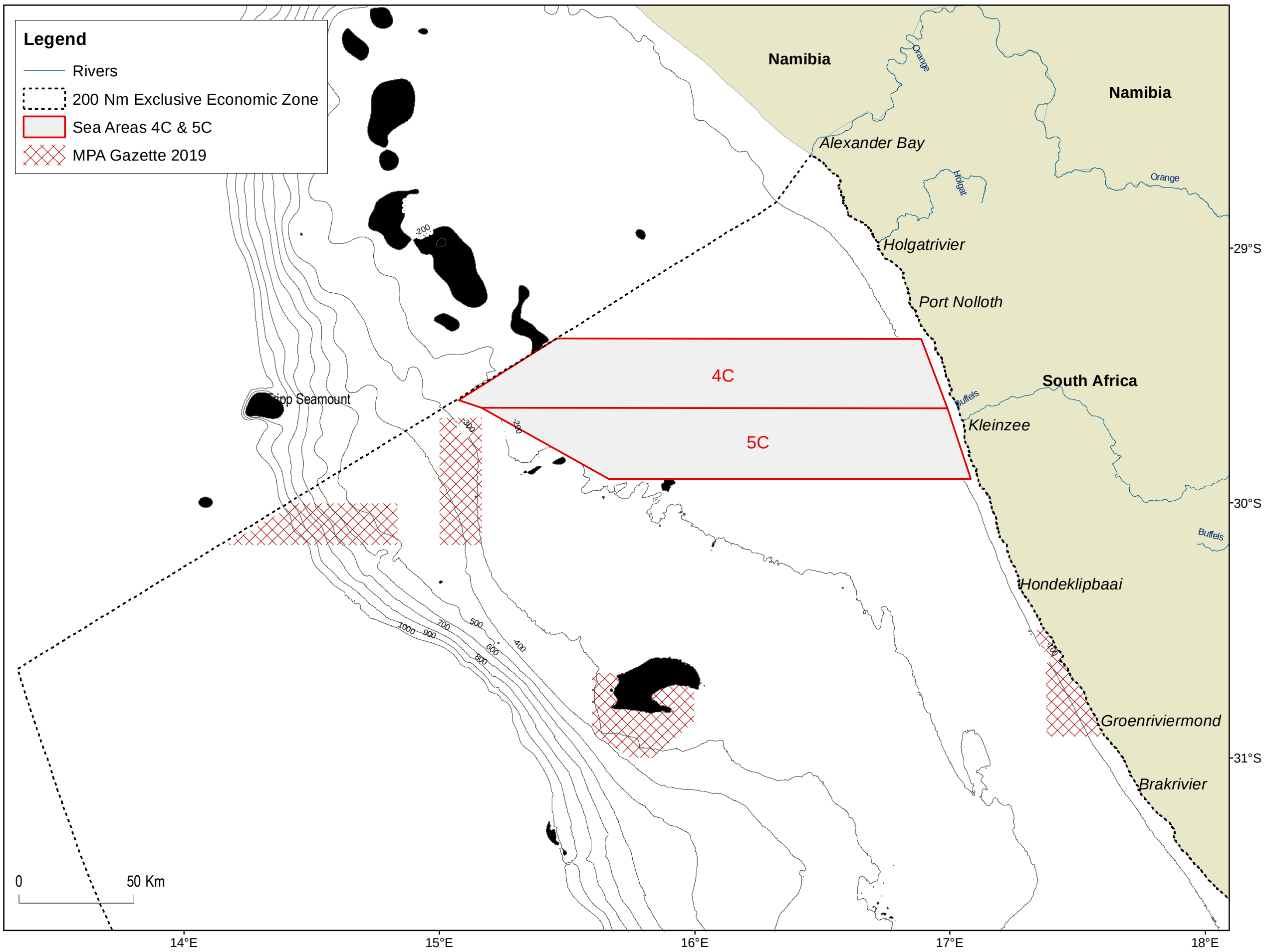

Figure 1.1: Location of Sea Areas 4C and 5C, off the West Coast of South Africa.

Table 1.1: Co-ordinates of the boundary points of Sea Areas 4C and 5C.

SEA AREA 4C POINT	Latitude	Longitude
A	15° 29' 25,928" E	29° 20' 33,856" S
B	16° 48' 18,676" E	29° 21' 5,979" S
C	16° 55' 59,101" E	29° 38' 24,614" S
D	15° 9' 5,264" E	29° 37' 9,661" S
E	15° 4' 58,99" E	29° 35' 44" S
SEA AREA 5C		
A	16° 55' 59,101" E	29° 38' 24,614" S
B	15° 9' 5,264" E	29° 37' 9,661" S
C	17° 4' 54,48" E	29° 54' 6,88" S
D	15° 39' 36,26" E	29° 54' 28,295" S

The planned timeframe to complete the proposed prospecting work is provided in Table 1.1 below. Due to the dynamic nature of prospecting and evaluation, the work programme may have to be modified, extended or curtailed as data and analyses become available.

Table 1.2: Proposed work programme.

Year	Activity	Timeframe
1 – 5 : Phase 1	Survey, Sampling & Desktop Studies	36 – 54 months
1 – 5 : Phase II	Economic Assessment	12 – 36 months

1.2 TERMS OF REFERENCE

This specialist report was compiled as a desktop study on behalf of SLR, for their use in preparing a Basic Assessment Report for the proposed prospecting activities off the South African West Coast. The information from this study is intended to inform the EMP process through providing fisheries baseline data for the prospecting application 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:

- Provide a description of the existing baseline fisheries characteristics within Sea Areas 4C and 5C (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 Sea Areas 4C and 5C on the spatial distribution of effort expended by each fishing sector.
- Calculation of the 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 DATA SOURCES

The description of the baseline environment in the study area is based on a review and collation of existing information. Catch and effort data were sourced from the Department of Forestry, Fisheries and Environment (Branch: Fisheries) (DFFE)[1] record for the years 2000 to 2021. 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 DFFE and from the *South Africa, Namibia and Mozambique Fishing Industry Handbook 2019 (47th Edition).*

The information for the identification of potential impacts on fish was primarily drawn from the marine fauna specialist report for this project (Pulfrich, 2023), as well as a number of scientific publications and primarily literature reviews by Carroll *et al*. (2017).

1.4 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.
- Unlike other commercial fishing sectors, the reporting requirements for small-scale fishers do not include GPS-referenced fishing locations therefore the mapping of the spatial extent of fishing grounds used by this sector is less accurate than that of the commercial sectors. Fishing areas have been inferred from the spatial distribution of commercial sectors which share targeted fish stocks namely, the inshore and offshore west coast rock lobster trap sectors, the traditional and commercial linefish sector, the snoek-directed fishing activity reported by the tuna pole-line sector and the netfish sectors.
- The effects of 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 sound on marine fauna is ongoing.

1.5 ASSESSMENT METHODOLOGY

The spatial distribution of fishing effort and catch was mapped at an appropriate resolution for each fishing sector (based on the fishing method and resulting area covered by fishing gear). Fishing catch

[1] On 01 April 2021, the Department of Environment, Forestry and Fisheries (DEFF) changed names to the Department of Forestry, Fisheries and the Environment (DFFE). The substitution and designation of names for National Department and Office of the Premiers and heads thereof was published in Government Gazette 44229 (Notice No. 172) in terms of the Public Service Act on 5 March 2021. References to DEFF appear within this report.

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

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

Definitions of Impact Assessment Criteria and Categories Applied

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

Criterion	Definition	Categories
Sensitivity	Sensitivity is a rating given to the importance and/ or vulnerability of a receptor (e.g. conservation value of a biodiversity feature or cultural heritage resource or social receptor.	Very Low/ Low Medium/ High/ Very High
Magnitude (or consequence)	A term describing the actual change predicted to occur to a resource or receptor caused by an action or activity or linked effect. It is derived from a combination of Intensity, Extent and Duration and takes into account scale, frequency and degree of reversibility	Very Low/ Low/ Medium/ High/ Very High
Intensity	A descriptor for the degree of change an impact is likely to have on the receptor which takes into account scale and frequency of occurrence.	Very Low/ Low Medium/ High
Extent	The spatial scale over which the impact will occur.	Site/ Local/ National Regional/ International /Transboundary

Criterion	Definition	Categories
Duration	Time scale over which the consequence of the effect on the receptor/s will last. [Note that this does not apply to the duration of the project activity]. The terms 'Intermittent' and 'Temporary' may be used to describe the duration of an impact.	Short-term Medium-term Long-term Permanent
Probability	A descriptor for the likelihood of the impact occurring. Most assessed impacts are likely to occur but Probability is typically used to qualify and contextualise the significance of unplanned events or major accidents.	Unlikely/ Possible Likely/ Highly Likely Definite
Confidence	A descriptor for the degree of confidence in the evaluation of impact significance.	Low/ Medium High/ Certain
Mitigation potential	A descriptor for the degree to which the impact can be mitigated to an acceptable level.	None/ Very Low Low/ Medium/ High
Loss of Irreplaceable resources	A descriptor for the degree to which irreplaceable resources will be lost, fragmented or damaged.	Low/ Medium/ High
Reversibility	A descriptor for the degree to which an impact can be reversed.	Irreversible Partially Reversible Fully Reversible
Cumulative	A descriptor of the potential for an impact to have cumulative impacts to arise.	Unlikely/ Possible Likely

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

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

Sensitivity Rating	Definition
	understand, anticipate, cope with, resist or recover from the consequences of a potential impact without substantive external support. For positive impacts, receptors are likely to derive substantial benefits or opportunities from the project which could lead to significant and sustained improvement in their quality of life.

Determination of Magnitude (or Consequence)

Definitions of Criteria Used to Derive Magnitude

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

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

Taking the above into account, Magnitude (or consequence) is derived from a combination of 'Intensity', 'Duration' and 'Extent'. The criteria for deriving Intensity, Extent and Duration are summarised below.

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

Determining Magnitude (or consequence) Ratings

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

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

Determination of Impact Significance

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

Significance = Magnitude x Sensitivity

Where Magnitude = Intensity +Extent + Duration

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

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

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

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

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

Additional Assessment Criteria

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

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

Definitions for these supporting criteria are indicated below.

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

Criteria	Rating	Description
Criteria for REVERSIBILITY – the degree to which an impact can be reversed	**IRREVERSIBLE**	Where the impact cannot be reversed and is **permanent**.
	PARTIALLY REVERSIBLE	Where the impact can be partially reversed and is temporary
	FULLY REVERSIBLE	Where the impact can be completely reversed.
Criteria for POTENTIAL FOR CUMULATIVE IMPACTS – the extent to which cumulative impacts may arise from interaction or combination from other planned activities or projects	**UNLIKELY**	Low likelihood of cumulative impacts arising.
	POSSIBLE	Cumulative impacts with other activities or projects may arise.
	LIKELY	Cumulative impacts with other activities or projects either through interaction or in combination can be expected.

2 PROJECT DESCRIPTION

Information for the project description was provided by De Beers Marine. The proposed prospecting activities would be undertaken within the Sea Areas 4C and 5C, located off the West Coast of South Africa (refer to Figure 1.1). The co-ordinates of the boundary points of Sea Areas 4C and 5C are provided in Table 1.1. The total area of the prospecting application area is ~ 9 265 km^2 and excludes the Namaqua Fossil Forest Marine Protected Area located in Sea Area 4C.

A phased approach is proposed for the prospecting, with each phase dependant on results of the previous phase. The two phases, which will run over a five year period, are:

- Phase I – Survey, Sampling & Desktop studies; and
- Phase II – Economic Assessment.

Due to the dynamic nature of mineral exploration and evaluation, the work programme may have to be modified, extended or curtailed as results and data become available. The proposed prospecting activities in Sea Areas 4C and 5C will be undertaken in conjunction with proposed activities in other DBCM prospecting rights within the South African Sea Areas. Results obtained from these prospecting activities will be used to develop the regional geological framework that will guide the prospecting work programme. This study deals only with the Phase I activities.

2.1 GEOPHYSICAL SURVEYS

Various exploration geophysical tools could be deployed from a fit-for-purpose vessel, including:

- <u>swathe bathymetry systems</u>, which produces a digital terrain model of the seafloor; backscatter data may be acquired as part of the process to determine textural models. Typical multi-beam echo sounders (MBES) emit a fan of acoustic beams from a transducer, providing depth sounding information on either side of the vessel's track across a swath width of approximately two times the water depth.
- <u>sub-bottom profiler (SBP) systems (e.g. boomer, chirp and sleeve gun)</u> are echo-sounders, which generate profiles beneath the seafloor to give a cross section view of the upper sediment layers. SBP systems transmit acoustic energy to the seabed and use reflected or refracted sound energy from subsurface boundaries to infer information of seabed conditions relating to depth and shallow

sub-surface geology. Penetrations typically varying between 5 to 100 m below the seabed, depending on the particular system being used.

- side-scan sonar systems, which produce acoustic intensity images of the seafloor and are used to map the different sediment textures from associated lithology of the seafloor. A sonar device that emits conical or fan-shaped pulses toward the seafloor across a wide angle perpendicular to the path of the sensor through the water.
- electrical, magnetic, electro-magnetic surveys, which measure local variations in the intensity of the Earth's magnetic fields (magnetometer), electrical impedance of the seabed layers (electrical resistivity) and variations in electrical properties of the seabed and bulk conductivity (electromagnetic).
- video and photographic equipment, (such as ROVs, drop cameras, SkiMonkey, etc.) may be used for visualising the seabed as part of groundtruthing studies.
- Underwater manned submersibles, used for visualisation purposes.

The geophysical and remote sensing systems that may be utilised for the proposed geophysical surveys are described below. The likely geophysical survey equipment and its source frequencies, source noise levels and soft start capabilities are provided in Table 2.1.

Table 2.1: Specifications of acoustic equipment that may be used in the proposed geophysical surveys.

	Sound type	Frequency	Source level (dB re 1 µPa at 1m)	Soft Start Capability
1	Multibeam Echo Sounder	70 -455 kHz	190 - 232	Yes
2	Sub Bottom Profiler - Chirp	1.5 – 12.5 kHz	195 – 220	No
3	Sub Bottom Profiler - IXSEA	1.7 – 5.5 kHz	224 – 227	No
4	Sub Bottom Profiler - Boomer	100 Hz – 5 kHz 300 Hz – 3 kHz	200 – 222 Typically 215	Yes
5	Sub Bottom Profiler - Sparker	200 Hz – 3 kHz	≤229	Yes
6	Sub Bottom Profiler - Sleeve gun system	100 – 800 Hz	≤225	Yes
7	Sub Bottom Profiler - Innomar	60 – 80 kHz (Primary) 1.5 – 15 kHz (Secondary)	<243	No
8	Sub Bottom Profiler - Parametric	35 – 45 kHz (Primary) 1 - 10 kHz (Secondary)	190 – 220	No
9	Side Scan Sonar	100 – 850 kHz	190 - 242	No
10	Magnetometer	Passive system - unchanged		

Wide spaced geophysical survey data (e.g. 100 – 2 000 km line spacing) may be acquired to refine the geological model and to identify geological features of interest for follow-up survey or sampling. Further localised geophysical survey may be undertaken, enabling refinement of the definition of the target features. These detailed high resolution geophysical surveys will utilise similar tools with the likely inclusion of an Autonomous Underwater Vehicle (AUV), which is typically used for surveying in areas where survey line-spacing is generally <100 m apart.

The geophysical survey equipment will be deployed from a fit-for-purpose vessel suitable to the water depth and survey method. The two-dimensional (2D) geophysical systems could be deployed from various platforms (Figure 2.1), such as towed systems, vessel mounted, pole mounted or Autonomous Underwater Vehicles (AUV). The towed 2D surveys will involve a single towed streamer (hydrophone array). Three-dimensional (3D) surveys for De Beers Marine (DBM) are acquired using the AUV, with all the sensors on the platform. This contrasts with 3D survey used for Petroleum exploration, which uses multiple towed streamers.

All survey data collection is likely to be acquired by DBM survey and/or a survey service provider and geophysics professional technical staff to optimise data acquisition, processing and interpretation. Each and/or all of the techniques described below may be used during Phase I of the proposed prospecting operation.

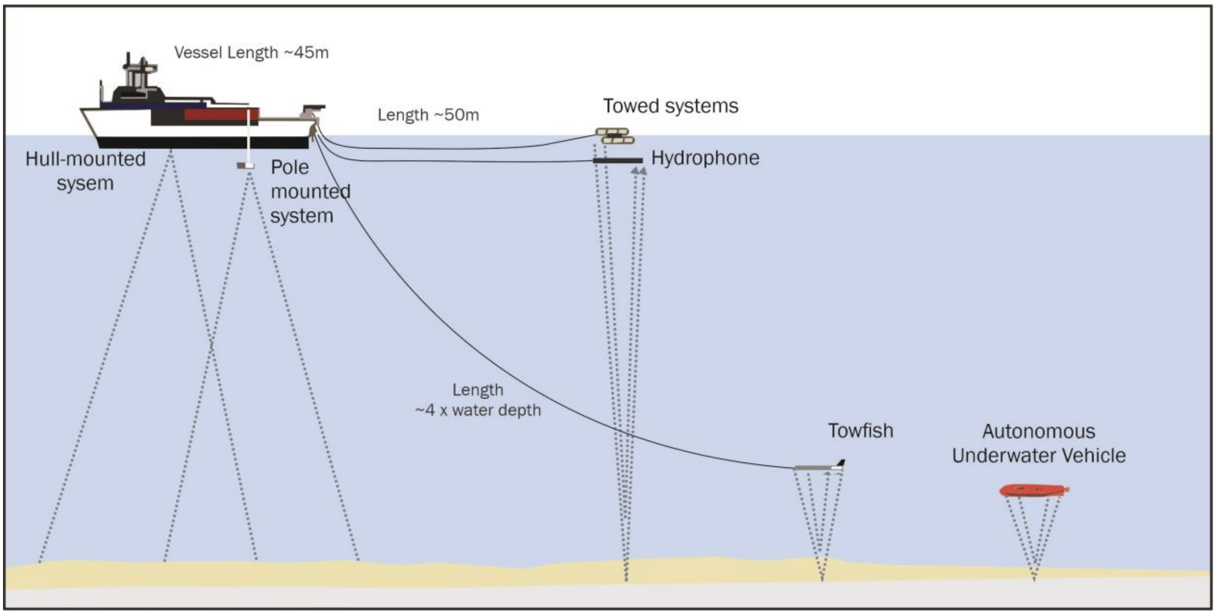

Figure 2.1: Diagram illustrating examples of the vessel-mounted, pole-mounted and towed systems that could be used for the surveys.

Multibeam Swath Bathymetry systems (includes backscatter)

The swath bathymetry system produces a digital terrain model of the seafloor and backscatter data may be acquired to determine textural models. The multi-beam system provides depth sounding information on either side of the vessel's track across a swath width of approximately two times the water depth. Typical multi-beam echo sounders emit a fan of acoustic beams from a transducer. This equipment has a variable power output and can therefore have the power ramped up in accordance with survey requirements and be contained within acceptable environmental noise levels. As a result, it is also capable of "soft starts".

Sub-bottom profiler systems (2D and 3D systems)

Sub-bottom profiler (SBP) systems (e.g. boomer and chirp) are lower frequency echo-sounders that provide profiles of the upper layers of the ocean floor. SBP systems use reflected or refracted sound energy to infer information of seabed conditions relating to depth and shallow sub-surface geology. The

2D acoustic survey involves transmitting acoustic energy to the seabed and recording energy reflected back from subsurface boundaries to acquire information on subsurface geology. These systems used for marine diamond exploration are focussed on the upper seabed layers, with penetrations typically varying between 5 to 100 m below the seabed, depending on the particular system being used. Two examples of potential SBPs that may be used for Phase 1 are given below – further options are provided in Table 2.1.

- Chirp: Chirp systems operate around a central frequency which is swept across a range of frequencies typically between 1.5 – 12.5 kHz. Penetrations are typically <15m below the seabed. This equipment is not capable of a "soft start". However, to mitigate this, one could start with turning on the equipment that has a soft start (e.g. Multibeam Echosounder) and then only once those are started, start the other equipment (such as the Chirp and Side Scan Sonar) that does not have a soft start.
- Boomer: The Boomer is an electromagnetically driven sound source. The source is usually mounted on a towed catamaran and a separate hydrophone array (single streamer) is used for a receiver. The sound is generated when a capacitor bank is discharged through one or more flat spiral coils and causes one or more copper or aluminium plates adjacent to the coil to flex away from the coil/s. This flexing creates an acoustic wave. The reflected signal from the acoustic pulse is then received by a towed hydrophone streamer. Depending on the subsurface material types and Boomer source frequency levels selected, a penetration depth from 25 to 100 m may typically be achieved. This equipment has a variable power output allowing the power to be ramped up in accordance with survey requirements and to be contained within acceptable environmental noise levels. As a result, it is also capable of "soft starts".

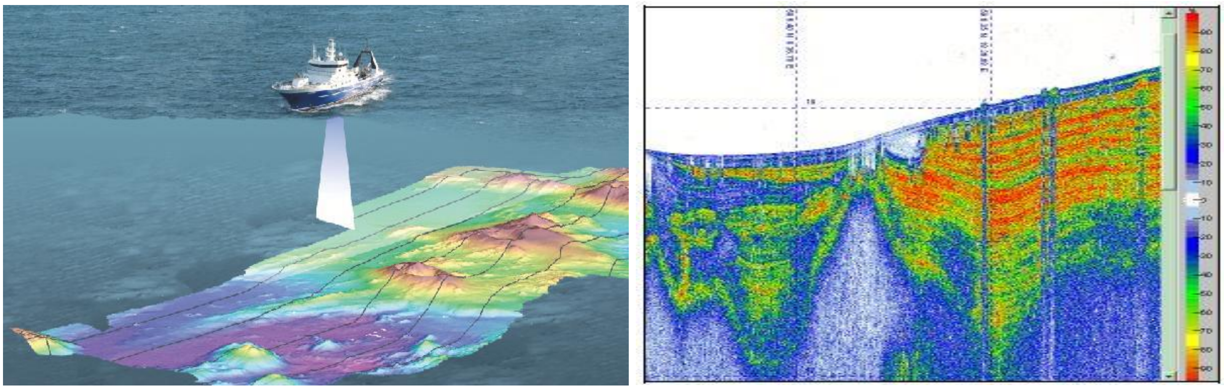

Figure 2.2: The geophysical survey techniques employed during Phase I of the proposed prospecting operations would include swath bathymetry (left) and sub-bottom profiling (right).

Side scan sonar

Side scan sonar systems produce acoustic intensity images of the seafloor and are used to map the different sediment textures of the seafloor. Side-scan uses a sonar device that emits conical or fan-shaped pulses down toward the seafloor across a wide angle perpendicular to the path of the sensor through the water. The intensity of the acoustic reflections from the seafloor of this fan-shaped beam is recorded in a series of cross-track slices. When stitched together along the direction of motion, these slices form an image of the sea bottom within the swath (coverage width) of the beam. This equipment is not capable of a "soft start". However, mitigation as proposed for the Chirp SBP system can be applied.

Electrical, Magnetic, Electro-Magnetic

Electrical, magnetic and/or electro-magnetic methods may possibly be used, some examples are given below:

- *Magnetometer*: A magnetometer measures local variations in the intensity of the Earth's magnetic field, which are caused by differences in composition of the sediment layers beneath the seafloor. A magnetometer is useful in defining magnetic anomalies which represent ore (direct detection), or minerals associated with ore deposits (indirect detection).
- Electrical Resistivity: Marine Resistivity surveys measure variations in the electrical resistance of layers in the seabed, through the application of electrical current into the seabed using current electrodes. Potential electrodes are then used to measure the resulting potential difference between them, which measures the electrical impedance of the seabed layers.
- Electro-magnetic (EM): EM surveys measure variations in electrical properties of the seabed and bulk conductivity. In EM survey currents are induced into the seabed through the application of time-varying magnetic fields. A towed dipole-source transmits a time-varying electro-magnetic field into the seabed and an array of receivers placed on the seabed or behind the towed transmit array then measure the seabed layers response changes in the field.

Video and photographic equipment

Video and photographic equipment (such as ROVs, drop cameras, SkiMonkey, etc.) may be used for visualising the seabed as part of groundtruthing studies.

Underwater manned submersibles

Underwater manned submersibles may also be utilised for visualisation purposes.

2.2 EXPLORATION SAMPLING

Exploration sampling (includes coring) will be undertaken using a fit-for-purpose tool using a vessel of opportunity (e.g. MV *The Explorer*, Figure 2.3) in water depths ranging from 70 to 160 m. The planned sampling methodology will take advantage of the latest technologies available to DBM. The sampling may be divided into stages with reviews and gate releases. The decision will be made to select the fit-for-purpose sampling technology appropriate to each target based on the results of the preceding stage.

Depending on the outcomes of previous stage work, samples may be collected in a fixed pattern over the identified target area. Samples may be taken along lines spaced 10 m to 500 m apart, with sample spacing based on the geological nature of the target area.

Once a decision is made on the sampling tool technology that will be chosen for taking samples from the seabed, the accompanying metallurgical sample processing technology onboard the vessel will then also be determined. Possible sampling tool technologies that could be employed include; coring, the use of a subsea sampling tool and a vertically-mounted tool. Groundtruthing studies may include the use of equipment such as box corers, van Veen grab samplers, etc.

Figure 2.3: Possible vessel of opportunity that could be used for sampling (MV *The Explorer*).

Possible sampling tool technologies that could be employed are described in more detail below.

Coring (e.g. vibrocoring)

A vibrocorer consists of a core barrel in a landing frame with a vibrating motor on top. The vibrocorer is landed on the seafloor, the motor turned on and the barrel penetrates the unconsolidated sediment. Once the core stops penetrating, the motor is turned off and the vibrocorer is raised back up to the deck. A PVC pipe is placed inside the core barrel prior to coring and the core sample is collected in this pipe. Cores can typically penetrate up to 6 m and typically have a diameter of approximately 11 cm.

Subsea Sampling Tool

Sampling could be undertaken using a subsea sampling tool operated from a drill frame structure (Figure 2.4), which is launched through the moon pool of the support vessel and positioned on the seabed. The tool removes a discrete sample with a seabed surface footprint of approximately 5 - 10 m^2. The unconsolidated sediments are fluidised with strong water jets and airlifted to the support vessel where they are treated in the on board mineral recovery plant. All oversized and undersized tailings are discharged back to the sea on site. The depth of sediment sampled typically varies between 0.5 m and 5 m below the seafloor surface.

Figure 2.4: Illustrative example of a drill bit operated from a drill frame structure located onboard a vessel of opportunity.

Vertically Mounted Tool

Sampling could potentially be undertaken using a vertically mounted tool suspended from a derrick mounted on the ship. The drill stem is suspended in a state of constant tension by means of a compensation system that absorbs the motion of the ship, enabling the tool to remain in contact with the seabed. The tool agitates the unconsolidated sediments and airlifts sediment particles of typically up to 250 mm in diameter to the vessel for processing. The tool removes a discrete sample with a seabed surface footprint of approximately 30 m^2. As with the Subsea Sampling Tool (discussed above), all oversized and undersized tailings are discharged back to the sea on site. The depth of sediment sampled is expected to typically be between 0.5 and 5 m below the seafloor surface.

For the purposes of this assessment it is assumed that up to a maximum of 22 500 samples may be obtained within the potential deposit area(s) during the five years of prospecting. The sample spacing for the initial wide spaced exploration sampling/coring, will be dependent on the geological feature size. The follow-up sample spacing is expected to typically vary between 50 and 200 m apart. The cumulative area of disturbance would be up to approximately 0.225 km^2 but would not be contiguous.

2.3 EMISSIONS AND DISCHARGES TO SEA

During geophysical and sampling operations, normal discharges to the sea from the vessels can come from a variety of sources. These discharges are regulated by onboard waste management plans and shall be MARPOL compliant. For the sake of completeness they are discussed briefly below:

2.3.1 VESSEL MACHINERY SPACES (BLIGES), BALLAST WATER AND DECK DRAINAGE

The concentration of oil in discharge water from any vessel (bilge and ballast) would comply with the MARPOL Regulation 21 standard of less than 15 ppm oil in water. Any oily water would be processed through a suitable separation and treatment system to meet the MARPOL Annex I standard before discharge overboard. Drainage from marine (weather) deck spaces would wash directly overboard.

2.3.2 SEWAGE

South Africa is a signatory to MARPOL Annex IV Regulations for the Prevention of Pollution by Sewage from Ships and contracted vessels would be required to comply with the legislated requirements of this Annex.

2.3.3 FOOD (GALLEY) WASTES

The disposal into the sea of food waste is permitted in terms of MARPOL when it has been comminuted or ground and the vessel is located more than 3 nautical miles (approximately 5.5 km) from land. Such comminuted or ground food wastes shall be capable of passing through a screen with openings no greater than 25 mm. Disposal overboard without macerating can occur when more than 12 nautical miles (approximately 22 km) from the coast. Although De Beers vessels macerate food regardless of the distance, this may not be the case for all contracted vessels, although it would encourage this best practice. The daily discharge from the vessel would be approximately 0.15 m^3.

2.3.4 DETERGENTS

Detergents used for washing exposed marine deck spaces would be discharged overboard. The toxicity of detergents varies greatly depending on their composition. Water-based detergents are low in toxicity and are preferred for use. Preferentially biodegradable detergents would be used.

2.3.5 SUPPORT AND SUPPLY VESSELS

The exploration vessels typically have the capability to be fully autonomous and operational for long periods of time before bunkering. Spares, consumables and victuals could possibly be supplied by support vessels while the exploration vessel is operational..

Personnel changes may be undertaken by helicopter or sea transport (similar for emergency equipment supplies, medical evacuations of injured personnel, etc.), Helicopter operations to and from the vessel would thus occur sporadically only, if at all.

3 DESCRIPTION OF RECEIVING ENVIRONMENT: FISHERIES BASELINE

3.1 OVERVIEW OF FISHERIES SECTORS

South Africa has a coastline that spans two ecosystems[2] over a distance of 3 623 km, extending from the Orange River in the west on the border with Namibia, to Ponta do Ouro in the east on the Mozambique border. The western coastal shelf has highly productive commercial fisheries similar to other upwelling ecosystems around the world, while the East Coast is considerably less productive but has high species diversity, including both endemic and Indo-Pacific species. South Africa's fisheries are regulated and monitored by the DFFE. All fisheries in South Africa, as well as the processing, sale in and trade of almost all marine resources, are regulated under the Marine Living Resources Act, 1998 (No. 18 of 1998) (MLRA).

Approximately 22 different 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 shown 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

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

Bank (South Coast) and a hand-jig fishery targeting chokka squid (*Loligo vulgaris reynaudii*) exclusively on the South Coast.

There are more than 230 small-scale fishing communities on the South African coastline (DFFE, 2020). Small-scale fisheries commonly use boats but occur mainly close to the shore. In addition to commercial and small-scale sectors, recreational fishing occurs along the coastline comprising. 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.

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.

Seaweed is also regarded as a fishery, with harvesting of kelp (*Ecklonia maxima)* and (*Laminaria pallida)* in the Western and Northern Cape and hand-picking of *Gelidium* sp. in the Eastern Cape. The seaweed industry employs over 1700 people, most of whom are previously disadvantaged. *E. maxima* is primarily used by the abalone aquaculture industry as abalone feed.

Aquaculture in the marine environment ("mariculture" or "marine aquaculture") refers to the farming of marine plants and animals which is conducted in the open ocean, in enclosed sections of the ocean, or in tanks, ponds or raceways which are filled with seawater. This means that marine aquaculture sites are either directly located in the marine environment (sea-based marine aquaculture) or located on land, which abstract/utilise seawater to cultivate the produce in suitable facilities (land-based marine aquaculture). Marine aquaculture is still in its infancy in South Africa but has been identified by government as a growth industry worthy of support.

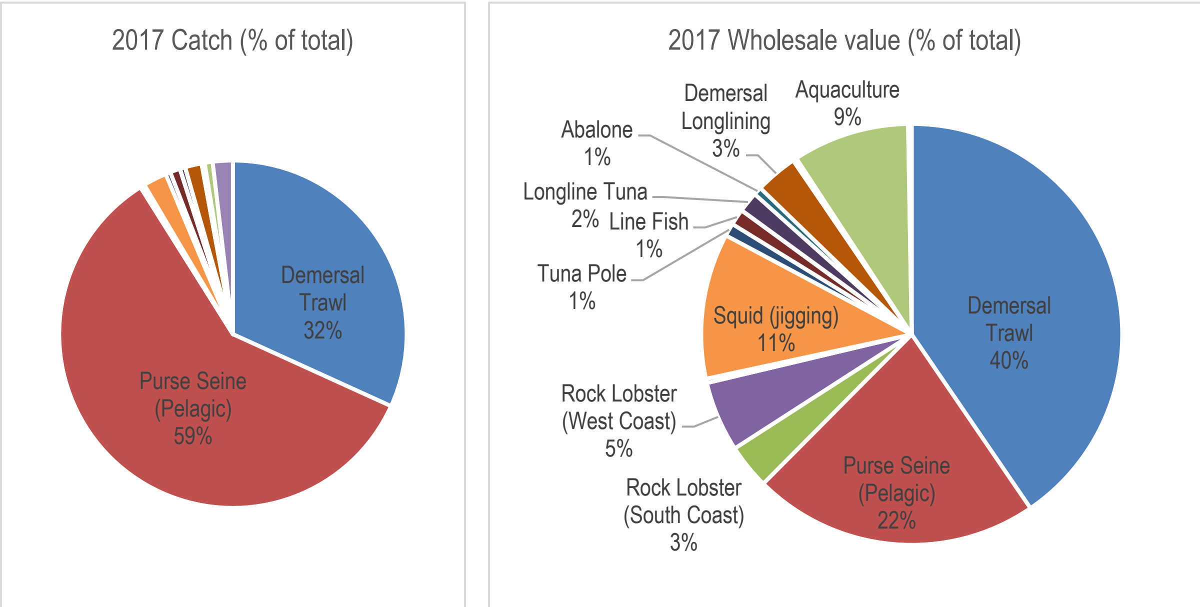

Figure 3.1: Pie chart showing percentage of landings by weight (left) and wholesale value (right) of each commercial fishery sector as a contribution to the total landings and value for all commercial fisheries sectors combined (2017). Source: DEFF, 2019.

Table 3.1: South African offshore commercial fishing sectors: number of rights holders, landings and 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)	17545			
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, areas of operation, deployment ports 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*)
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

Sector	Areas of Operation	Main Ports in Priority	Target Species
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 MIGRATION, 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. This migration is central to the sustainability of the West Coast small pelagic and hake fisheries. Hake, sardines, anchovy and horse mackerel are mostly serial, broadcast spawners, producing large numbers of eggs sporadically that are widely dispersed in ocean currents (Hutchings et al., 2002). Adults spawn on the Agulhas Bank during Spring, between the shelf-edge upwelling and the cold-water ridge, where copepod availability is highest (Crawford 1980; Hutchings 1994; Roel & Armstrong 1991; Hutchings et al. 2002). The spawn products are thought to move southwards from the central Agulhas Bank and then may drift northwards in the Benguela current across the shelf and up the west coast, or inshore and eastwards towards the south coast. As the eggs drift, hatching takes place followed by larval development. Settlement of larvae occurs in the inshore areas, in particular the bays that are used as nurseries, from October to March. In the southern Benguela system, juveniles shoal and then begin a southward migration down the west coast – it is at this stage that anchovy and sardine are targeted by the small pelagic purse seine fishery. Juveniles of demersal species such as hake are thought to move from a pelagic phase and to systematically migrate to the seafloor (a vertical migration) and then as they mature and grow in size, move offshore into deeper water where they are targeted by commercial fisheries (in hake this occurs in their third year of growth and is referred to as “recruiting” to the fishery).

Refer to Figure 3.2 for an overview of the main fish spawning grounds and nursery areas off the West and South Coasts of South Africa. Figure 3.3 shows the distribution of egg density of sardine and anchovy, and Figure 3.4 shows spawning ground and nursery areas of snoek and anchovy.

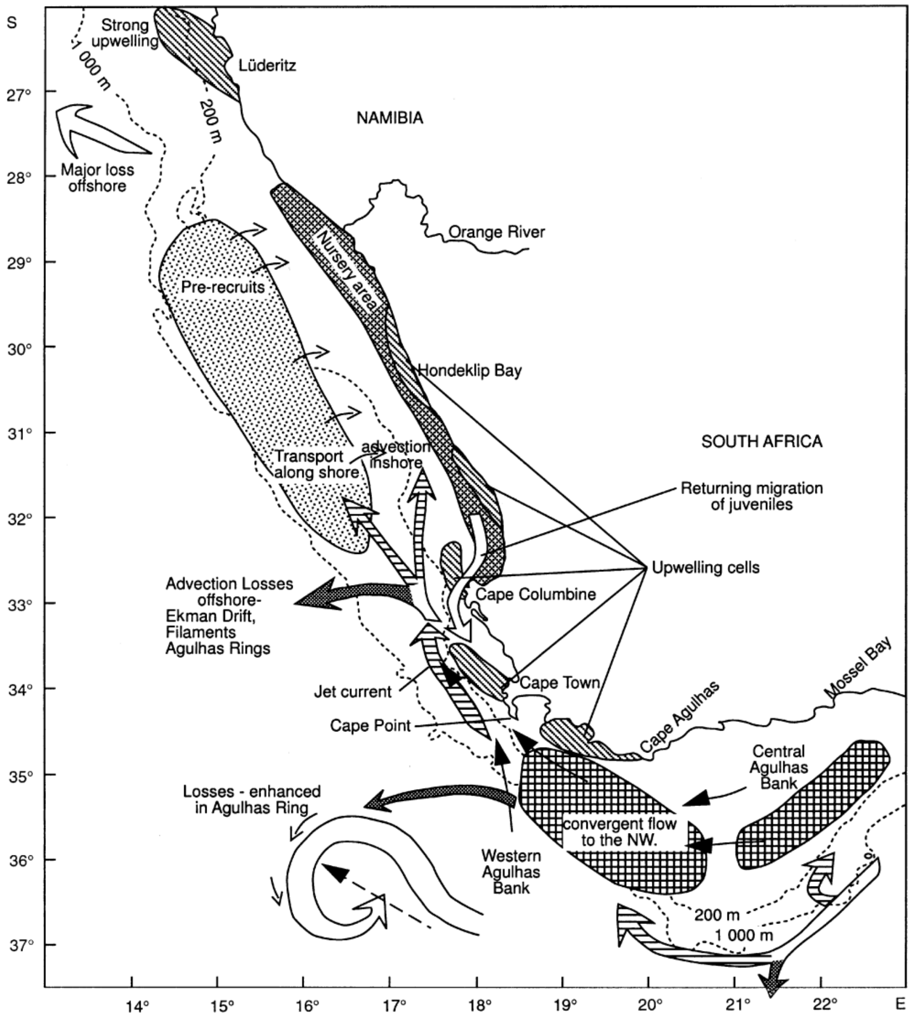

Figure 3.2: Generalised figure of the main fish recruiting process for species caught on the West Coast of South Africa (after Hutchings et al., 2002). Figure shows the West Coast nursery area and the western/central Agulhas Bank spawning grounds. Light stippled area on the West Coast marks the main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

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

- Hake, snoek and round herring move to the western Agulhas Bank and southern west coast to spawn during key periods (late winter to early spring), when losses due to offshore drift are at a minimum and eggs and larvae drift northwards and inshore to the west coast nursery grounds.
- Hake are serial spawners and are reported to spawn throughout the year with peaks in October/November and March/April (Johann Augustyn, SADSTIA and Dave Japp, CapMarine pers com.). During these periods there is a greater concentration of drifting eggs and larvae compared to other months. Spawning of the shallow-water hake occurs primarily over the shelf (<200 m) whereas that by the deep-water hake occurs off the shelf.
- Horse mackerel spawn over the east/central Agulhas Bank during winter months but are also concentrated on the eastern part of the bank most months in feeding aggregations. Juveniles occur close inshore off the southern Cape coastline and west coast nursery habitats.

- Anchovies are known to spawn on the western, central and eastern Agulhas Bank, from October to March with spawning peaking during October to January (van der Lingen and Huggett, 2003) and some shifts to the west coast in years when Agulhas Bank water intrudes strongly north of Cape Point (van der Lingen *et al*., 2001 in Hutchings *et al*., 2002).

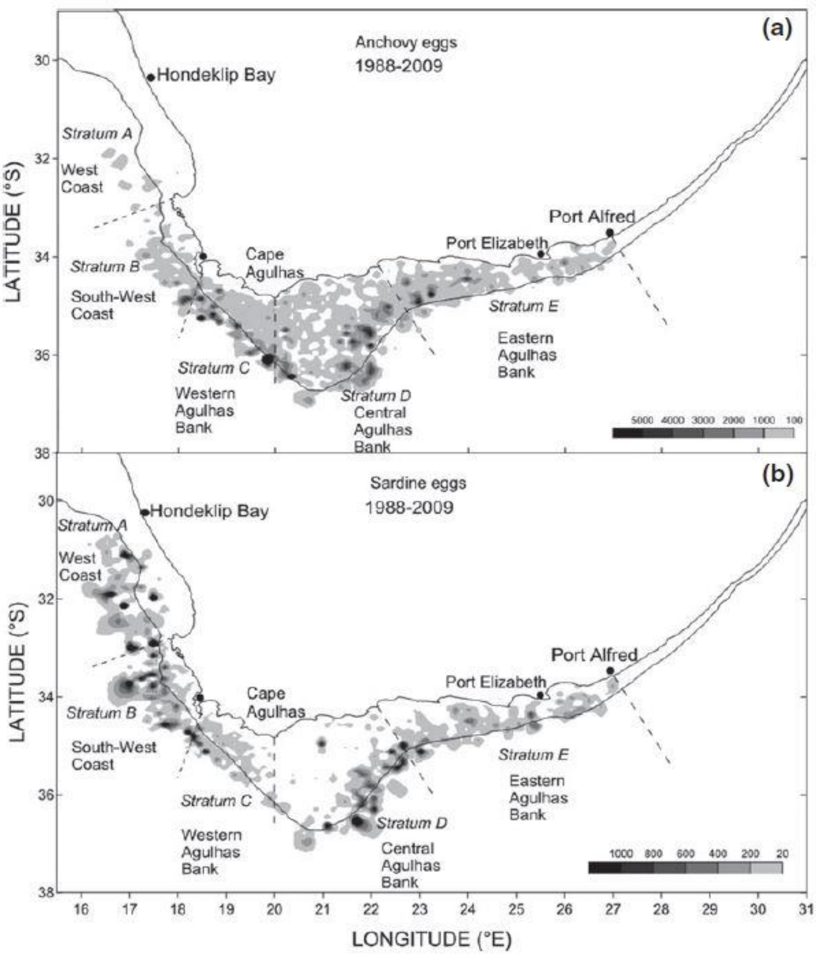

Figure 3.3: Composite distribution maps for eggs (eggs.m^{-2}) of (a) anchovy and (b) sardine collected during spawner biomass surveys by DFFE over the period 1988-2009 (Mhlongo *et al*., 2015).

- Genomic and transcriptomic analyses have shown that there are two stocks of sardine off South Africa; the Cool Temperate Sardine (CTS) off the west coast and Warm Temperate Sardine (WTS) off the south coast, with some mixing (in both directions) between the two (Teske *et al.* 2021). Sardines spawn on the western, central and eastern Agulhas Bank, and also off the west coast north of Cape Point. Sardine eggs are found throughout the year, but spawning occurs from August to February (spring-summer) for the CTS off the west coast, and from June to November (winter-spring) for WTS off the south coast. There is an intense seasonal movement of sardine eastwards (the "sardine run") that occurs in mid-winter and which is associated with westerly frontal systems driving fish inshore in counter currents. And whilst sardine eggs are found off the east coast from June to December (see Connell 2010 AJMS 32(2)), the KwaZulu-Natal sardine run is not the spawning migration of a third stock but a navigation error by CTS.
- Snoek spawning occurs offshore during winter-spring (June to October), along the shelf break (150-400 m) of the western Agulhas Bank and the South African west coast. Prevailing currents transport eggs and larvae to a primary nursery ground north of Cape Columbine and to a secondary nursery area to the east of Danger Point; both shallower than 150 m. Juveniles remain on the nursery grounds until maturity, growing to between 33 and 44 cm in the first year (3.25 cm/month). Onshore-offshore

distribution (between 5- and 150-m isobaths) of juveniles is determined largely by prey availability and includes a seasonal inshore migration in autumn in response to clupeoid recruitment. Adults are found throughout the distribution range of the species, and although they move offshore to spawn - there is some southward dispersion as the spawning season progresses - longshore movement is apparently random and without a seasonal basis (Griffiths, 2002).

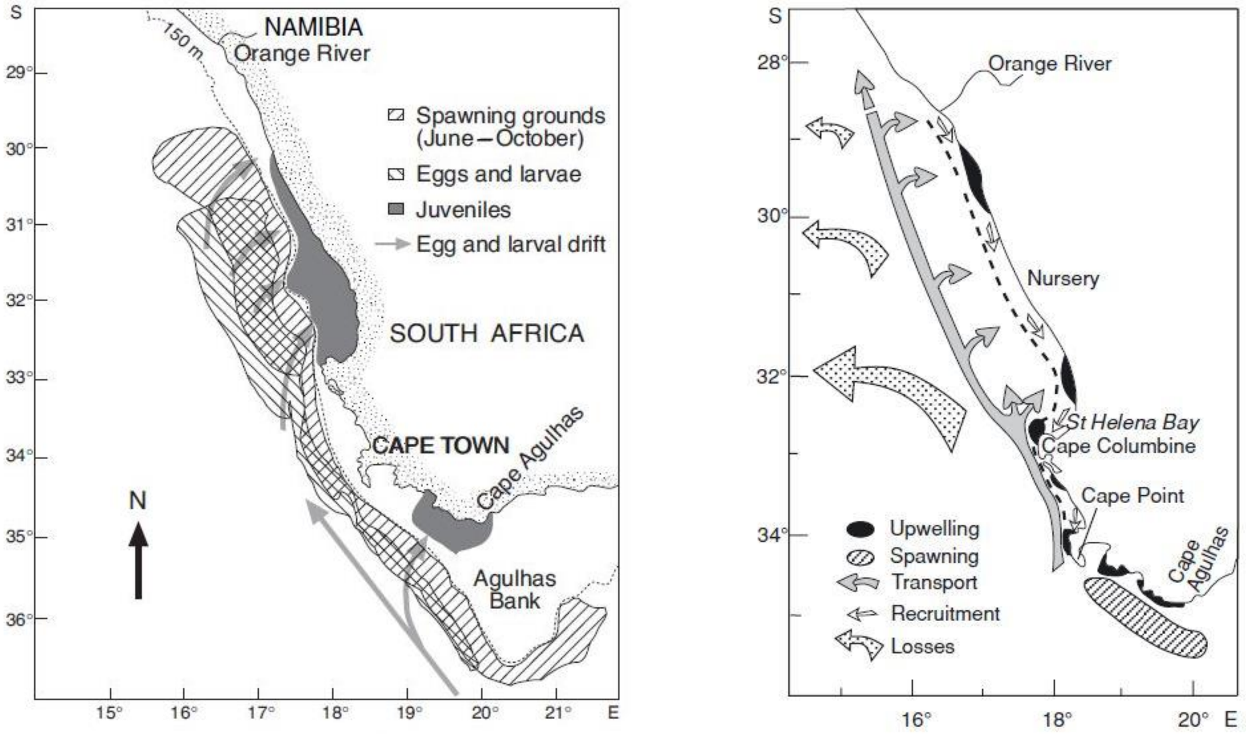

Figure 3.4: Conceptual model depicting the life history of snoek (left; Source: Griffiths, 2002) and anchovy (right; Hutchings et al., 1992) in the southern Benguela ecosystem, including spawning grounds, distribution and transport of eggs and larvae, and the nursery areas

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

The 2022 TAC for hake is set at 132 154 tons, of which 84% and 6% is allocated to the offshore and inshore trawl sectors, respectively. (The remaining 10% is allocated to the hake demersal longline sector – refer to section 3.3.3).

The annual TAC limits and landings of hake (both species) by the trawl and longline sectors is listed in Table 3.3. A time-series of total hake catch as well as hake catch by sector is shown in Figure 3.5.

Table 3.3: Annual total allowable catch (TAC) limits and catches (tons) of the two species of hake by the hake-directed fisheries on the West (WC) and South (SC) coasts (Adapted from DEFF, 2020[3]).

		M. paradoxus					*M. capensis*						TOTAL both species
Year	TAC	Deep-sea		Longline		TOTAL	Deep-sea		Inshore	Longline		TOTAL	
		WC	SC	WC	SC		WC	SC	SC	WC	SC		
2010	119831	69709	15457	2394	1527	89087	10186	4055	5472	3086	3024	26098	115185
2011	131780	76576	17904	2522	140	97142	15673	4086	6013	3521	3047	35525	129667
2012	144671	81411	16542	4358	306	102616	12928	4584	3223	2570	1737	25050	127666
2013	156075	74341	28859	6056	60	109316	8761	4475	2920	2606	1308	20071	129387
2014	155280	73252	41156	6879	8	121295	9671	6286	2965	2123	315	21361	142656
2015	147500	77521	31745	4001	18	113286	12727	4085	3077	2325	53	22217	135503
2016	147500	93173	18968	2806	1	114948	14744	2810	3973	4360	2	25889	140837
2017	140125	72326	30961	5288	25	108600	15273	4466	2812	2807	126	25488	134088
2018	133119	64252	29218	5217	90	98777	12689	12863	3983	2615	481	32668	131370
2019	146431	70608	22201	5328	34	98171	14193	9454	4149	3623	299	31718	129898
2020	146400	97093	10061	5847	47	113048	18115	3500	4536	2348	321	28820	141872
2021	139109	102865	15597	5892	18	124372	15585	2937	4517	2932	194	26165	150537
2022	132154												

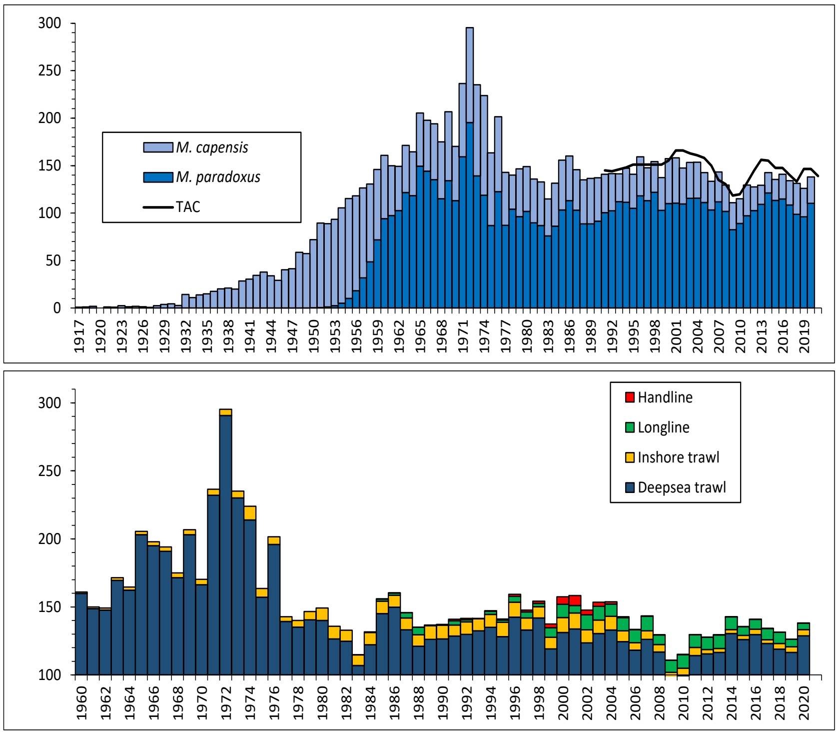

Figure 3.5: (upper) Total catches ('000 t) of Cape hakes split by species over the period 1917–2020 and the TAC set each year since the 1991. (lower) Catches of Cape hakes per fishing sector for the period 1960–2020. Prior to 1960, all catches are attributed to the deep-sea trawl sector (Source DFFE, 2022).

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

The offshore fishery comprises 45 vessels that operate from most major harbours on both the West and South Coasts. On the West and South-West Coasts, these grounds extend in a continuous band along the shelf edge between the 200 m and 1 000 m bathymetric contours although most effort is in the 300 m to 600 m depth range. Monkfish-directed trawlers tend to fish shallower waters than hake-directed vessels on mostly muddy substrates. 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 Gqeberha. Inshore grounds are located on the Agulhas Bank and extend towards the Great Kei River in the east. Vessels also target sole close inshore between Struisbaai and Mossel Bay, between the 50 m and 80 m isobaths. Hake is targeted further offshore in traditional grounds between 100 m and 200 m depth in fishing grounds known as *the Blues* located on the Agulhas Bank.

The Deepsea Trawling Industry Association (SADSTIA) has implemented a self-imposed restriction which confines fishing effort to a designated area (the historical footprint of the fishery). This spatial restriction is also written into the permit conditions for the fishery. Demersal trawling is centred along the 500 m bathymetric contour but ranges to 300 m and to 200 m in places. Figure 3.6 shows an overview of the spatial distribution of fishing activity within the EEZ and in relation to Sea Areas 4C and 5C. Figure 3.7 shows the demersal trawling activity in the vicinity of the prospecting application area. Over the period 2017 to 2019, there has been no fishing effort reported within the prospecting application area; however, trawling activity may be expected offshore of the prospecting application area in waters deeper than 200 m on both the Namibian and South African sides of the maritime border. The concession areas coincide with recruitment areas for hake and other demersal species (see Figure 3.2). Figures 3.8 and 3.9 show the distribution of hake eggs and larvae on the west and south-west coasts, with typically higher abundance evident in September and October (spring) compared with March and April (autumn).

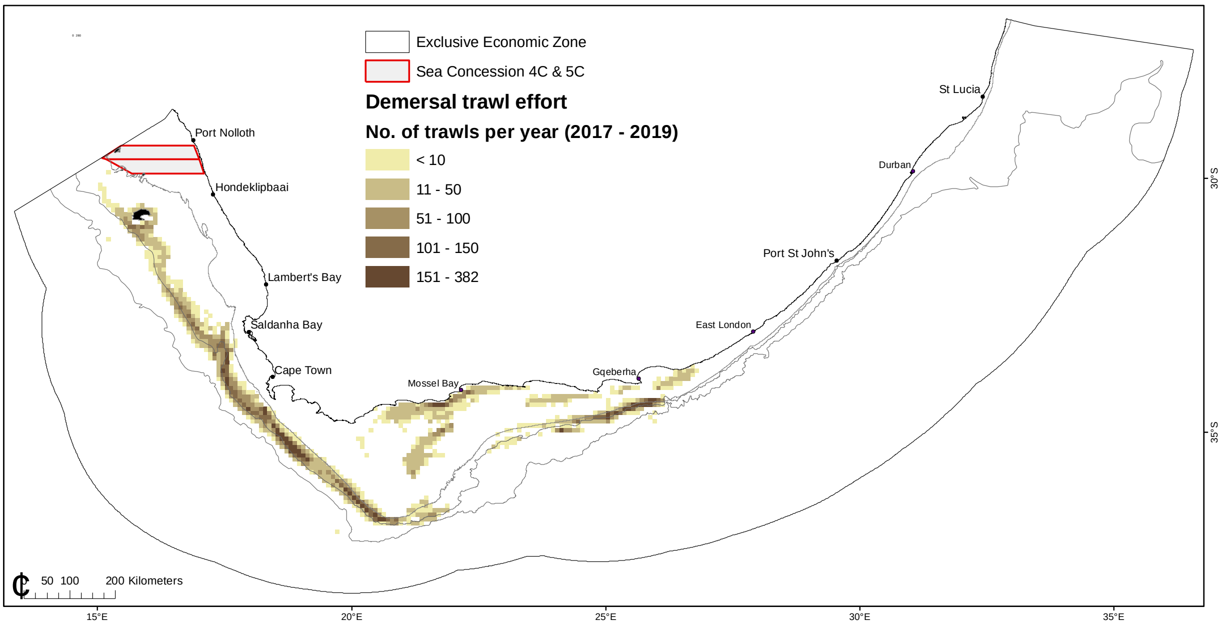

Figure 3.6: Overview of the spatial distribution of fishing effort expended by the demersal trawl sector within the South African EEZ and in relation to Sea Areas 4C and 5C.

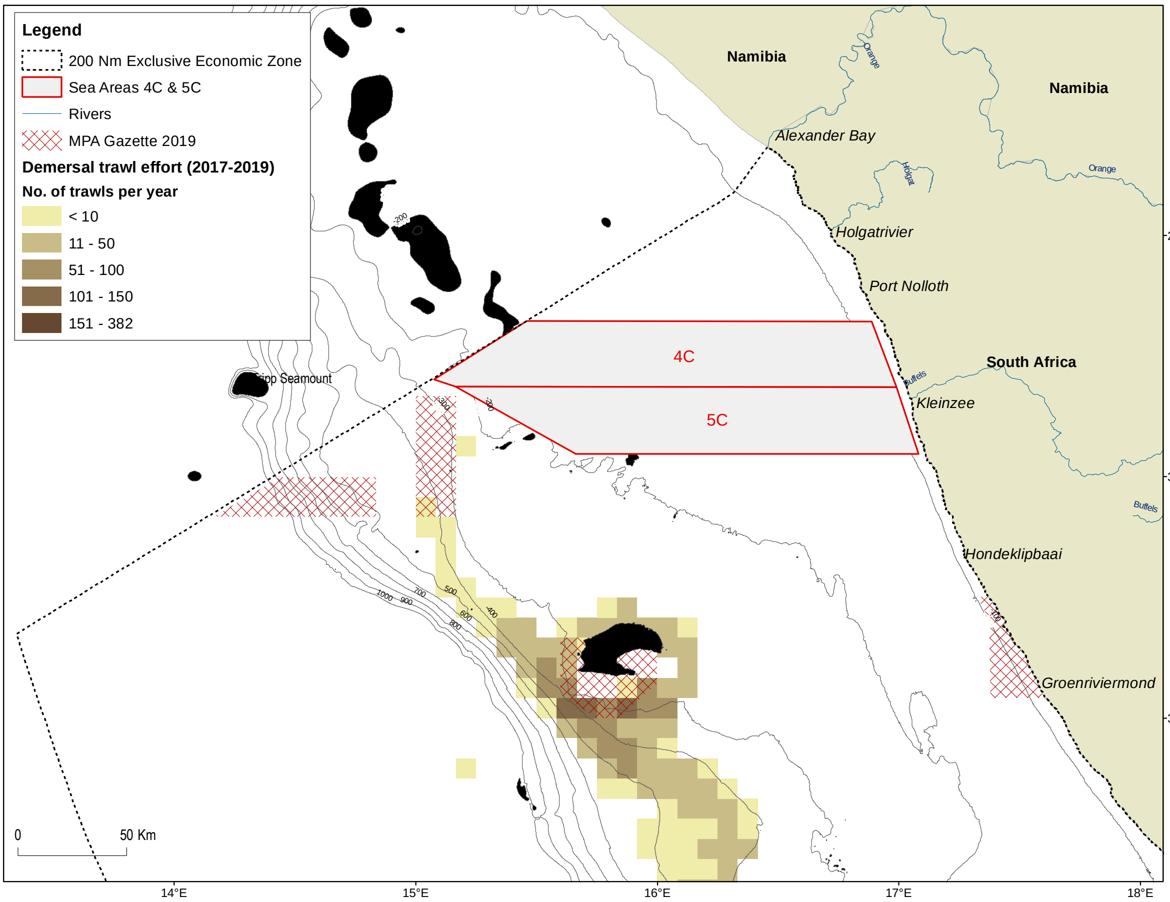

Figure 3.7: Spatial distribution of fishing effort expended by the demersal trawl sector in relation to Sea Areas 4C and 5C (2017 – 2019). (Note that the Prospecting Right area excludes the Namaqua Fossil Forest Marine Protected Area located in Sea Area 4C).

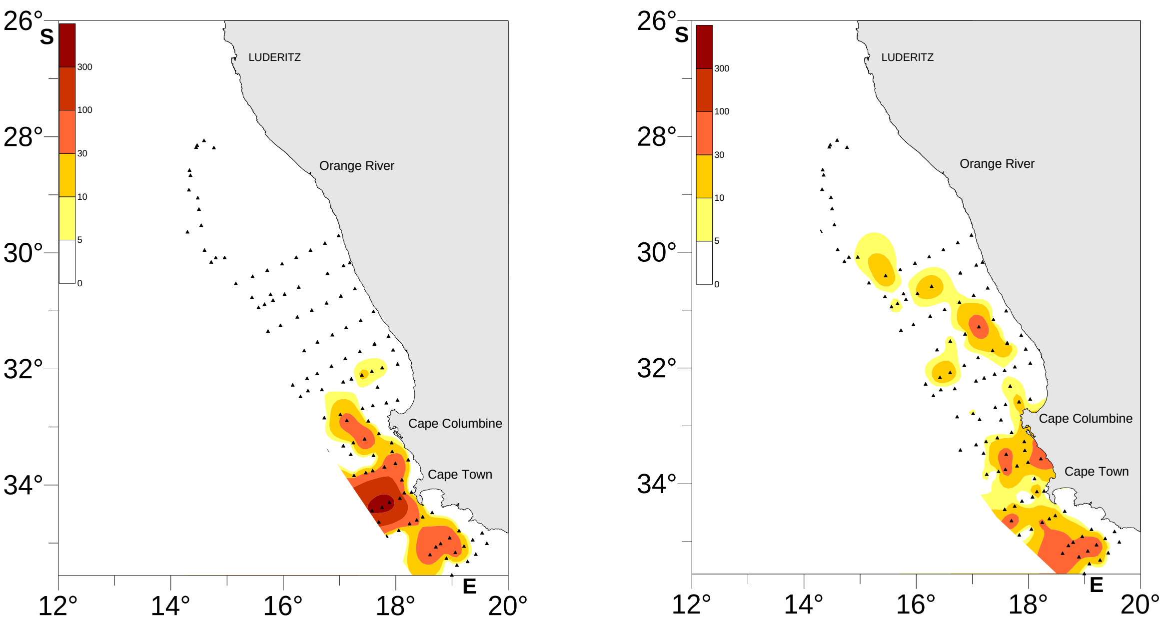

Figure 3.8: Typical distribution of hake eggs (left) and larvae (right) off the West Coast of South Africa between September and October 2005 (Institute of Marine Research Bergen, Norway).

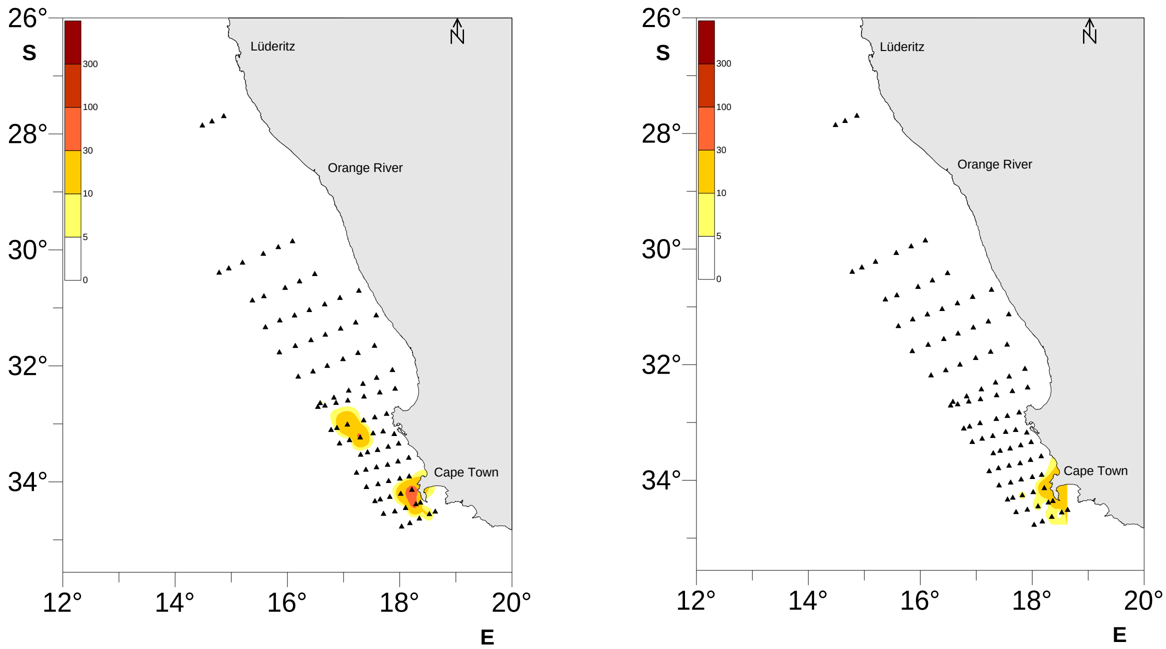

Figure 3.9: Typical distribution of hake eggs (left) and larvae (right) off the West Coast of South Africa between March and April 2007 (Institute of Marine Research Bergen, Norway).

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

Figure 3.10 shows the location of demersal trawls for research purposes over the period 2013 to 2021. The location of these trawls within the concession areas ranged between the 75 m and 196 m bathymetric contours. Up to 10 trawls could be expected within the concession areas during the annuarl research survey, timed to take place between January and possibly extending into March.

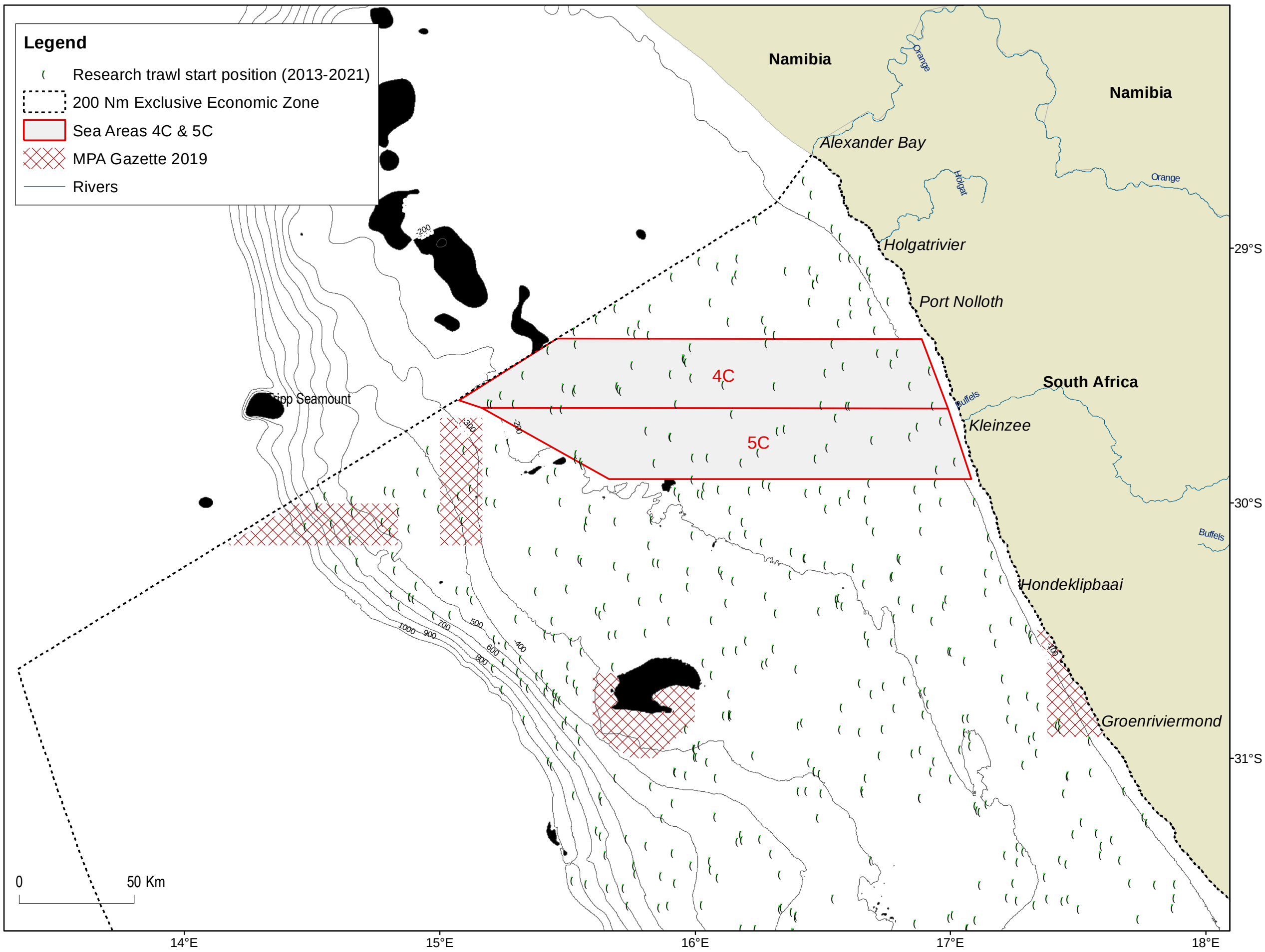

Figure 3.10: Spatial distribution of trawling effort expended by DFFE in relation to Sea Areas 4C and 5C over the period 2013 to 2021 in assessing the biomass of demersal fish species off the West Coast of South Africa.

3.3.2 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 8563 tons of hake were reported for the longline sector in 2020 and 9036 tons in 2021. Refer to Table 3.3 for the landings of hake by the demersal longline fishery over the period 2010 to 2021.

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 3.11.

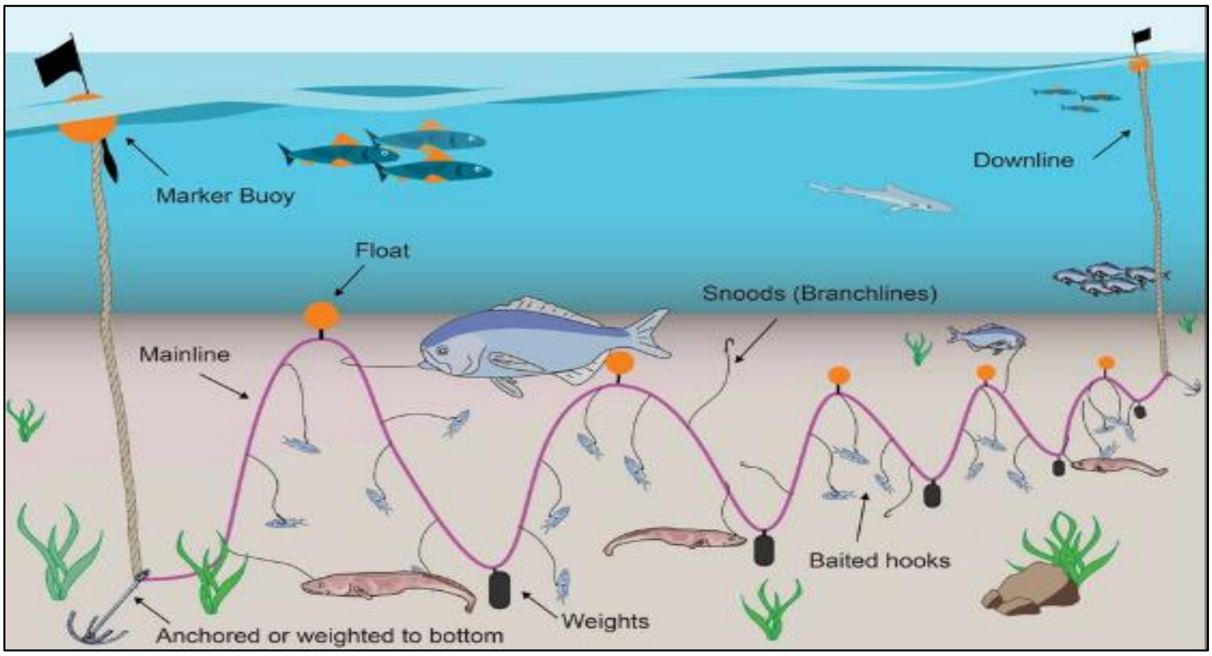

Figure 3.11: Photograph of a registered hake longline fishing vessel (above) and typical configuration of demersal longline gear used in the South African hake-directed fishery (below: http://www.afma.gov.au/portfolio-item/longlining).

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 3.12 shows the spatial extent of demersal longline grounds within the South African EEZ.

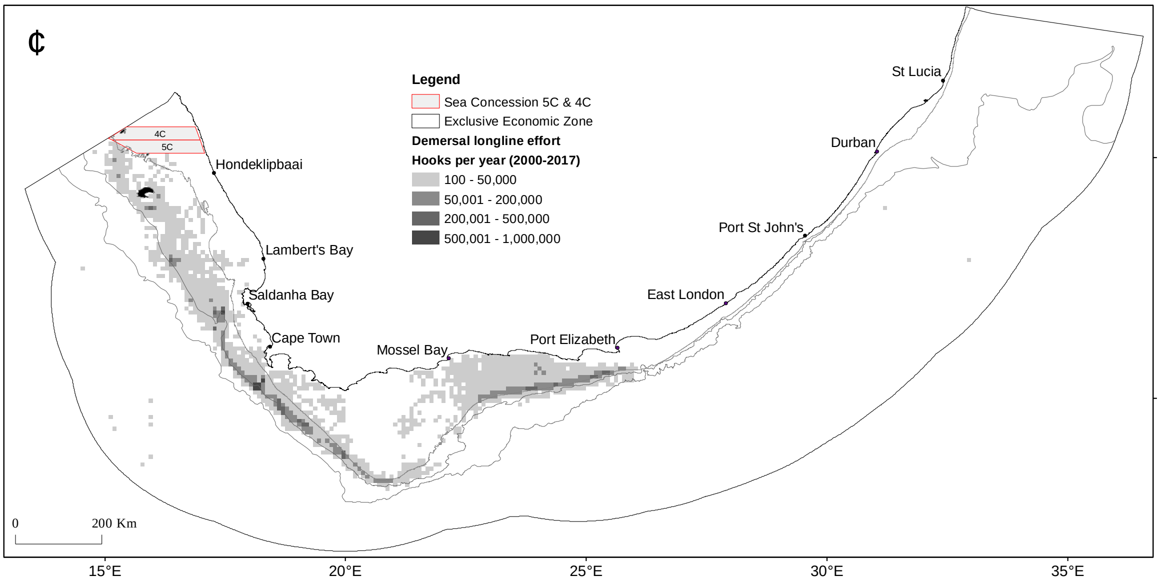

Figure 3.12: An overview of the spatial distribution of fishing effort expended by the demersal longline sector within the South African EEZ and in relation to Sea Areas 4C and 5C.

Figure 3.13 shows the spatial distribution of demersal longline fishing areas in Namibian and South African waters in the vicinity of Sea Areas 4C and 5C. 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 Sea Area 4C which runs along the maritime border with Namibia. The South African fleet of demersal longline vessels also operate at a similar depth range and therefore only minimal amounts of fishing activity were reported within the prospecting application area, which falls inshore of the main fishing grounds.

Over the period 2018 to 2020, an average of 128 000 hooks per year were set within the deep water portion of the prospecting application area yielding 21.9 tonnes of hake. This is equivalent to 0.47% of the overall effort and 0.47% of the overall catch reported nationally by the sector. Since survey and sampling operations would be limited to a depth range of between 70 m and 160 m across the application area, there is no overlap of project activities expected with fishing grounds of the demersal longline sector. Fishing grounds are situated at least 20 km offshore of the 160 m depth contour in this area.

Figures 3.8 and 3.9 show the distribution of hake eggs and larvae on the west and south-west coasts, with typically higher abundance evident in September and October (spring) compared with March and April (autumn).

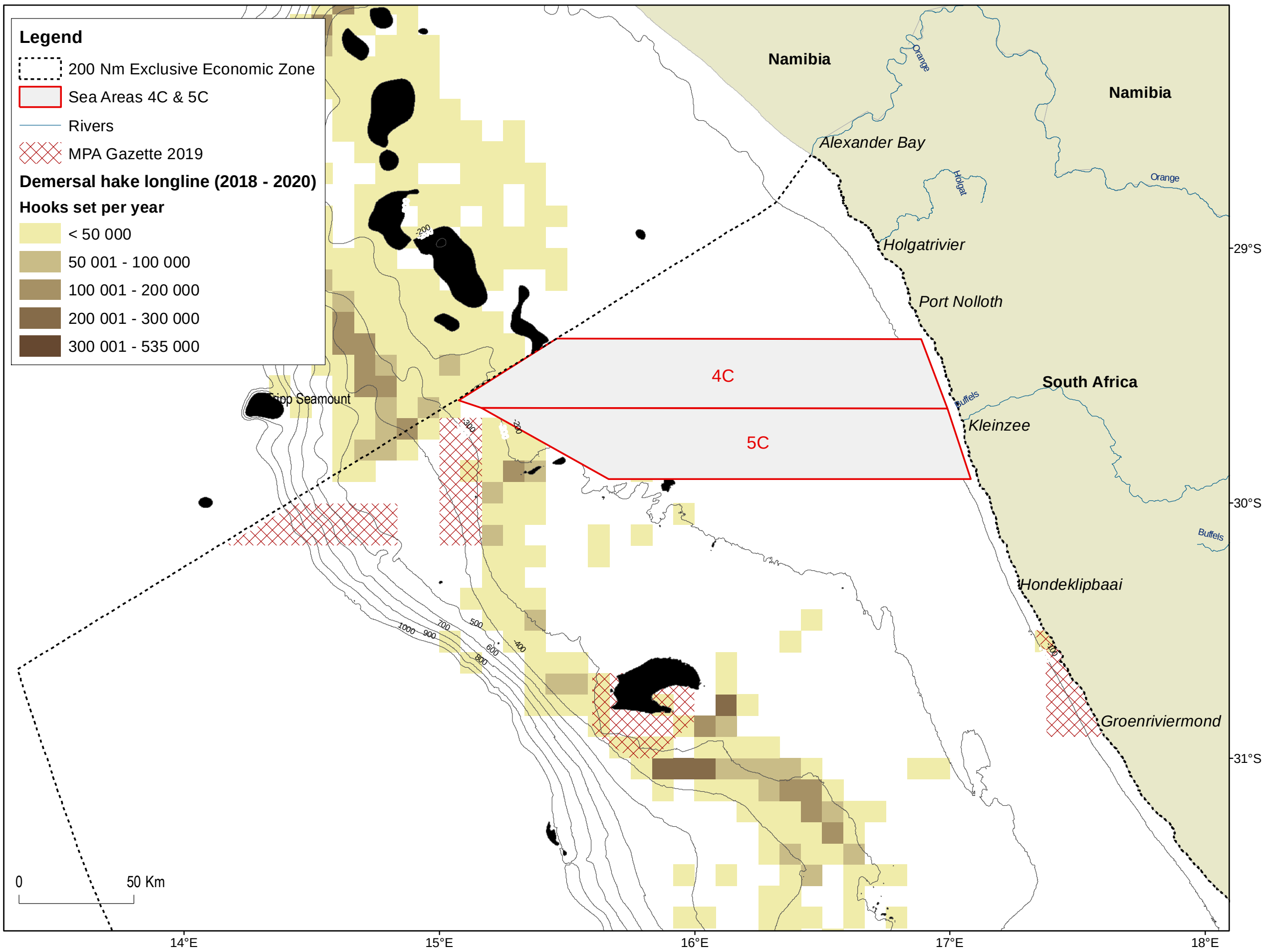

Figure 3.13: Spatial distribution of fishing effort expended by the longline sector targeting demersal fish species in the vicinity of Sea Areas 4C and 5C. South African and Namibian demersal longline sectors are shown. (Note that the Prospecting Right area excludes the Namaqua Fossil Forest Marine Protected Area located in Sea Area 4C).

3.3.3 MID-WATER TRAWL

This sector included six vessels and 34 rights holders which target adult horse mackerel (*Trachurus capensis*) of which a total catch of 19 710 tons were landed in 2020. 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 3.14 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.

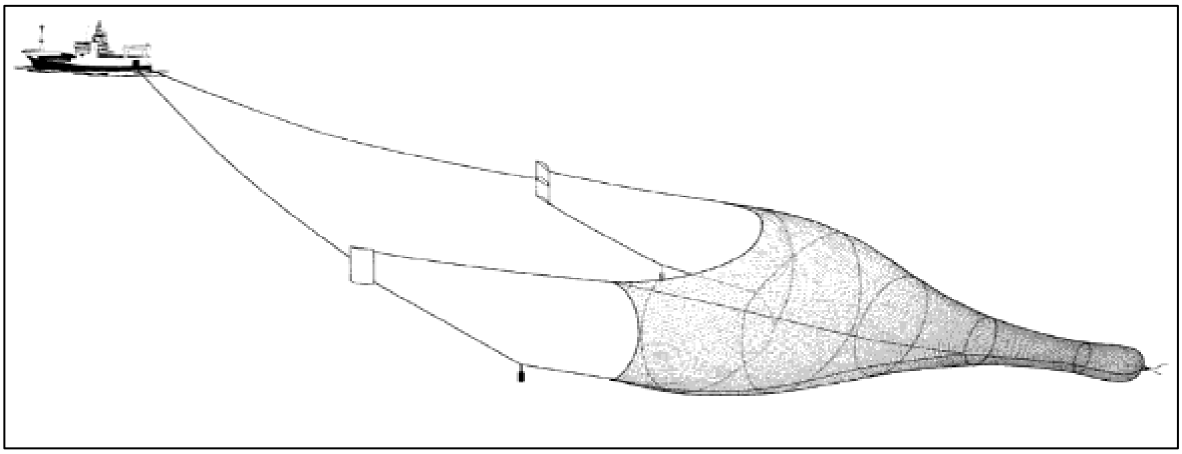

Figure 3.14: Schematic diagram showing the typical gear configuration of a mid-water trawler.

The fishery operates predominantly on the edge of the Agulhas Bank, where shoals are found in commercial abundance. Fishing grounds off the South Coast are situated along the shelf break and three dominant areas can be defined. The first lies between 22 °E and 23 °E at a distance of approximately 70 nm offshore from Mossel Bay and the second extends from 24 °E to 27 °E at a distance of approximately 30 nm offshore. The third area lies to the south of the Agulhas Bank 21 °E and 22 °E. These grounds range in depth from 100 m to 400 m and isolated trawls are occasionally recorded up to 650 m. From 2017, DFFE has permitted experimental fishing to take place westward of 20°E. Figure 3.15 shows the spatial extent of grounds fished by mid-water trawlers within the EEZ and in relation to Sea Areas 4C and 5C. The prospecting application area is situated approximately 330 km from grounds fished by the sector and there is no expected overlap of project activities with these grounds.

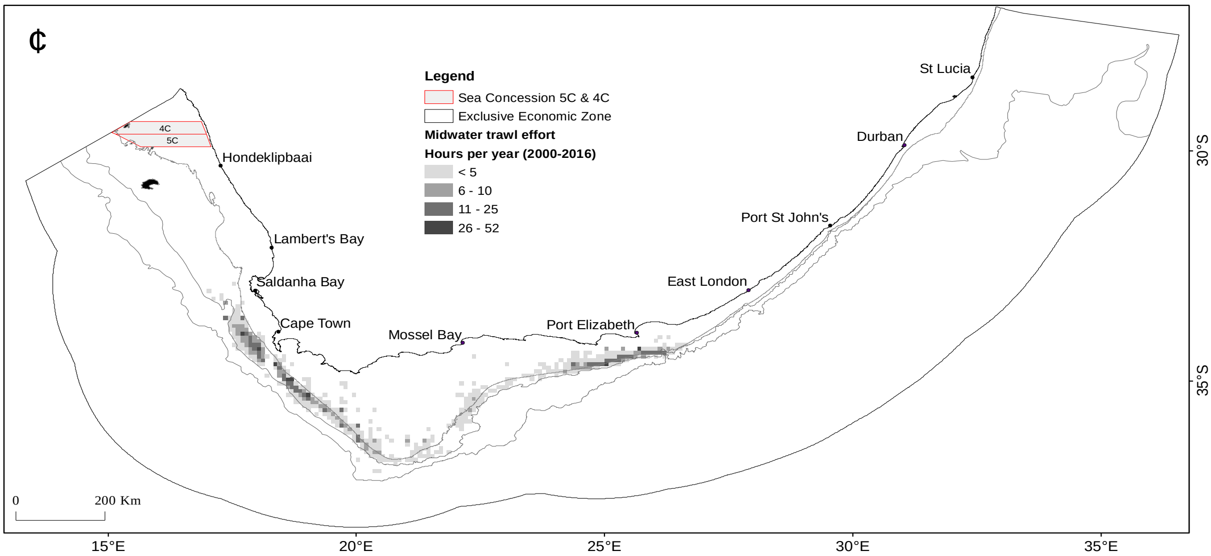

Figure 3.15: Overview of the spatial distribution of fishing effort expended by the mid-water trawl sector targeting horse mackerel within the South African EEZ and in relation to Sea Areas 4C and 5C.

3.3.4 SMALL PELAGIC PURSE-SEINE

The pelagic-directed purse-seine fishery targets adult sardine (*Sardinops sagax)* and anchovy (*Engraulis encrasicolus*). Right Holders may also target round herring (*Etrumeus whitheadi*) and meso pelagic species (Lantern and Lightfish combined) which have industry precautionary upper catch limits (PUCLs) – currently set at 100 000 t for round herring and 50 000 t for Lantern and Lightfish (combined). Bycatch species are mainly juvenile sardine, horse mackerel and chub mackerel. It is the largest South African fishery by volume (tons landed) and the second most important in terms of economic value. The wholesale value of catch landed by the sector during 2017 was R2.164 Billion, or 22% of the total value of all fisheries combined.

The total combined catch of anchovy, sardine and round herring landed by the pelagic fishery has decreased by 38% from 395 000 t in 2016 to just 243 000 t in 2021 (Figure 3.16). This is below both long-term (338 000 t) and short-term (294 000 t) averages. In 2019 and 2020, both the sardine and anchovy management procedures required "exceptional circumstances" due the low abundance levels. Refer to Figure 3.17 for the time-series of biomass estimates for anchovy, sardine and round herring from 1984 to 2020 (Coetzee *et al.*, 2020).

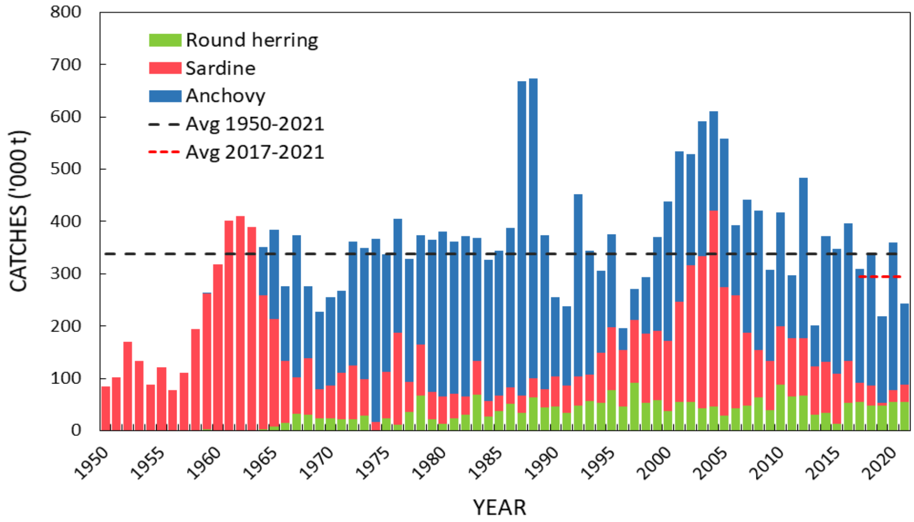

Figure 3.16: The annual combined catch of anchovy, sardine and round herring. Also shown is the average combined catch since the start of the fishery (1950-2021; black dashed line) and for the past five years (red solid line). Source DFFE, 2022.

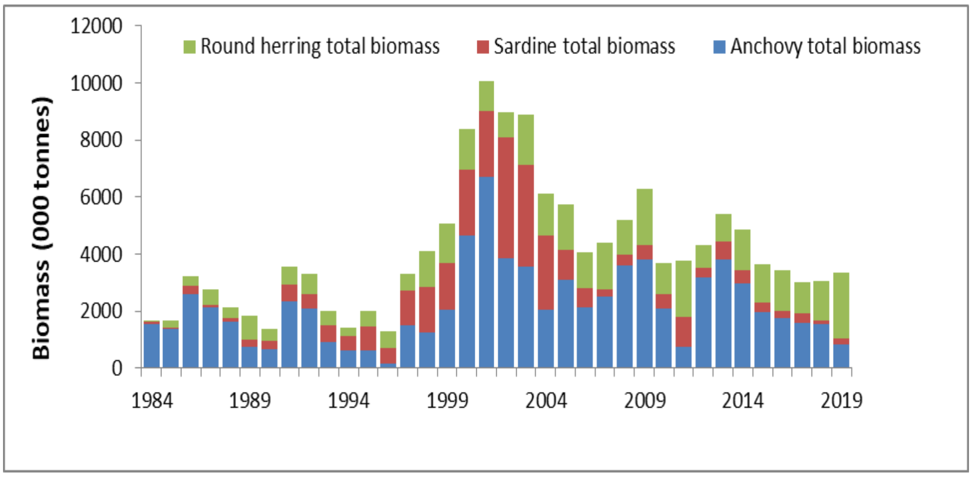

Figure 3.17: Biomass estimates of anchovy, sardine and round herring from the DFFE recruitment surveys from 1984 to 2020 (Source: Coetzee et al., 2020).

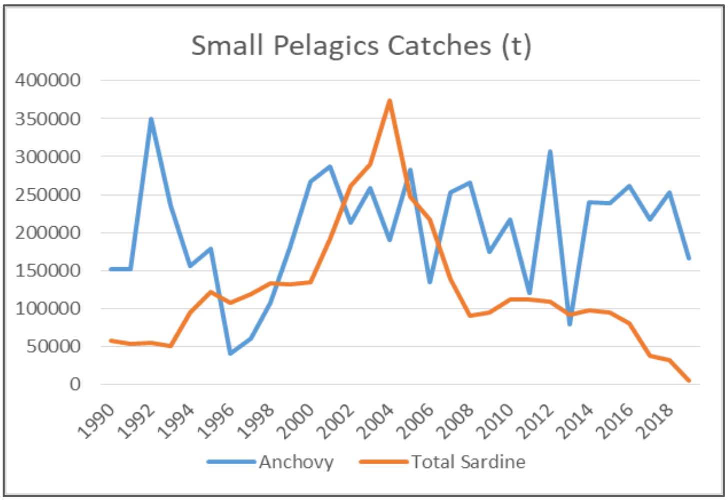

Figure 3.18: Graph showing catch of the main small pelagic species by the South African purse-seine fleet for the years 1990 to 2019.

The abundance and distribution of these small pelagic species fluctuates 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 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. Red-eye 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 **3.19**3.19 shows the species composition by month of landings over the period 2000 to 2016, as well as the average fishing effort by month.

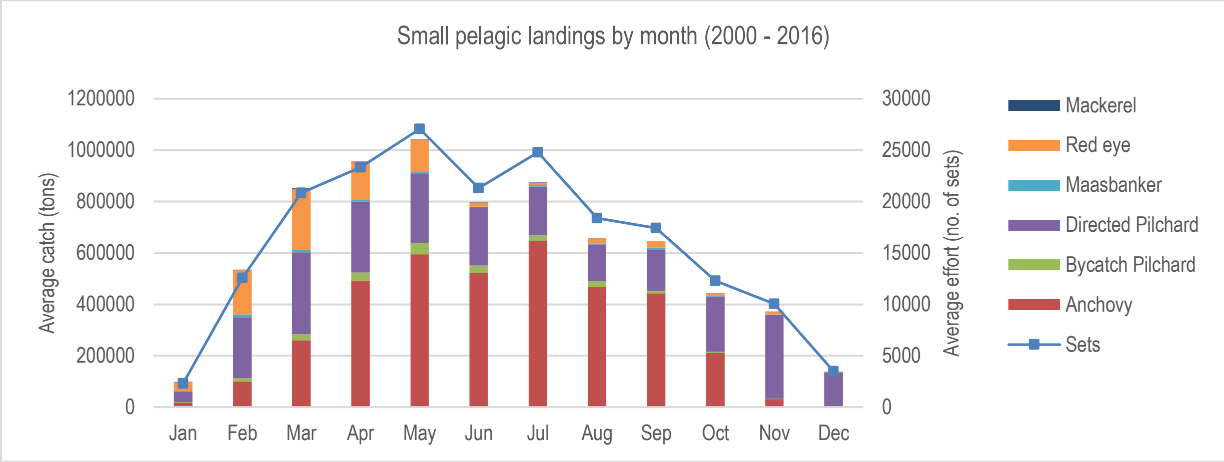

Figure 3.19: Graph showing average monthly catch (tons) and effort (number of sets) reported for the small purse-seine fleet over the period 2000 to 2016.

The fleet consists of approximately 64 wooden, glass-reinforced plastic and steel-hulled vessels ranging in length from 11 m to 48 m (J. de Goede, pers. comm, 2023). 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 (refer to Figure 3.20). 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.

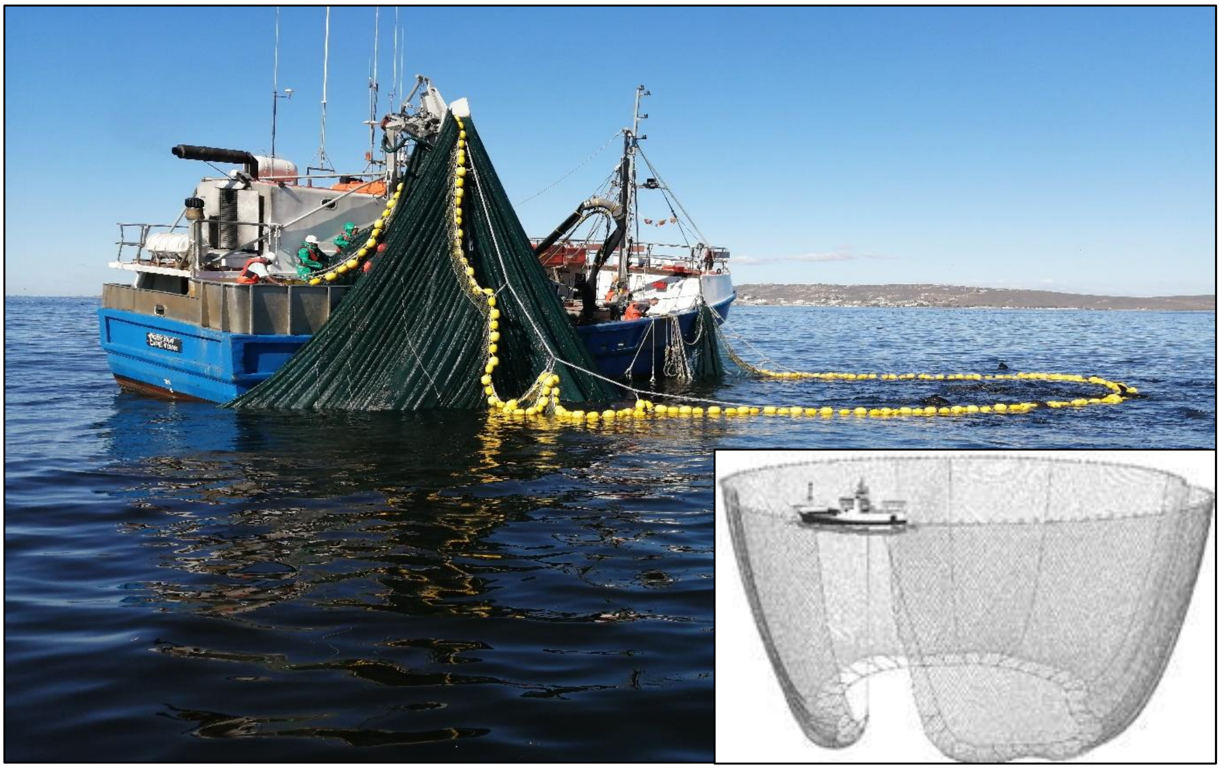

Figure 3.20: Photograph of a purse-seine vessel registered to fish for small pelagic species. Inset shows schematic diagram of typical configuration and deployment of a small pelagic purse-seine for targeting anchovy and sardine as used in South African waters.

Figure 3.21 shows the spatial extent of fishing grounds within the South African EEZ and Figure 3.22 shows grounds in relation to Sea Areas 4C and 5C.

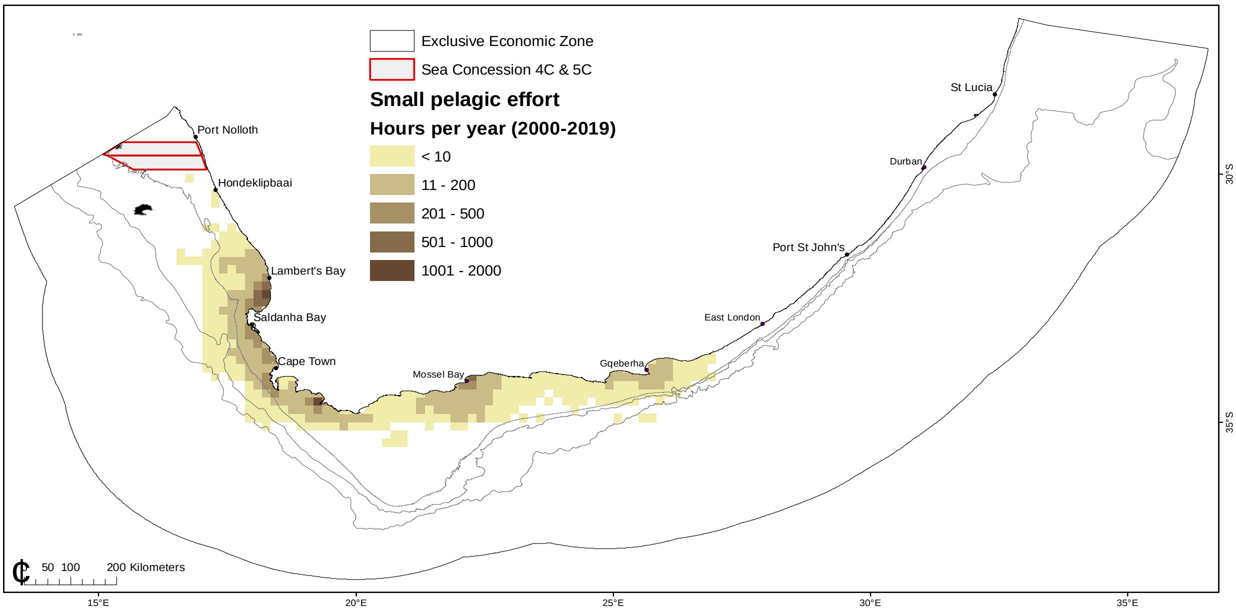

Figure 3.21: An overview of the spatial distribution of fishing effort reported by the purse-seine sector targeting small pelagic species over the period 2000 to 2019 within the South African EEZ and in relation to Sea Areas 4C and 5C.

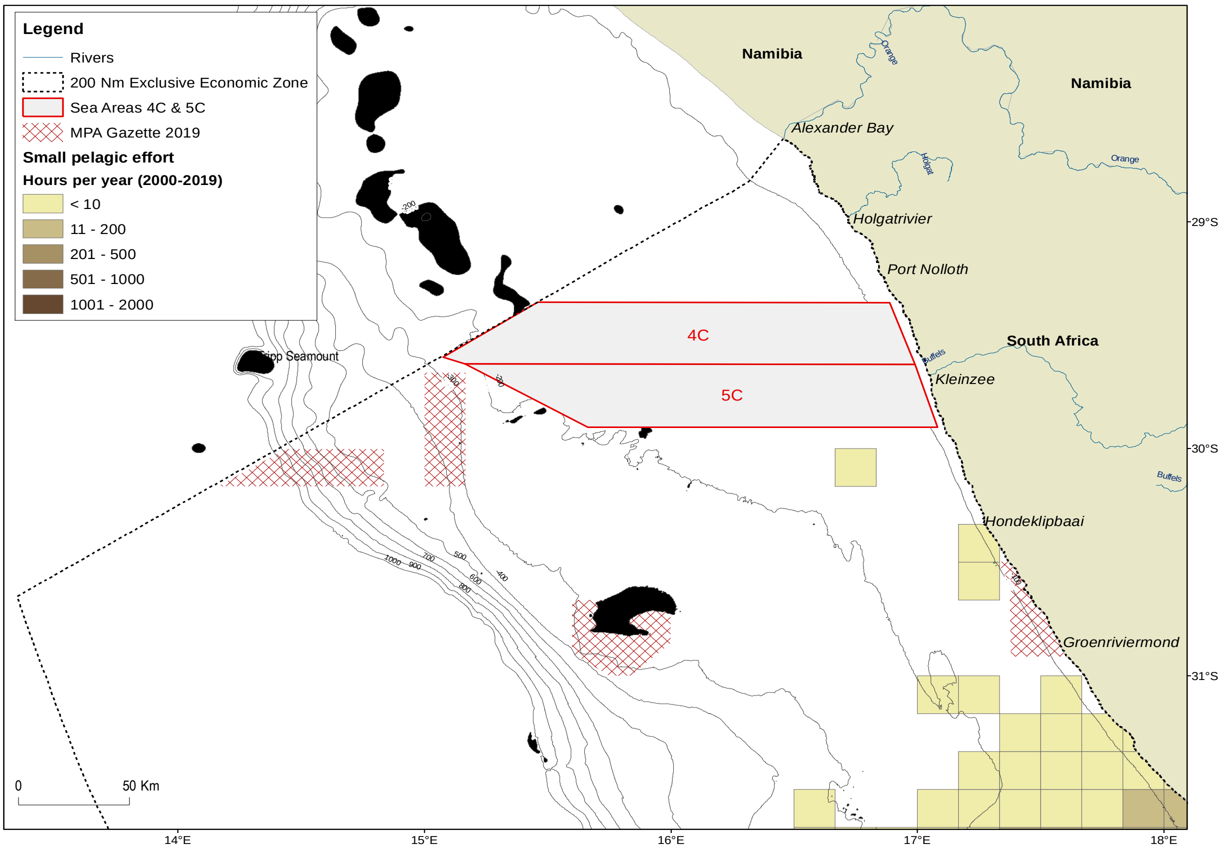

Figure 3.22: Spatial distribution of fishing grounds of the small pelagic purse-seine sector in relation to Sea Areas 4C and 5C. Fishing activity is reported by 10 x 10 nautical minute grid block and average annual effort is shown for the period 2000 to 2019.

The main fishing areas are situated at least 150 km south of the prospecting application area and there is no spatial overlap of Sea Areas 4C and 5C with the expected fishing activity of the small pelagic purse-seine sector.

The biomass of small pelagic species is assessed bi-annually by an acoustic survey. The first of these surveys is timed to commence in mid-May and runs until mid-June while the second starts in mid-October and runs until mid-December. The timing of the demersal and acoustic surveys is not flexible, due to restrictions with availability of the research vessel as well as scientific requirements. The surveys are designed to cover an extensive area from the Orange River on the West Coast to Port Alfred on the East Coast and the DFFE survey vessel progresses systematically from the Northern border Southwards, around Cape Agulhas and on towards the east. During these surveys the survey vessels travel pre-determined transects (perpendicular to bathymetric contours) running offshore from the coastline to approximately the 200 m isobath. There are a few occasions that the transects off Cape Point will just extend to about 1000 m, with the shelf being so narrow there and the offshore fish distribution being dictated by strong frontal features, there would be occasions where the survey would go even further offshore than the 1000 m. Figure 3.23 shows the abundance of anchovy recruits as measured in the most recent 2020 pelagic recruitment survey undertaken by DFFE. Figure 3.24 shows that up to five research survey transects are undertaken by DFFE within Sea Areas 4C and 5C.

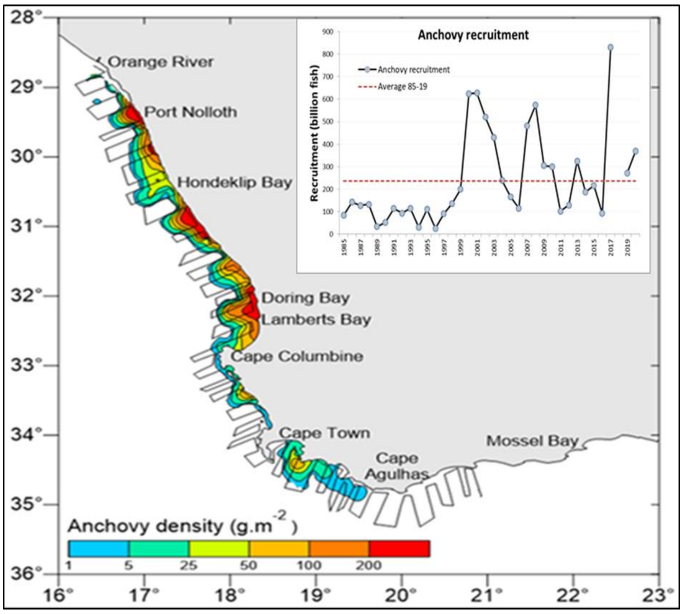

Figure 3.23: Recruitment survey results (May 2020) for anchovy and recruitment trend (inset). The red dotted line is the running average level of recruitment since 1985 and is used as one of the stock status indicators (information and figure provided by J. Coetzee and D. Merkel of DFFE).

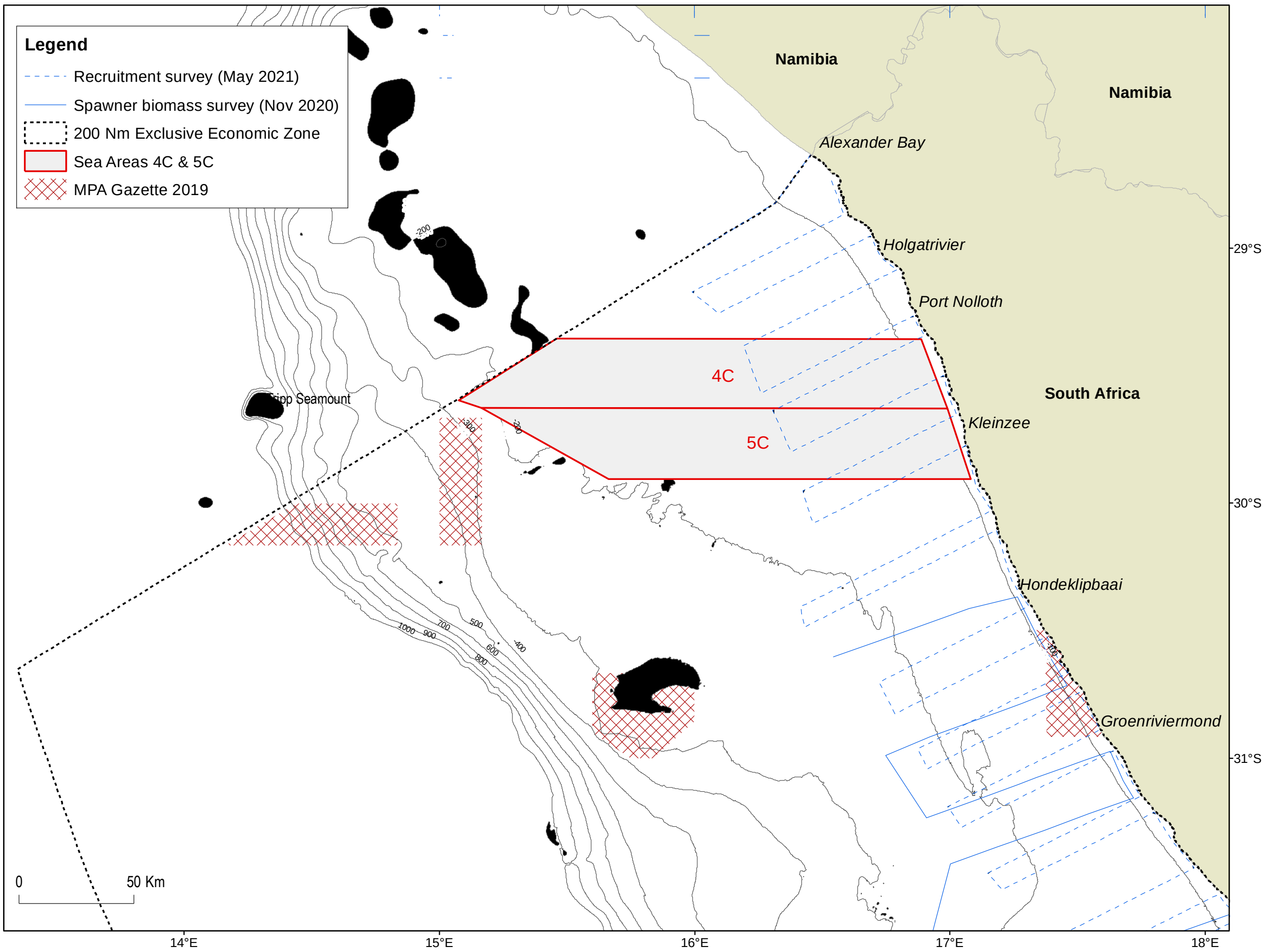

Figure 3.24: Spatial distribution of survey transects undertaken by DFFE during November 2020 and May 2021 during the research surveys of recruitment and spawner biomass of small pelagic species, respectively.

3.3.5 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 tonnes (2017) and 2815 tonnes (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 geophysical 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 3.25 below.

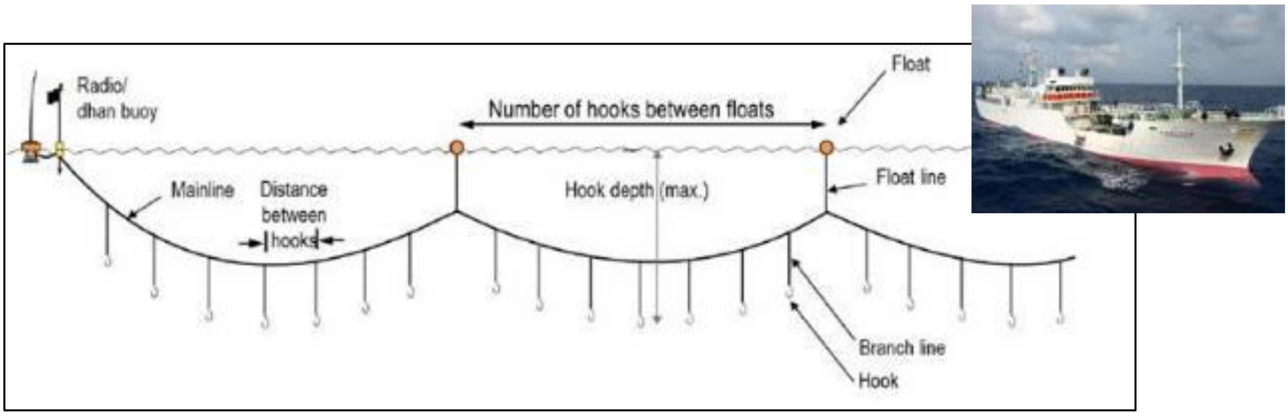

Figure 3.25: Schematic diagram showing typical configuration of long-line gear targeting pelagic species (left), and photograph of typical high seas longline vessel (upper right).

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 3.26. Catches landed by the South African fleet operating in the ICCAT region (i.e. off the West Coast) from 1998 – 2020 are shown in Figure 3.27. Eighteen vessels were active in 2018.

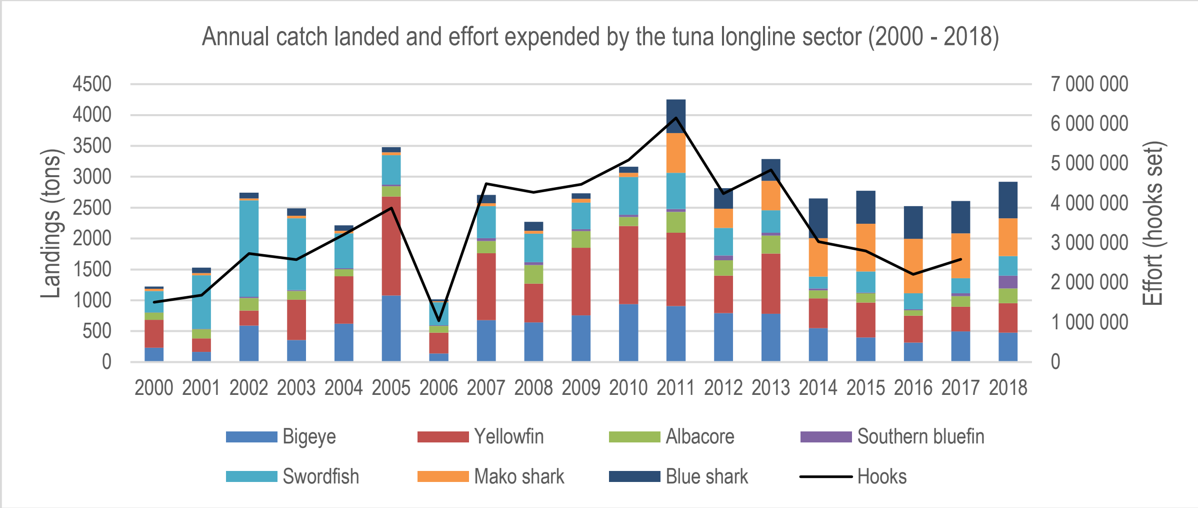

Figure 3.26: Inter-annual variation of catch landed and effort expended by the large pelagic longline sector in South African waters as reported to the two regional management organisations, ICCAT and IOTC (2000 – 2018).

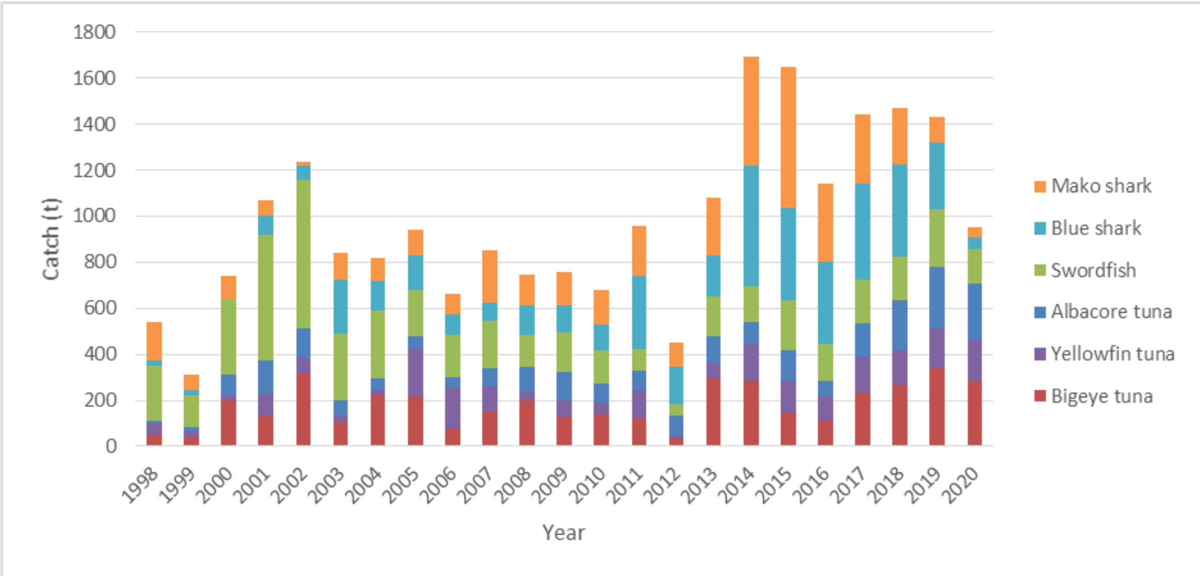

Figure 3.27: Inter-annual variation of catch landed by the large pelagic longline sector operating in the ICCAT region of South African waters (i.e. West of 20°E from 1998 – 2020).

Rights Holders in the large pelagic longline fishery are required to complete daily logs of catches, specifying catch locations, number of hooks, time of setting and hauling, bait used, number and estimated weight of retained species, and data on bycatch. The fishery operates extensively within the South African EEZ, primarily along the continental shelf break and further offshore (see Figure 3.28). Over the period 2000 to 2019, no fishing activity was reported within the prospecting application area and targeted areas were situated at least 50 km from the prospecting application area offshore of the 500 m bathymetric contour. The Namibian fleet of large pelagic longline vessels are permitted to target pelagic shark species in addition to tuna and therefore also operate inshore of the shelf break. The Namibian fleet would be expected to operate offshore of the 200 m depth contour adjacent to the South African maritime border and Sea Area 4C.

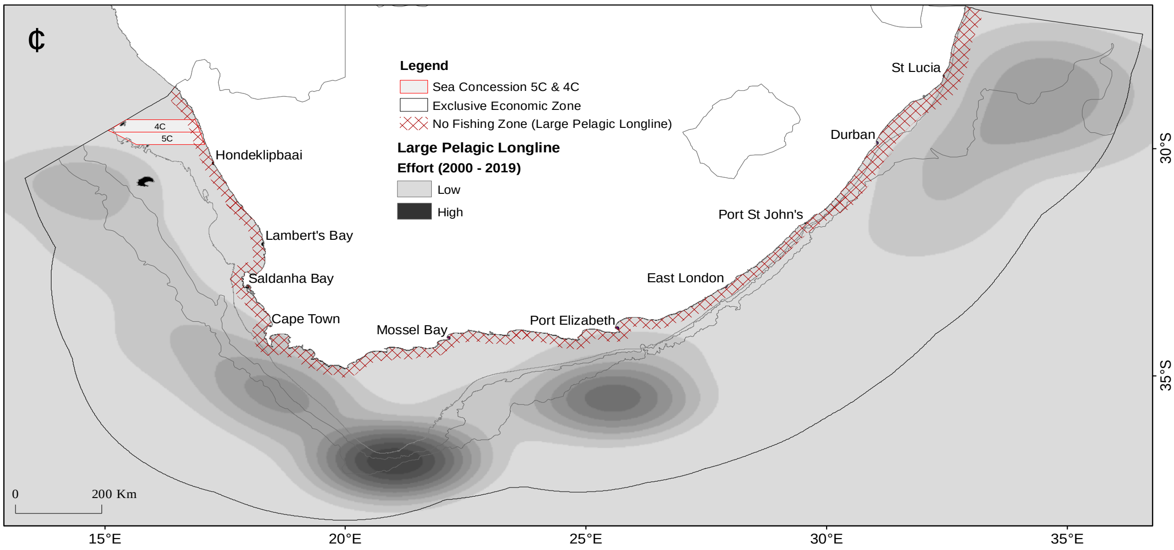

Figure 3.28: An overview of the spatial distribution of fishing effort expended by the longline sector targeting large pelagic fish species in the South African EEZ.

The spatial distribution of catch by both the Namibian and South African pelagic longline fleets is shown in Figure 3.29. Catch by reported fishing position is shown in the vicinity of the prospecting application area at a grid resolution of 10 by 10 nautical miles.

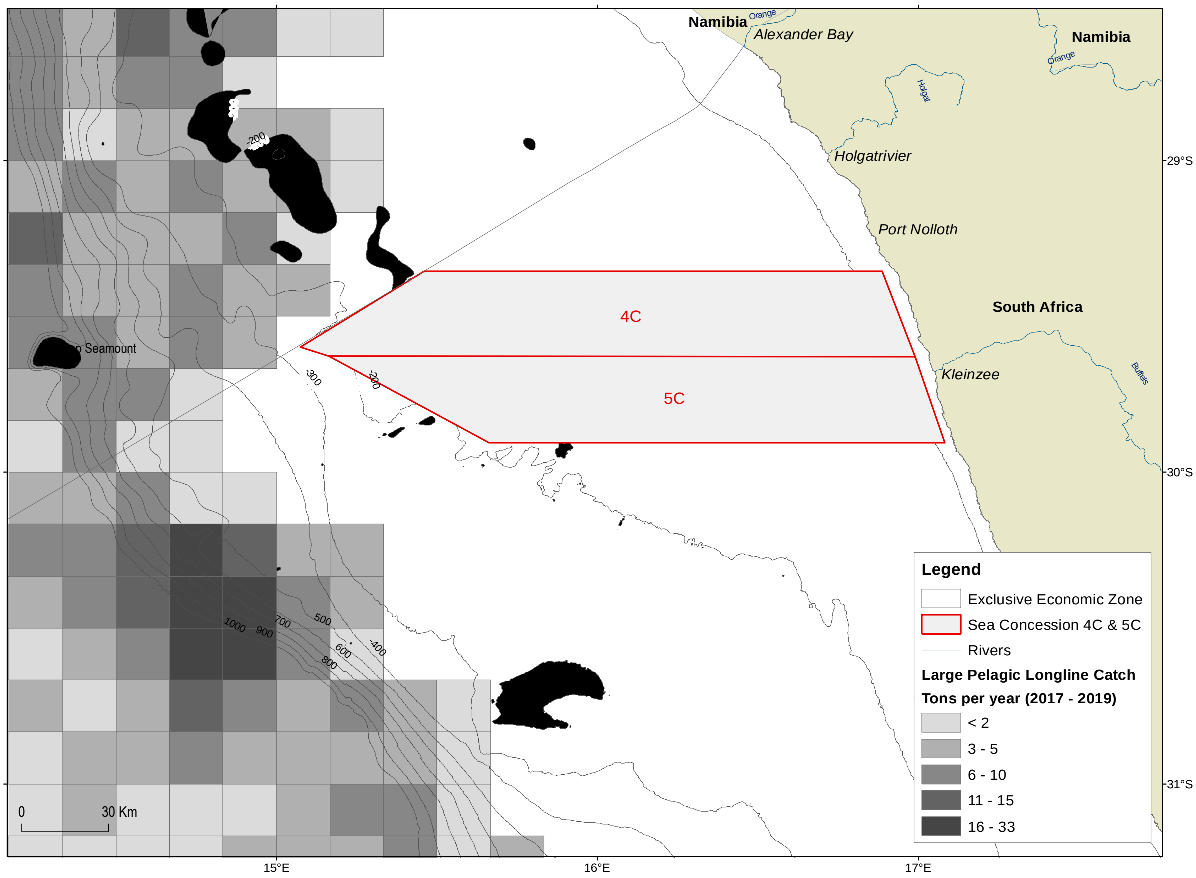

Figure 3.29: Spatial distribution of catch reported by the Namibian and South African longline sectors targeting large pelagic fish species in relation to Sea Areas 4C and 5C. (Note that the Prospecting Right area excludes the Namaqua Fossil Forest Marine Protected Area located in Sea Area 4C).

3.3.6 POLE-AND-LINE (TUNA POLE)

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

The reported wholesale value of the fishery in 2018 was R124 Million in 2018, or 1.2% of the total value of all fisheries combined. Landings of albacore in 2020 amounted to 3941 tons. A historical time series of catch and effort reported by the South African sector operating within the Atlantic region is shown in Table 3.4 and Figure 3.30. The total effort of 4131 catch days within the ICCAT convention area in 2019 represents an increase in effort of 9% compared to 2018.

Table 3.4: Total number of fishing days (effort), active vessels and total catch (t) of the main species caught by tuna pole vessels in the ICCAT region (West of 20E), 2008 – 2020 (ICCAT, 2022).

	Total Effort		Catch (t)			
Year	Fishing days	Active vessels	Albacore	Yellowfin tuna	Bigeye tuna	Skipjack tuna
2008	3052	115	2083	347	8	4
2009	4431	123	4586	223	17	4
2010	4408	116	4087	177	8	1
2011	5001	118	3166	629	15	5
2012	5157	123	3483	162	12	8
2013	4114	107	3492	374	142	3
2014	4416	95	3620	1351	50	5
2015	4738	91	3898	885	57	2
2016	4908	98	2001	599	10	2
2017	3062	92	1640	235	22	7
2018	3751	92	2353	242	14	2
2019	4131	91	2190	378	91	2
2020	3975	97	3941	534	71	1

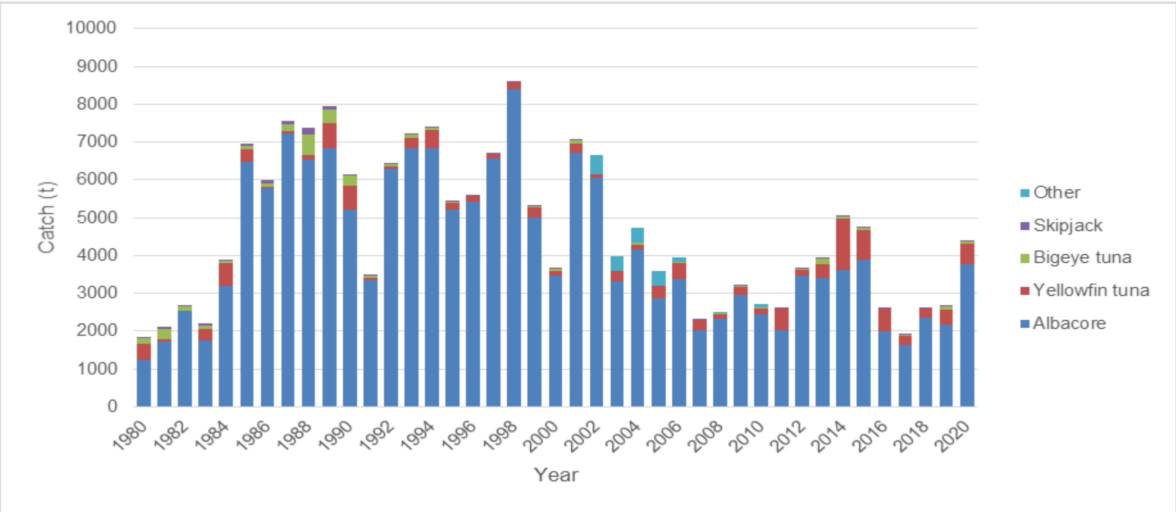

Figure 3.30: Catches (tons) of pelagic species by the South Africa pole-line ("Baitboat") fleet between 1980 and 2020 (ICCAT, 2022).

The active fleet consists of approximately 92 pole-and-line vessels (also referred to as “baitboat”), which are based at the ports of Cape Town, Hout Bay and Saldanha Bay. Vessels normally operate within a 100 nm (185 km) radius of these locations with effort concentrated in the Cape Canyon area (South-West of Cape Point), and up the West Coast to the Namibian border with South Africa.

Vessels are typically small (an average length of 16 m but ranging up to 25 m). Catch is stored on ice, refrigerated sea water or frozen at sea and the storage method often determines the range of the vessel. Trip durations average between four and five days, depending on catch rates and the distance of the fishing grounds from port. Vessels drift whilst attracting and catching shoals of pelagic tunas. Sonars and echo sounders are used to locate schools of tuna. Once a school is located, water is sprayed outwards from high-pressure nozzles to simulate small baitfish aggregating near the water surface. Live bait is then used to entice the tuna to the surface (chumming). Tuna swimming near the surface are caught with hand-held fishing poles. The ends of the poles are fitted with a short length of fishing line leading to a hook. In order to land heavier fish, lines may be strung from the ends of the poles to overhead blocks to increase lifting power (see Figure 3.31).

Figure 3.31: Schematic diagram of pole and line operation (Source: http://www.afma.gov.au/portfolio-item/minor-lines).

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

Fishing activity for tuna occurs along the entire West Coast beyond the 200 m bathymetric contour, along the shelf break with favoured fishing grounds including areas north of Cape Columbine and between 60 km and 120 km offshore of Saldanha Bay. Snoek-directed fishing activity is coastal and seasonal in nature – taking place inshore of the 100 m depth contour during the period March to July.

Figure 3.32 shows the location of fishing activity within the South African EEZ and in relation to Sea Areas 4C and 5C. Fishing records received from DFFE over the reporting period 2007 to 2019 indicate that tuna-directed fishing does not take place within the prospecting application area (see Figure 3.33). Over the period 2017 to 2019, an average of 14 fishing events were reported having taken place within the prospecting application area yielding 48 tonnes of snoek. This is equivalent to 0.53% of the overall effort expended by the pole-and-line sector (inclusive of offshore fishing activity targeting albacore tuna) and 6.97% of the snoek catch landed by the sector.

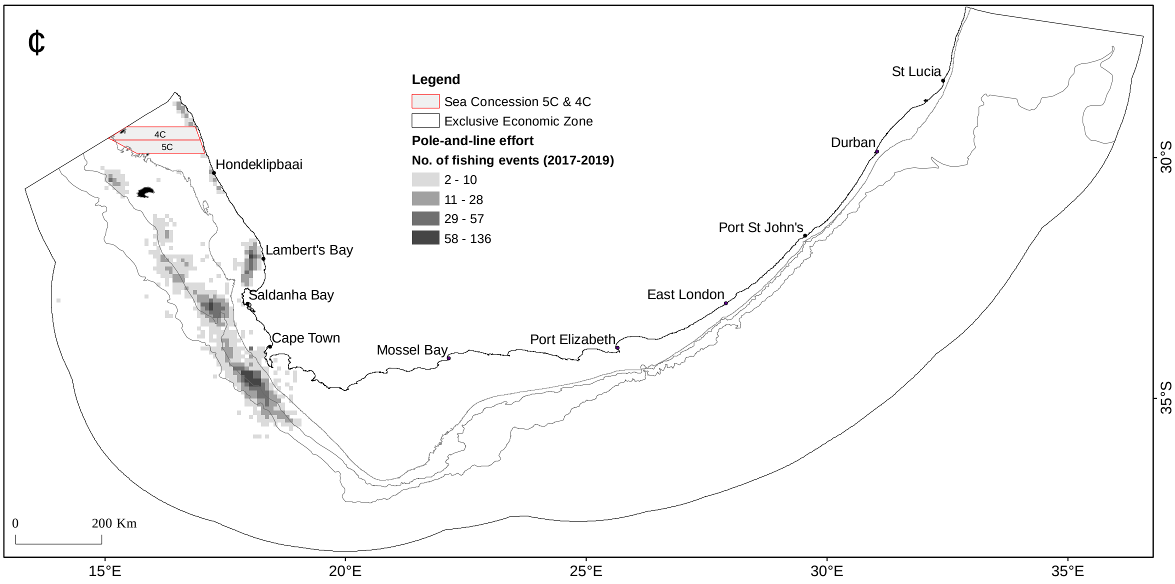

Figure 3.32: An overview of the spatial distribution of fishing effort expended by the pole-and-line sector targeting pelagic tuna and snoek within the South African EEZ and in relation to Sea Areas 4C and 5C.

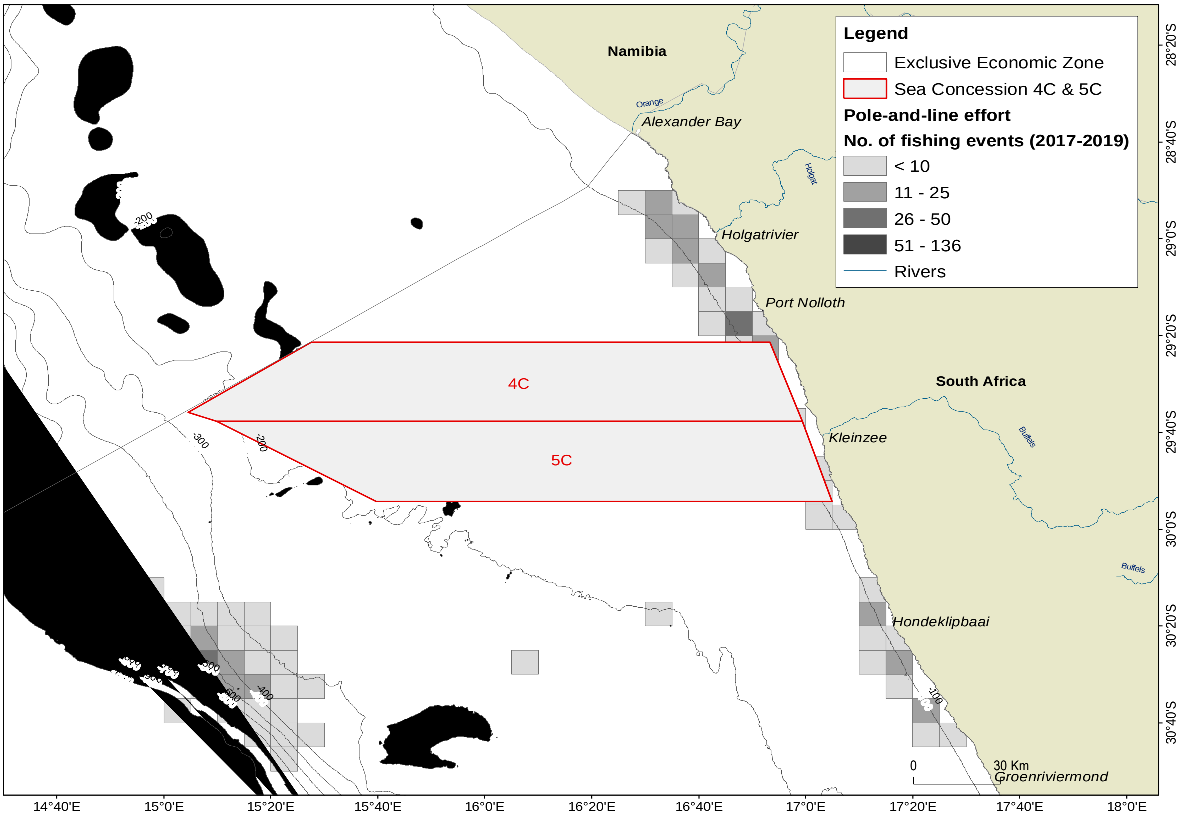

Figure 3.33: An overview of the spatial distribution of fishing effort expended by the pole-and-line sector targeting pelagic tuna and snoek in relation to Sea Areas 4C and 5C. (Note that the Prospecting Right area excludes the Namaqua Fossil Forest Marine Protected Area located in Sea Area 4C).

3.3.7 COMMERCIAL OR TRADITIONAL LINEFISH

The commercial linefish sector is one of the oldest fisheries in South Africa and has its origins from the recreational sector. Essentially recreational line-fishers commercialised resulting in a systematic decline in the "linefish" stocks. The Minister of Fisheries in the 1980's reformed the sector. This was done by creating a smaller commercial linefish sector, as well as introducing a moratorium on the exploitation of many species that were collapsed or near collapse. The commercial linefish sector now only allows a limited number of key species to be exploited using hook and line, but excludes the use of longlines[4]. Target species of the linefishery include temperate, reef-associated seabreams (e.g. carpenter, hottentot, santer and slinger), coastal migrants (e.g. geelbek and dusky kob) and nomads (e.g. snoek and yellowtail). More than 90% of the current linefish catch is derived from the aforementioned eight species and almost all of the traditional line fish catch is consumed locally. Table 3.5 lists the catch of important linefish species for the years 2010 to 2021.

Table 3.5: Annual catch (t) of the eight most important linefish species for the period 2010 to 2021 (DFFE, 2022).

Year	Snoek	Yellowtail	Kob	Carpenter	Slinger	Hottentot seabream	Geelbek	Santer	Total catch
2010	6360	171	419	263	180	144	408	69	13688
2011	6205	204	312	363	214	216	286	62	12530
2012	6809	382	221	300	240	160	337	82	11855
2013	6690	712	157	481	200	173	263	84	9142
2014	3863	986	144	522	201	192	212	74	6849
2015	2045	594	121	519	175	142	238	68	4421
2016	1643	474	133	690	211	209	246	65	4289
2017	2055	377	111	844	218	204	158	74	4391
2018	2089	654	213	723	173	213	214	68	5304
2019	1879	439	454	604	215	188	132	78	N/A*
2020	2356	548	635	533	183	222	158	66	N/A*
2021	2747	239	352	441	186	151	88	64	N/A*

Figure 3.34 shows the variability in catches of the eight most importance species by the linefish sector over the period 1985 to 2021. In 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).

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

[4] To distinguish between line fishing and long-lining, line fishers are restricted to a maximum of 10 hooks per line.

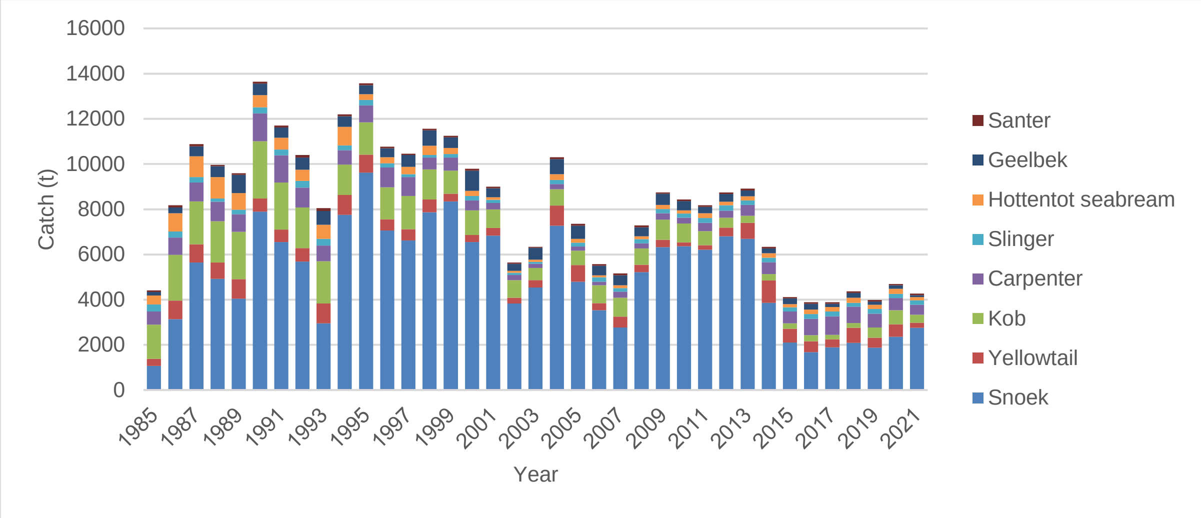

Figure 3.34: Annual catch (t) of the eight most important linefish species for the period 1985-2021 (DFFE, 2022).

Figure 3.35: Fishermen landing snoek on board a vessel operating in the traditional linefishery (photo credit Jaco Barendse).

The traditional commercial line fishery is a relatively low-cost and labour-intensive industry, and important from an employment and human livelihood point of view. Although the commercial linefishery has the largest fleet, it contributes only 6% of the total estimated value of all South African marine fisheries (DFFE, 2020). In 2017, the wholesale value of catch was reported as R122.1 million. Annual catches prior to the reduction of the commercial effort were estimated at 16 000 tons for the traditional commercial line fishery. The fishery is widespread along the country's shoreline from Port Nolloth on the West Coast to Cape Vidal on the East Coast. 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. Effort is managed geographically with the spatial effort 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. Sea Areas 4C and 5C fall within Zone A.

The commercial line fishery is a nearshore boat-based activity which is currently managed through a total allowable effort (TAE) allocation, based on boat and crew numbers. The number of rights holders[5] is currently 425. For the 2021/2022 fishing season, 325 vessels were apportioned to commercial fishing, whilst 122 vessels apportioned to small-scale fishing[6] (refer to Section 3.3.10).

A standard vessel is defined as a vessel that can carry a crew of 7. Vessels with a maximum length overall of 10 m and a maximum crewing capacity of 12, including the skipper. The maximum standard vessel allocation for the commercial linefishery within the three management Zones (2021/2022) is 340 vessels for Zone A (Port Nolloth to Cape Infanta), 64 vessels for Zone B (Cape Infanta to Port St Johns) and 51 vessels for Zone C (KwaZulu-Natal). Table 3.6 lists the annual Total Allowable Effort (TAE) and activated effort per linefish management zone from 2007 to 2019.

Table 3.6: Annual total allowable effort (TAE) and activated commercial linefish effort per management zone from 2010 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
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

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. Operating ranges vary but most of the activity is conducted within 15 km of a launch site.

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

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

This fishery's operational footprint may at times be limited by operating costs and is sensitive to local reports of fish availability. Figure 3.36 shows the spatial extent of traditional linefish grounds at a national scale and Figure 3.37 shows catch in relation to Sea Areas 4C and 5C. Vessels operate from Port Nolloth, Doring Bay and Hondeklipbaai and fishing activity is directed in waters shallower than 100 m and in proximity to these launch sites. Records over the period 2017 to 2019 show that fishing activity within this area is seasonal – March to September – and that catches are exclusively snoek[7].

Due to the largely informal nature of the snoek fishery, a TAE approach has been used to manage the sector, which places constraints on the maximum level of fishing effort that can be applied to a fish stock during a specific period through limitations on the total number of vessels permitted in the sector, size of the vessel (maximum length 10 m), number of crew members per vessel, and geographic zone(s) which can be fished. In 2019, 340 rights were allocated for the area Port Nolloth to Cape Infanta with 218 rights activated. Besides the economic importance of direct landings to fishing communities, snoek provides indirect benefits through a combined formal and informal value chain, where snoek is processed and sold in different forms. Snoek reaches consumers through retail outlets supplied by large hawkers and processors or directly through small hawkers.

Fishing effort has not been reported within the prospecting application area; however approximately 57.8 tonnes per year were reported in the vicinity of Doring Bay and Port Nolloth combined and 0.7 tonnes per year off Hondeklipbaai. Note that the 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, reporting complexities and also the unwillingness of local fisherman to share fishing locations, inaccuracies in the spatial representation are to be expected. Although there is no evidence from the DFFE dataset of fishing having taken place within the prospecting application area, vessels could be expected to range to a distance of 15 km from the launch sites of Doring Bay, Port Nolloth and Hondeklipbaai and fishing activity within the inshore portions of the prospecting application area is possible.

[7] Snoek are regarded as mesopelagic predators and are found from the surface to depths of ~550m. In southern Africa, snoek has been known to occur from northern Angola to Algoa Bay but is mostly concentrated along the West Coast within the Benguela Ecosystem (Isaacs 2013). Snoek is the main predator for anchovy and sardine, placing direct top-down control on prey species and indirectly on populations which anchovy and sardine feed upon (mainly zooplankton), and forms a vital fishery sector in South Africa. Therefore, they are important from both an ecological and fisheries perspective. The spatial distribution of snoek is highly variable with fish moving between the inshore and offshore, depending on the season, spawning characteristics and availability of prey items. It is widely accepted that snoek populations within the Benguela ecosystem comprise a single population and undergo a seasonal longshore migration, moving southwards to South Africa from southern Angola waters to spawn before returning north (Isaacs 2013). Spawning occurs during winter when most exploitation within fisheries occurs, and populations return to southern Angola in Spring. However, work by Griffiths (2002) has shown that adult snoek is targeted by commercial line fishermen throughout the year, and instead availability of snoek in trawling grounds is seasonal as a result of spawning migrations. Therefore, the results of Griffiths (2002) suggest that snoek comprises two subpopulations, with limited interaction and exchange. Additionally, the results from ovarian analysis and migration patterns show that snoek spawn between 150- and 400-m isobaths of the western Agulhas Bank. The northward flow of the Benguela current acts as a transport vector for epipelagic snoek eggs and larvae from spawning grounds to nursery areas north of Cape Columbine and to the east of Danger Point, where juveniles remain until mature (growing between 33 and 44 cm). The distribution of juveniles within nursery areas is largely determined by prey availability, with a seasonal inshore migration in autumn due to the recruitment of clupeoid. Although longshore movement has been noted to occur during spawning season, there is no evidence connecting the movement to seasonal components and is thought to be random.

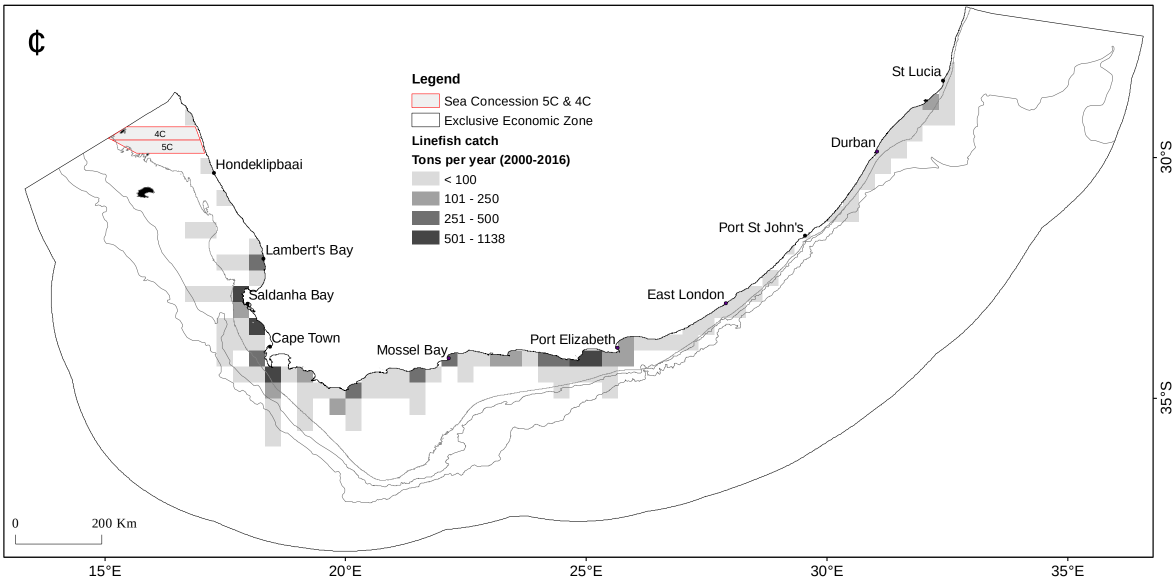

Figure 3.36: An overview of the spatial distribution of catch taken by the traditional linefish sector in the South African EEZ and in relation to Sea Areas 4C and 5C.

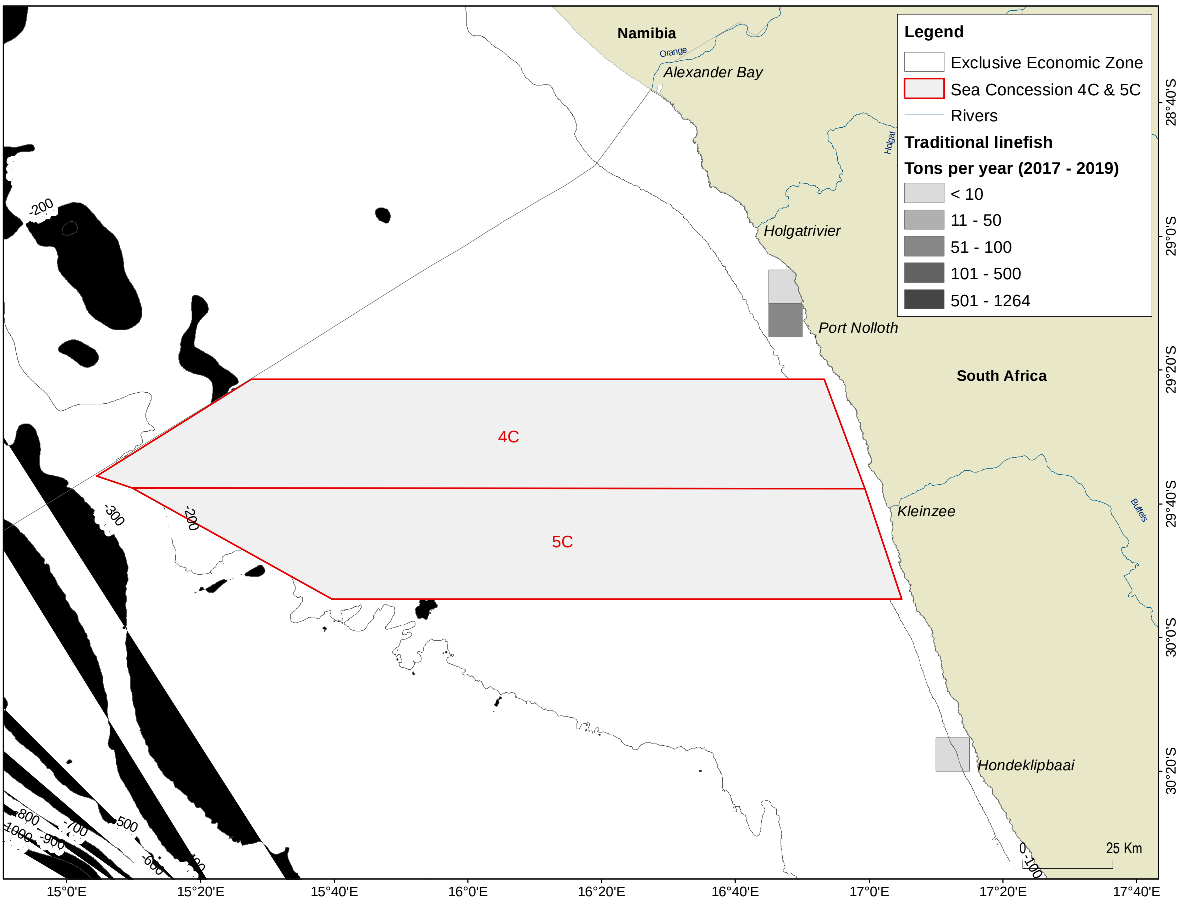

Figure 3.37: Spatial distribution of catch taken by the line-fish sector in relation to Sea Areas 4C and 5C. (Note that the Prospecting Right area excludes the Namaqua Fossil Forest Marine Protected Area located in Sea Area 4C).

3.3.8 WEST COAST ROCK LOBSTER

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

The fishery Is comprised of four sub-sectors – commercial offshore, commercial nearshore, small-scale and recreational, all of which have to share from the same national TAC. The 2021/22 TAC was set at 600 tonnes and apportionment of TAC by sub-sector is listed in Table 3.7. The TAC for the 2021/2022 fishing season was reduced by 28% from the previous fishing season (2020/2021). The updated stock assessment for the resource has indicated that it is further depleted than was thought to be the case two years ago, and poaching[8] is one of the major contributors to the recently exacerbated depleted status of the resource. The resource has over recent decades been at about 2.5% of the pristine level, but that over the last few years this had dropped to about 1.5%. Annual TAC and average monthly landings over the period 2006 to 2020 are shown in Figures 3.38 and Figure 3.39, respectively. A historical time-series of TACs and landings is listed in Table 3.8.

Table 3.7: Apportionment of TAC of rock lobster by sub-sector (DEFF, 2021).

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

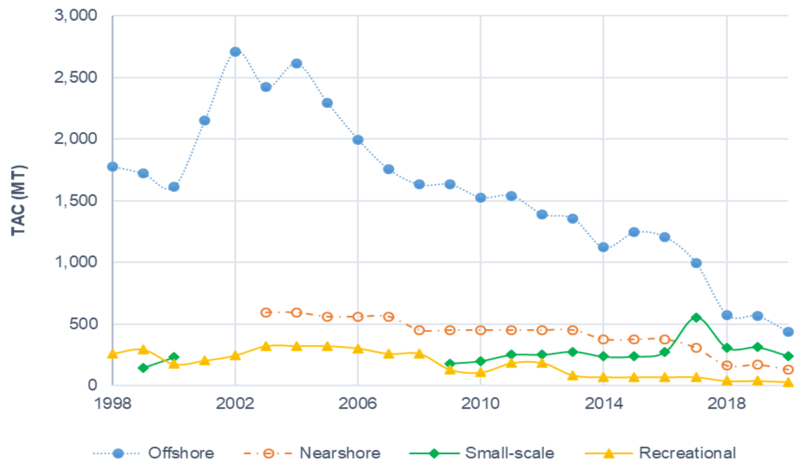

Figure 3.38: Graph showing the total allowable catch (TAC) of west coast rock lobster.

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

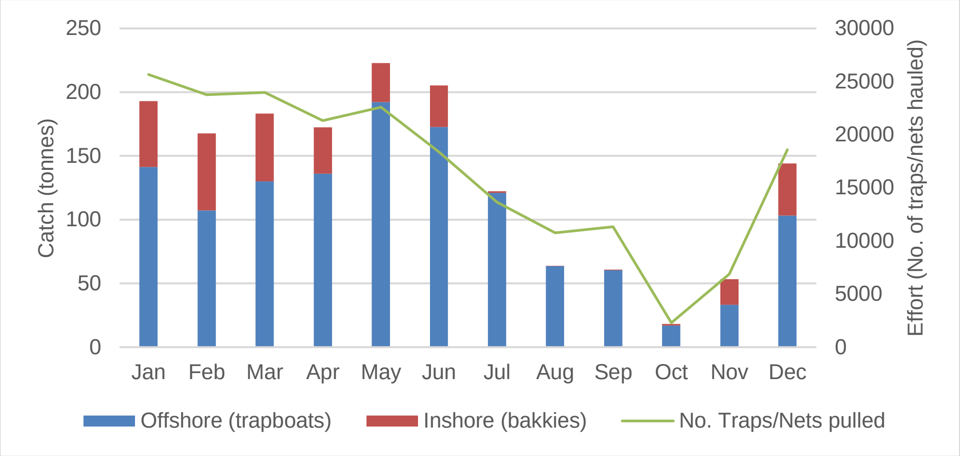

Figure 3.39: Graph showing the average monthly catch (tonnes) and effort (number of traps hauled) reported by the offshore (trapboat) and inshore (bakkie) rock lobster sectors over the period 2006 to 2020.

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
1999/00	2 156	1720		145	291	2152
2000/01	2 018	1614		230	174	2154
2001/02	2 353	2151		[1]	202	2410
2002/03	2 957	2713		[1]	244	2706
2003/04	3 336	2422	594	[1]	320	3258
2004/05	3 527	2614	593	[1]	320	3222
2005/06	3 174	2294	560	[1]	320	2291
2006/07	2 857	1997	560	[2]	300	3366
2007/08	2 571	1754	560	[2]	257	2298
2008/09	2 340	1632	451	[2]	257	2483
2009/10	2 393	1632	451	180	129	2519
2010/11	2 286	1528	451	200	107	2208
2011/12	2 426	1541	451	251	183	2275
2012/13	2 276	1391	451	251	183	2308
2013/14	2 167	1356	451	276	83	1891
2014/15	1 800	1120	376	235	69	1688
2015/16	1 924	1243	376	235	69	1524
2016/17	1 924	1204	376	274	69	1564
2017/18	1 924	994	305	554	69	1355
2018/19	1 084	564	170	170	39	
2019/20	1 084	564	170	170	39	
2020/21	837	436	131	131	30	
2021/22	600	301	101	101	22	

[1] No Interim Relief allocated / [2] Interim Relief accommodated under Recreational allocation

The resource is managed geographically, with TACs set annually for different management areas. The commercial and small-scale fishing sectors are authorised to undertake fishing for four months in each management zone therefore closed seasons are applicable to different management zones. The start and end dates for the 2021/22 fishing season per sector and zone are shown in Table 3.9.

Table 3.9: Start and end dates for the fishing season 2021/22 by management zone. Special Project Report on the review of the TAC for West Coast Rock Lobster for the 2021/22 fishing season by the Consultative Advisory Forum for Marine Living Resources.

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

The commercial offshore sector operates at a depth range of approximately 30 m to 100 m, making use of traps consisting of rectangular metal frames covered by netting. These traps are set at dusk and retrieved during the early morning. Approximately 138 vessels participate in the offshore sector. The commercial nearshore sector makes use of hoop nets to target lobster at discrete suitable reef areas along the shore at a water depth of up to 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 3.40. The five super-areas are: areas 1–2, corresponding to zone A; areas 3–4, to zone B; areas 5–6, to zone C; area 7, being the northernmost area within zone D; and area 8+, comprising area 8 of zone D as well as zones E and F.

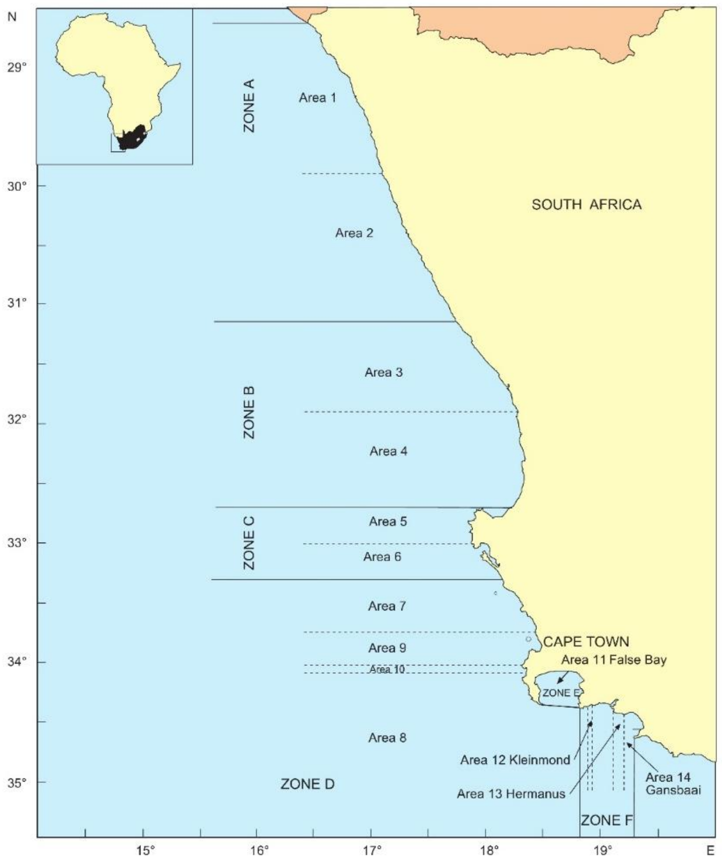

Figure 3.40: West Coast rock lobster fishing zones and areas. The five super-areas are: areas 1–2, corresponding to zone A; areas 3–4, to zone B; areas 5–6, to zone C; area 7, being the northernmost area within zone D; and area 8+, comprising area 8 of zone D as well as zones E and F.

As there is currently no commercial offshore fishing permitted within Management Areas 1 and 2, the proposed project activities would not coincide with areas targeted by the offshore commercial sub-sector.

Figure 3.41 shows the spatial distribution of fishing effort expended by the nearshore commercial sub-sector in the vicinity of the prospecting application area over the period 2006 to 2016. The prospecting application area is situated offshore of rock lobster management zone 1 (Port Nolloth) and management zone 2 (Hondeklipbaai). Over the period 2005 to 2016, the nearshore sector reported an annual average of 742 nets set and 2.7 tonnes of lobster caught within the management areas adjacent to the prospecting application area. The amount of catch and effort reported within the area amounted to 0.7% and 1.4%, respectively, of the total national landings and overall effort expended by the nearshore sub-sector. A fleet of small dinghies/bakkies target lobster at discrete suitable reef areas along the shore at a water depth of up to 15 m. Fishing activity is expected to only be outside of the prospecting right application area, within 1.5 km of the nearshore boundary of the prospecting application area. Management zones 1 and 2 have a seasonal operational window from 15 October to 15 February.

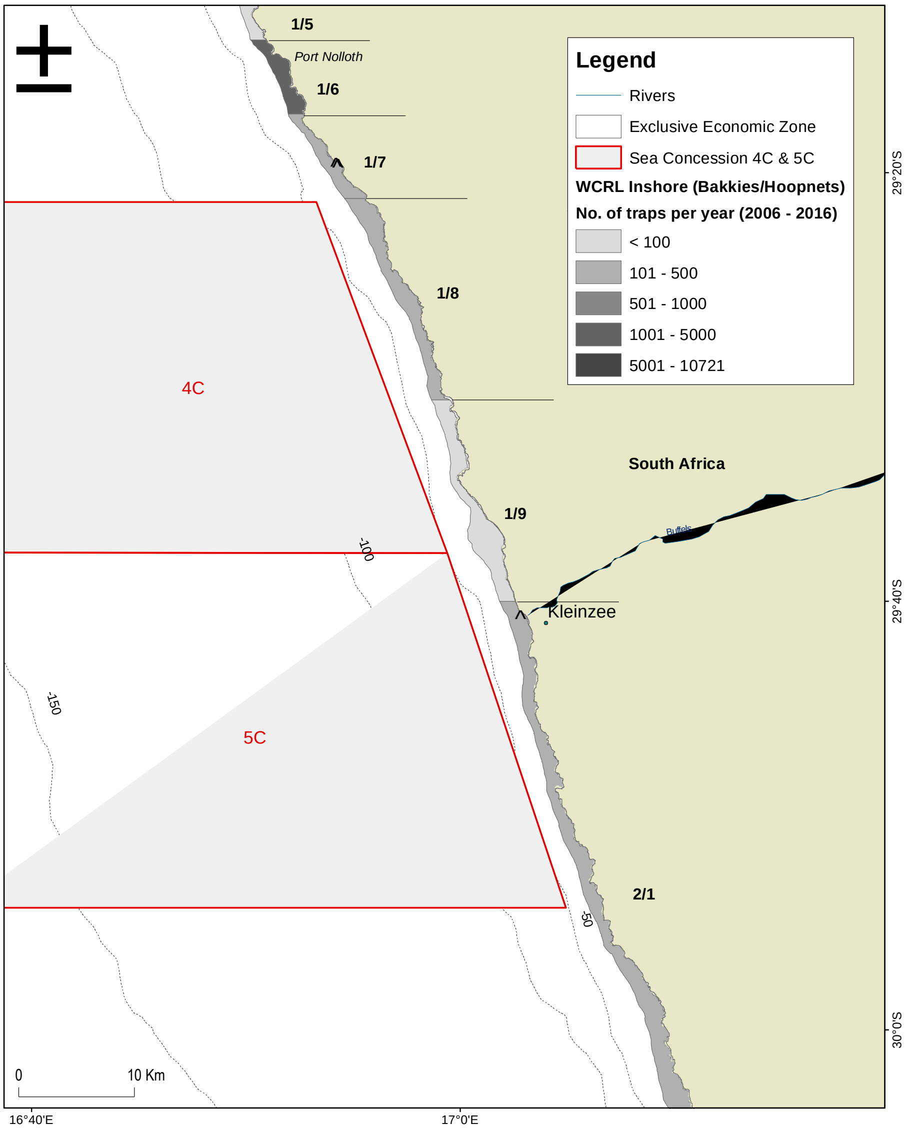

Figure 3.41: Spatial distribution of fishing effort expended by the west coast rock lobster inshore (bakkies/hoopnets) sector in relation to Sea Areas 4C and 5C. Lobster management zones are demarcated and labelled. Bathymetric contours shown are 50 m, 100 m and 150 m. (Note that the Prospecting Right area excludes the Namaqua Fossil Forest Marine Protected Area located in Sea Area 4C).

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 3.38). 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 3.42: 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). Bannister (1991) defines marine ranching (reseeding) as “Identifiable stock released with the intention of being harvested by the releasing agency” (Government Gazette, 2010 No. 33470). Translocation 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 DFFE issued rights for each of four Concession Area Zones (refer to Figure 3.43).

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. Sea Area 4C coincides with Zone 2 and Sea Area 5C coincides with Zone 3 (refer to Figure 3.43). As the maximum depth of seeding is considered to be approximately 10 m, which this lies inshore of the prospecting right area, the proposed area of operations within the prospecting application area would not coincide with abalone seeding areas.

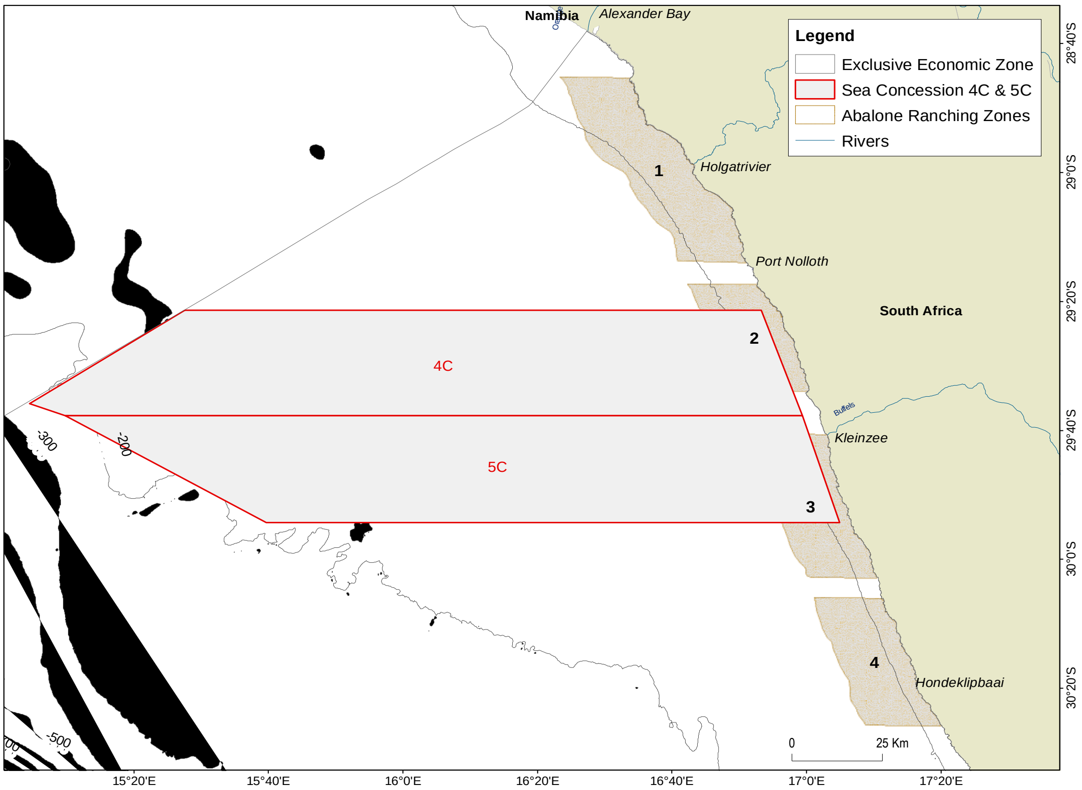

Figure 3.43: An overview of the spatial distribution of abalone ranching concession areas in relation to Sea Areas 4C and 5C. (Note that the Prospecting Right area excludes the Namaqua Fossil Forest Marine Protected Area located in Sea Area 4C).

3.3.10 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%""bycatc"" species such as galjoen (*Dichistius capensis*), yellowtail (*Seriola62alandii*) and white steenbras (*Lithognathus lithognathus*). Catch-per-unit-effort declines eastwards from 294 and 115 kg·net-day^{-1} for the beach-seine and gillnet fisheries respectively off the West Coast to 48 and 5 kg·net-day^{-1} off KwaZulu-Natal. Consequently, the fishery changes in nature from a largely commercial venture on the West Coast to an artisanal/subsistence fishery on the East Coast (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 3.10 for the number of rights issued and Figure 3.44 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.

Table 3.10: 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	Gillnet/driftnet	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

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).

Sea Area 5C 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 prospecting application area which is situated in waters deeper than 50 m. Figure 3.45 and Figure 3.46 show the expected range of gillnet and beach-seine fishing activity in relation to the prospecting application area.

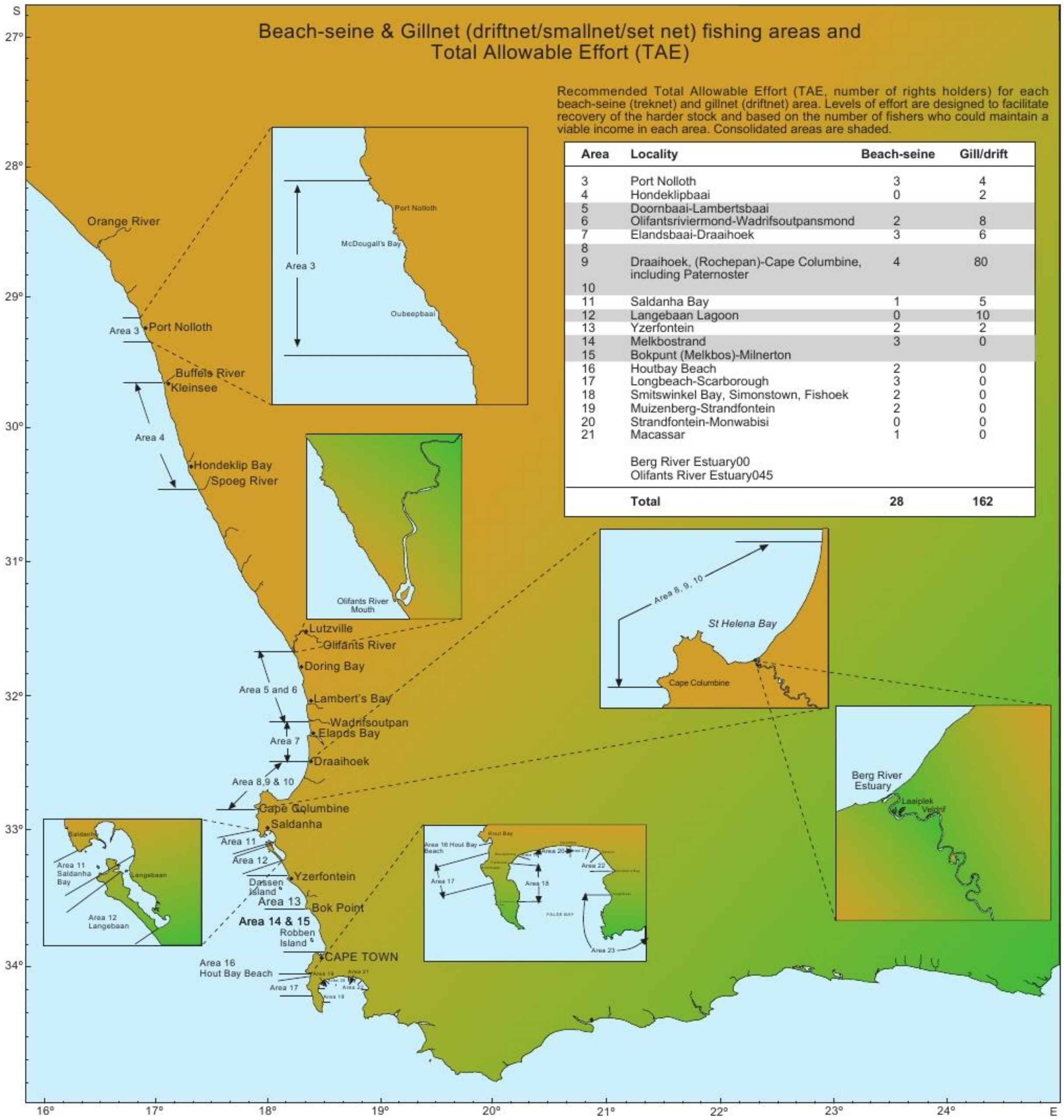

Figure 3.44: Beach-seine and gillnet fishing areas and TAE (DAFF, 2014)

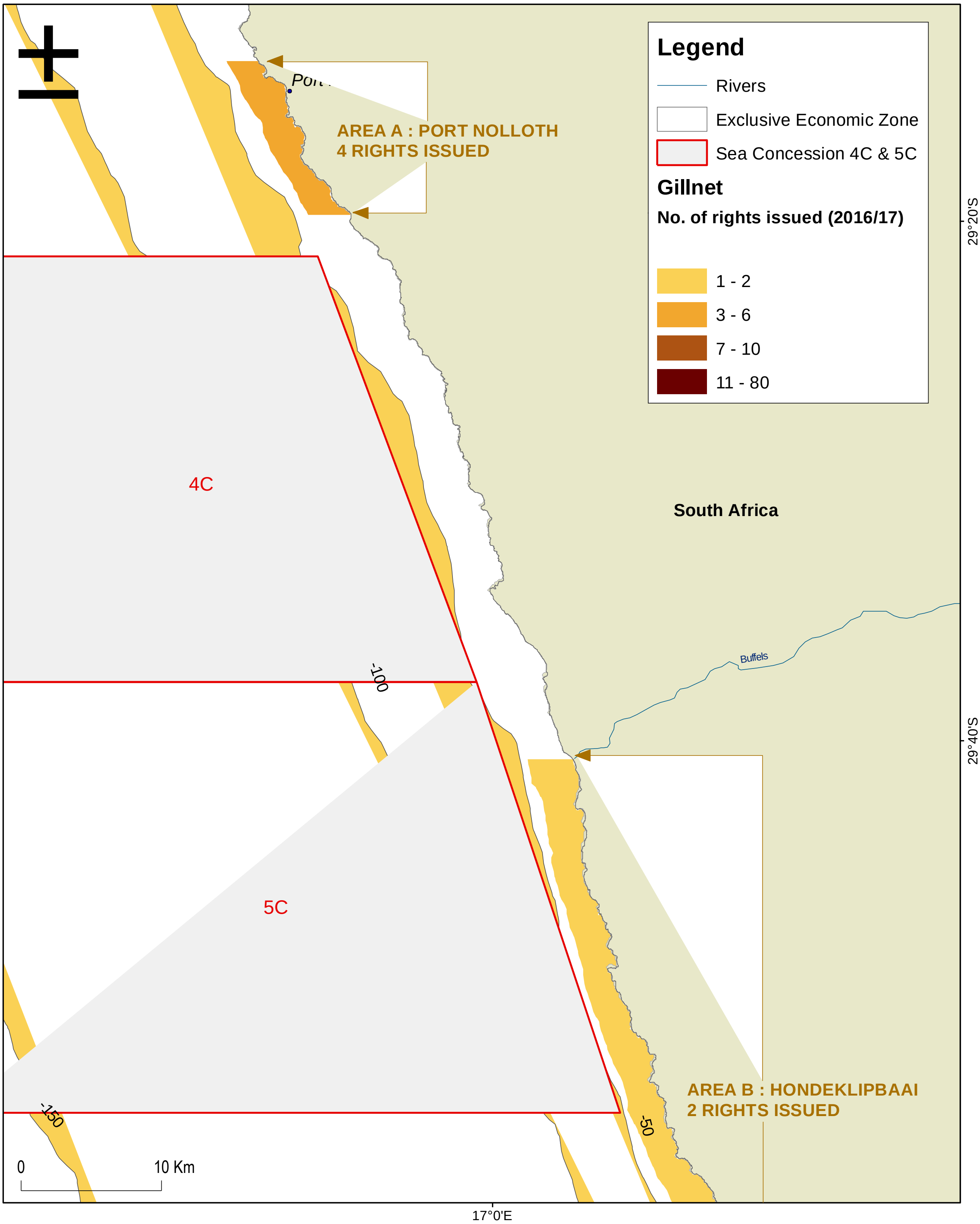

Figure 3.45: Number of rights issued for gillnet fishing areas A (Port Nolloth) and B (Hondeklipbaai) to a maximum fishing depth of 50 m (DAFF, 2016/17) in relation to Sea Areas 4C and 5C. Depth contours shown are 50 m, 100 m and 150 m.

(Note that the Prospecting Right area excludes the Namaqua Fossil Forest Marine Protected Area located in Sea Area 4C).

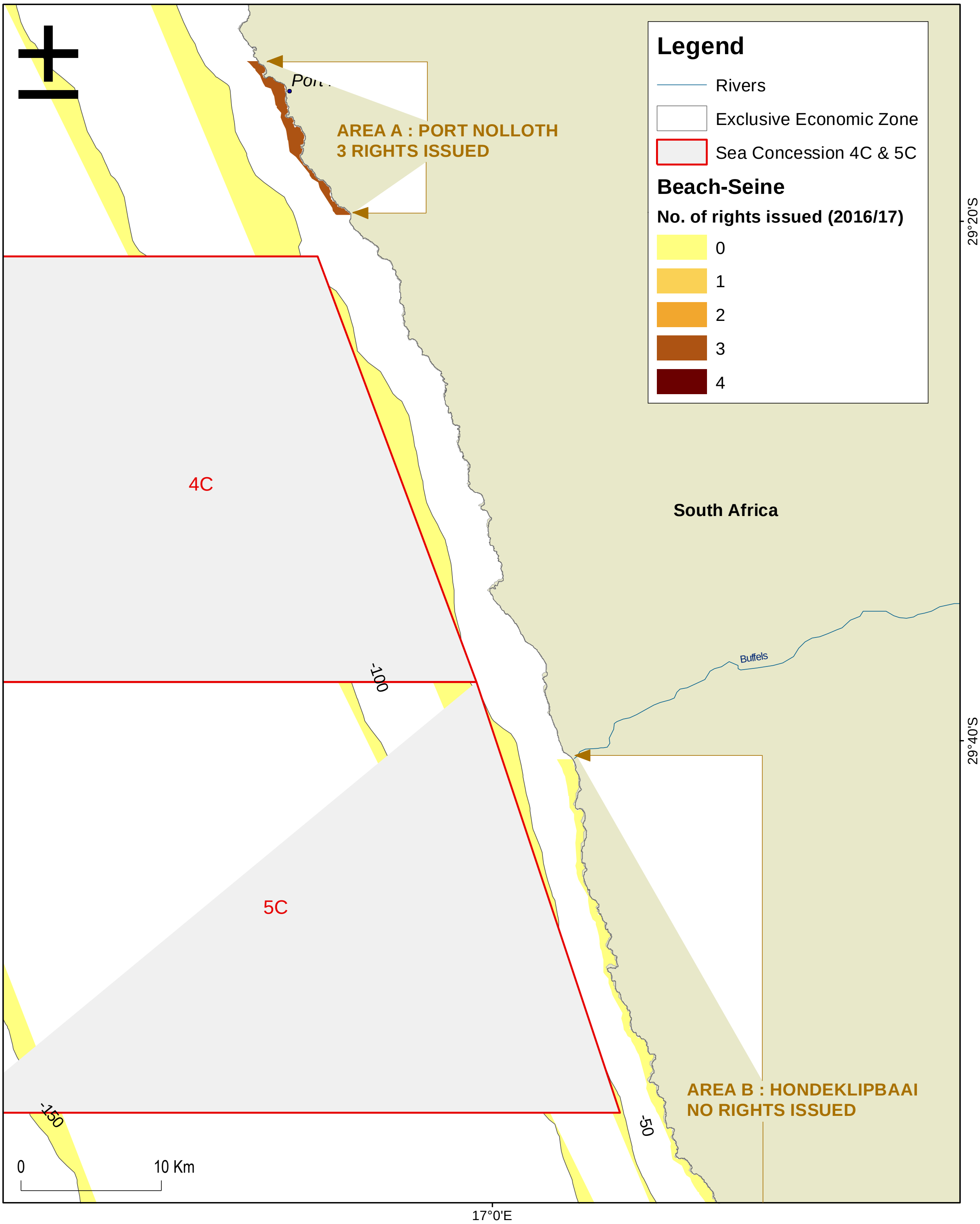

Figure 3.46: Number of rights issued for beach-seine fishing areas A (Port Nolloth) and B (Hondeklipbaai) to a maximum fishing depth of 20 m (DAFF, 2016/17) in relation to Sea Areas 4C and 5C. Depth contours shown are 50 m, 100 m and 150 m.

(Note that the Prospecting Right area excludes the Namaqua Fossil Forest Marine Protected Area located in Sea Area 4C).

3.3.11 SMALL-SCALE FISHERIES

The concept of Small-Scale Fisheries (SSF) is a relatively new addition to the fisheries complexity in South Africa. The concept has its origin in a global initiative supported by the Food and Agricultural Organisation of the United Nations (FAO). In South Africa, there is a long history of coastal communities utilizing marine resources for various purposes. Many of these communities have been marginalized through apartheid practices and previous fisheries management systems. In 2007 government was compelled through an equality court order to redress the inequalities suffered by these traditional fishers. The development of a SSF sector aims in part to compensate previously disadvantaged fishing communities that have been displaced either politically, economically or by the development of large-scale commercial fisheries. This led to the development of the Small-Scale Fisheries Policy (SSFP), the aim of which is to redress and provide recognition of the rights of small-scale fishers (DAFF, 2015). The SSFP was gazetted in May 2019 under the Marine Living Resources Act, 1998 (Act No. 18 of 1998). It is only now (2021/2022) in an advanced process of implementation. It is a challenging process that has been exacerbated by the conflict and overlap with another fisheries-related process of fishing rights allocations (known as Fishery Rights Allocation Process or "FRAP"). As of August 2022, neither process has been concluded and the issues at stake are highly politicised. The SSF overlaps other historical fisheries in South Africa, leading to legal challenges where the SSF rights allocations are in conflict with other established commercial fishing sectors, most notably the commercial squid fishing sector. SSF is defined as a fishery although specific operations and dynamics are not yet fully defined as they are subject to an ongoing process by DFFE. The SSF regulations (DAFF, 2016) do however define the fishing area for SSF as ""near-shore"", meaning "the region of sea (including seabed) within close proximity to the shoreline". The regulations further specify under Schedule 5 *Small-scale fishing areas and zones* in which "5. (1) In order to facilitate the establishment of areas where small-scale fishers may fish, the Department must set up a procedure to engage and consult with the small-scale fishing community in proposing demarcated areas that may be established as areas where small-scale fishers may fish and which under section 5 (2)b. "*take into account the mobility of each species in the allocated basket of species with sessile species requiring smaller fishing areas while nomadic and migratory species requiring larger area.*

Small-scale fishers fish to meet food and basic livelihood needs, but may also directly be involved in fishing for commercial purposes[9]. These fishers traditionally operate on nearshore fishing grounds to harvest marine living resources on a full-time, part-time or seasonal basis. Fishing trips are usually of short-duration and fishing/harvesting techniques are labour intensive[10].

Small-scale fishers are an integral part of the rural and coastal communities in which they reside and this is reflected in the socio-economic profile of such communities. In the Eastern Cape, KwaZulu-Natal and the Northern Cape, small scale fishers live predominantly in rural areas while those in the Western Cape live mainly in urban areas (Sunde & Pedersen C., 2007; Sunde, 2016.).

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

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

Many communities living along the coast have, over time, developed local systems of rules to guide their use of coastal lands, forests and waters. These local rules are part of their systems of customary law. Rights to access, use, and own different natural resources arise from local customary systems of law. These systems of law are not written down as in Western law, but are passed down from generation to generation through practice (https://www.masifundise.org/wp-content/uploads/2011/06/vissernet-eng-news-3-final.pdf). South Africa's Constitution recognises customary law together with common law and state law. Section 39 (3) makes provision for a community that has a system of customary rights arising from customary law to be recognised as long as these rights comply with the Bill or Rights. In line with this, the SSFP also recognises rights arising in terms of customary law. Customary fishers are normally associated with discrete groups (tribes or communities with unique identities and associations with the sea) who may be defined by traditions and beliefs (see also Pretorius, 2022). These traditions are increasingly being challenged as stocks and marine resources have been depleted. This would include, for example, intertidal harvesting of seaweed, mussels, oysters, cephalopods and virtually any species available to these communities. These fishers are generally localised and do not range far beyond the areas in which they live[11].

SSF resources are managed in terms of a community-based co-management approach that aims to ensure that harvesting and utilisation of the resource occurs in a sustainable manner in line with the ecosystems approach. The SSF is to be implemented along the coast in series of community co-operatives. Only a co-operative is deemed to be a suitable legal entity for the allocation of small-scale fishing rights[12]. These community co-operatives will be given 15-year small-scale fishing Rights. The criteria to be applied in determining whether a person is a small-scale fisher are that the person must (a) be a South African citizen who associates with or resides in the relevant small-scale fishing community; (b) be at least 18 years of age; (c) historically have been involved in traditional fishing operations, which include catching, processing or marketing of fish for a cumulative period of at least 10 years; and (d) derive the major part of his or her livelihood from traditional fishing operations and be able to show historical dependence on fish, either directly or in a household context, to meet food and basic livelihoods needs..

More than 270 communities have registered an Expressions of Interest (EOI) with the Department and approximately 10 000 small-scale fishers have been identified around the coast. DFFE has split SFF by communities into district municipalities and local municipalities. These fishers are generally localised and do not range far beyond the areas in which they live. The location of these coastal communities and the number of fishers per community relative to Sea Areas 4C and 5C are shown in Figure 3.47 with Port Nolloth and Hondeklipbaai being the closest communities.

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

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

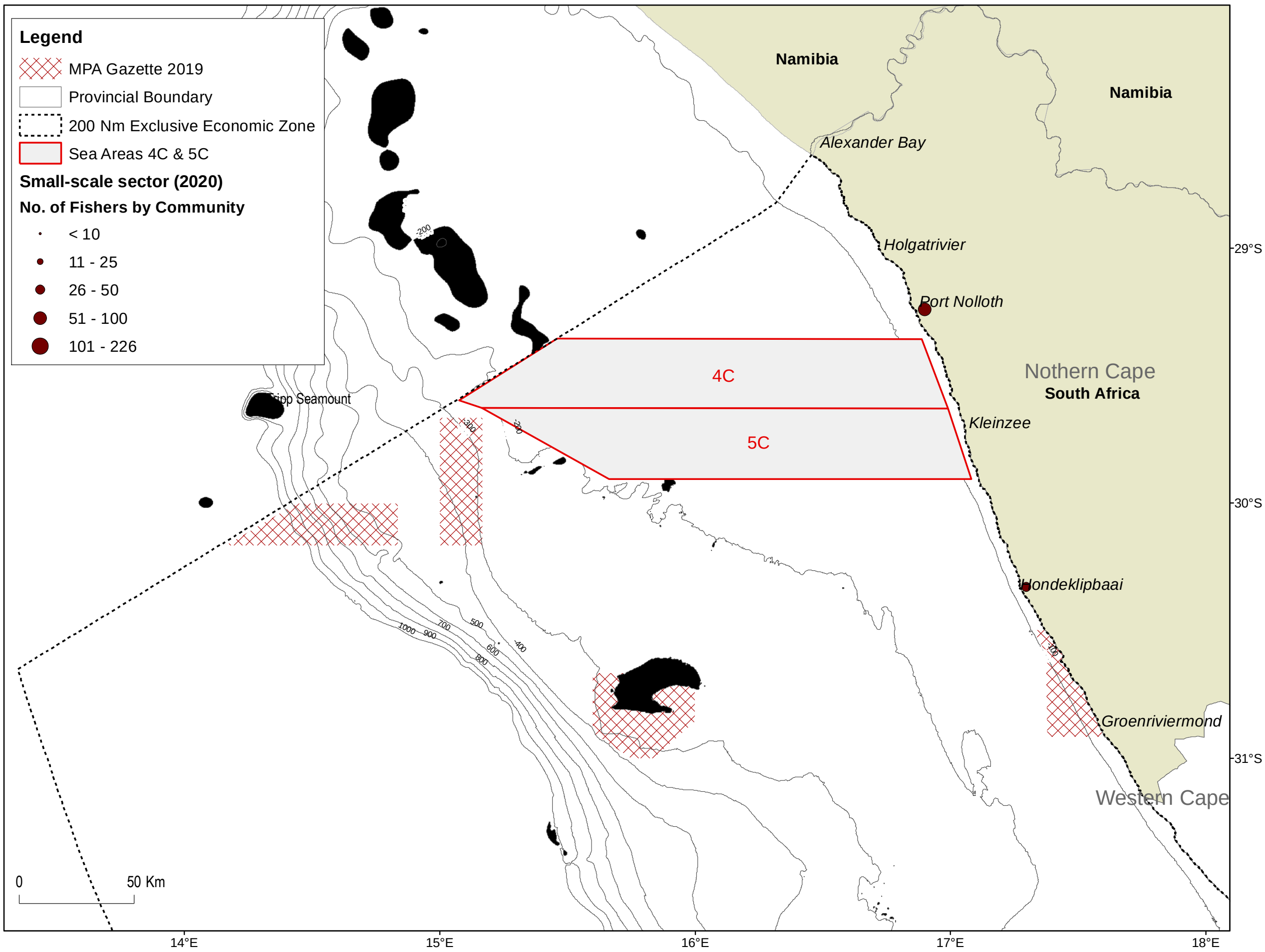

Figure 3.47: Sea Areas 4C and 5C in relation to the spatial distribution of small-scale fishing communities and number of participants per community along the west coast of South Africa.

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

The SSFP requires a multi-species approach to allocating rights, which entails the allocation of rights for a basket of species that may be harvested or caught within particular designated areas[13]. Section 6 of the regulations covers access *Management of the rights of access*. Co-operatives can only request access to species found in their local vicinity. DFFE recommends five basket areas: 1. Basket Area A – The Namibian border to Cape of Good Hope – 57 different resources 2. Basket Area B – Cape of Good

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

Hope to Cape Infanta – 109 different resources 3. Basket Area C – Cape Infanta to Tsitsikamma – 107 different resources 4. Basket Area D – Tsitsikamma to the Pondoland MPA – 138 different resources 5. Basket Area E – Pondoland MPA to the Mozambican border – 127 different resources.

The mix of species to be utilised by small-scale fishers includes species that are exploited by existing commercial sectors viz; traditional linefish, west coast rock lobster, squid, hake handline[14], abalone, KZN beach seine, netfish (gillnet and beach-seine), seaweed and white mussel. An apportionment of TAE/TACs for these species will be transferred from existing commercial rights to SSF[15], whereas white mussels will become the exclusive domain of SSF. Species nominated for commercial use will be subject to TAE and/or TAC allocation. Species nominated for own use will be available to all members of a particular co-operative, but subject to output controls.

The small-scale fishery rights cover the nearshore area (defined in section 19 of the MLRA as being within close proximity of shoreline). Small-scale fishermen along the Northern Cape and Western Cape coastlines are typically involved in the traditional line, west coast rock lobster and abalone fisheries, whereas communities on the South Coast would be involved in traditional line, squid jig and oyster harvesting. The small-scale communities on the West Coast, with long family histories of subsistence fishing, prioritise the harvest of nearshore resources (using boats) over the intertidal and subtidal resources. An example of such boats is shown in Figure 3.48.

Figure 3.48: Fishing boats outside the Hondeklipbaai small-scale community co-operative (photo credit Carika van Zyl).

Snoek (*Thyrsites atun*), Cape bream / hottentot (*Pachymetopon blochii*) and yellowtail (*Seriola lalandi*) are important linefish species that are targeted by small-scale fishers operating nearshore along the West and South-West Coast of South Africa (refer to Section 3.3.7 for traditional linefish).

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

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

Snoek are targeted by small-scale fishers during the snoek seasonal migration between April and June, during which time they shoal nearshore and are therefore available to handline fishermen[16]. Snoek availability coincides with peaks in the availability of other small pelagic species, notably anchovy and sardine (Nepgen, 1979). As shown by Crawford *et al.* (1987) [17][18] snoek stay inshore on their southward migration (i.e. April through to June) and then move offshore into deeper waters to spawn[19] in July and August (and are not available to linefishers during these times as the fish are beyond the depth range of surface linefishers).

Small-scale fishers also target west coast rock lobster (*Jasus70alandii*) using hoopnets set by small "bakkies" on at a water depth of less than 30 m. Fishing activity may range up to 100 m water depth by the larger vessels that participate in the offshore commercial rock lobster trap sector (refer to Section 3.3.8).

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. Small-scale fishermen along the Northern Cape coast are typically involved in the traditional line, west coast rock lobster and net fisheries (refer to sections 3.3.7, 3.3.8 and 3.3.10).

3.3.12 SEAWEED

Seaweed is also regarded as a fishery, with harvesting of kelp (*Ecklonia maxima*) and (*Laminaria pallida*) in the Western and Northern Cape and hand-picking of *Gelidium* sp. in the Eastern Cape. The seaweed industry employs over 1 700 people, most of whom are previously disadvantaged. Although both species are harvested, *E. maxima* are most in demand and constitute most of the biomass, which is primarily used by the abalone aquaculture industry as abalone feed. However, the demand placed on the resource outweighs what is available for harvest, particularly in areas close to abalone farms. Seaweed harvesting is highly regulated in South Africa and is managed in the form of concession areas. Each concession area is awarded to a rights holder with a limit set for that particular area on the amount

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

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

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

[19] Snoek spawning occurs offshore during winter-spring, along the shelf break (150-400 m) of the western Agulhas Bank and the South African west coast. Prevailing currents transport eggs and larvae to a primary nursery ground north of Cape Columbine and to a secondary nursery area to the east of Danger Point; both shallower than 150 m. Juveniles remain on the nursery grounds until maturity, growing to between 33 and 44 cm in the first year (3.25 cm/month). Onshore-offshore distribution (between 5- and 150-m isobaths) of juveniles is determined largely by prey availability and includes a seasonal inshore migration in autumn in response to clupeoid recruitment. Adults are found throughout the distribution range of the species, and although they move offshore to spawn - there is some southward dispersion as the spawning season progresses - longshore movement is apparently random and without a seasonal basis (Griffiths, 2002).

(biomass) of kelp that can be legally harvested. Seaweed is either harvested in situ or from beaches in the form of kelp-wrack. Kelp-wrack consists of kelps dislodged from the substratum during times of high wave energy and are transported by ocean currents towards the coast, eventually depositing on beaches. The quality of in situ kelp is considered higher than that of kelp-wrack; therefore, in situ kelp is the preferred option; however, kelp-wrack is targeted when in situ harvesting is not possible. Kelp can also be harvested by the general public by hand from beaches and shorelines, provided they have the appropriate permit.

The biogeographical distribution of kelps is limited by several environmental factors, with seawater temperature being the main limitation. Due to this limiting factor, the two main species of kelp in South Africa, *Ecklonia maxima* and *Laminaria pallida*, are distributed along the south coast from De Hoop, extending westward around the Cape Peninsula and further extending north into Namibia (Molloy and Bolton, 1996; Stegenga, 1997). Temperature around the coastline varies as one moves from Namibia towards the Cape Peninsula and De Hoop, where coastal temperature increases. False Bay is a region of warmer temperatures where *E. maxima* and *L. pallida* have extended their distribution eastwards in recent years (Bolton et al., 2012), which has thought to be related to climate change effects (Bolton et al., 2012). Upwelling is an essential oceanographic process in the marine environment, which supplies cool, nutrient-rich water from the deep ocean into coastal regions (Rouault et al. 2010). The increased frequency of upwelling along the coastline, as a result of climate change, has created a temperature environment suitable for kelp populations (Bolton et al., 2012). The extension of kelp species has these endemic species in a unique position relative to other kelp species worldwide, where populations have declined significantly (Krumhansl *et al*. 2016). The expansion of kelp biomass along the coastline provides the opportunity for further exploitation and harvesting activities. Also, it expands the habitat for economically important species, such as abalone and West Coast rock lobster.

Although both species (*E. maxima* and *L. pallida*) occur together for most of the coastline, their resource needs vary. Generally, *E. maxima* occur between depths of 4-10 m deep and extend to the surface to form a canopy, while *L. pallida* occupy depths greater than 10 m and do not extend to the surface but instead form a subsurface canopy (Coppin *et at*. 2020). In general, kelp species are known for their resilience to environmental changes and are able to adapt rapidly to changing environmental conditions. Rapid adaptation is achieved through developing morphological characteristics which reduce drag forces, and ultimately, the probability of dislodgement (Coppin *et at.* 2020). In high wave energy environments, kelps take on morphological characteristics that either increase strength of attachment to the substrate or reduce drag forces on structural components (Coppin *et at*. 2020). The reduction of surface area (drag reducing trait) comes at a physiological cost which in turn reduces the amount of light and nutrients which can be absorbed. Therefore, kelps must balance their photosynthetic need with that of reducing probability of dislodgment (Coppin et at. 2020). Warmer temperatures affect important kelp physiological processes such as photosynthesis and respiration which influences growth and productivity (Bearham *et al*. 2013; Gao *et al*. 2013). Although kelps are highly resilient species, there is a threshold beyond which kelps will no longer be able to adapt (Coppin *et at*. 2020).

The larger species, *E. maxima*, is a conspicuous organism along the coastline and dominates the biomass of the nearshore, while *L. pallida* are limited to the sub-surface for most of the coastline. Towards the north along the west coast, from approximately Hondeklipbaai, *L. pallida* replaces *E. maxima* as the dominant kelp species (Velimirov *et al*., 1977; Stegenga, 1997) and occupy increasingly shallow subtidal regions. The northern populations also exhibit an increase in stipe hollowness compared to the solid stipe morphs in the species' southern distributions (Molloy and Bolton, 1996). This variation in morphology was thought to represent two distinct species, with the northern populations formerly described as Laminaria schinzii Foslie (Molloy and Bolton, 1996). Genetic work has subsequently shown that the two morphs are, in fact, the same species (Rothman et al., 2017b). Although the mechanism which influences morphology between populations of *L. pallida* has not been empirically established, it has been suggested that the distinct morphology and replacement of *E. maxima* further north of the coast is a result of turbidity (Rothman et al., 2017a). Light is a significant influencer of kelp populations, with *E. maxima* requiring more light than *L. pallida* which can exploit low-light habitats (Rothman et al., 2017a). The lower light requirement of *L. pallida* allows this species to outcompete *E. maxima* along the west coast and ultimately dominate the biomass of the coastline further North and into Namibia.

The biggest threat to kelp forests is temperature and wave exposure which may thin populations over time. Warmer temperatures (rising ocean temperatures and marine heatwaves) cause physiological stress to individuals, and high wave energy (storms) dislodges kelps from the substrate (Graham, 2004; Byrnes *et al.* 2011). Kelps with air-filled structures, which allow them to remain upright within the water column, may float to the surface once dislodged and are transported via ocean currents to near and distant offshore areas and coastlines (Smith, 2002). The dispersion of kelp to near and distant ecosystems has been recognised as an important organic subsidy that many organisms rely on (Bustamante and Branch, 1996; Krumhansl and Scheibling, 2012). Along with the organic subsidy, kelps also provide a vital economic resource for coastal populations (Troell et al. 2016).

The South African seaweed industry is based on the commercial collection of kelps (*E. maxima* and *L. 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).

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.

Table 3.11 lists the annual yields of commercial seaweeds in South Africa between 2003 and 2018. The South African coastline is divided between the Orange River and Port St Johns into 23 seaweed Rights areas (Figure 3.49). Table 3.12 lists the yield of kelp by area for the 2018 season. Permit conditions stipulate that beach cast kelp may be collected by hand within these management areas and that kelp may be harvested using a diver deployed from a boat or the shore.

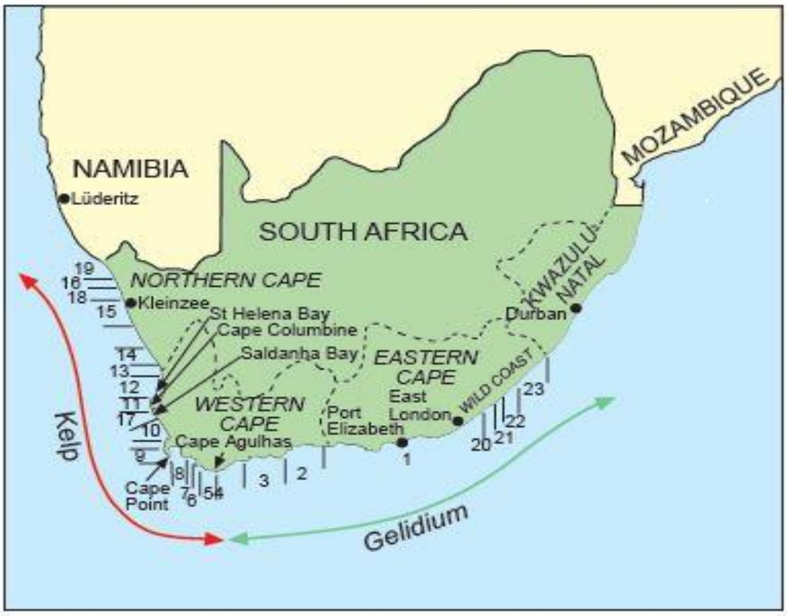

Figure 3.49: Map of seaweed rights areas in South Africa (DEFF, 2020).

Table 3.11: Annual yields of commercial seaweeds in South Africa (2003 – 2018). "Kelp beach cast' refers to material that is collected in a semi-dry state, whereas 'kelp fresh beach cast' refers to clean, wet kelp fronds that, together with 'kelp fronds harvest', are supplied as abalone feed (DEFF, 2020).

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

Table 3.12: Maximum sustainable yield of harvested kelp for all areas for the 2018 season (1 March 2018 – 28 February 2019). Source DFFE, 2020.

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

Figure 3.50 shows Sea Areas 4C and 5C in relation to management areas 16 and 15, situated offshore of Port Nolloth and Hondeklipbaai, respectively.

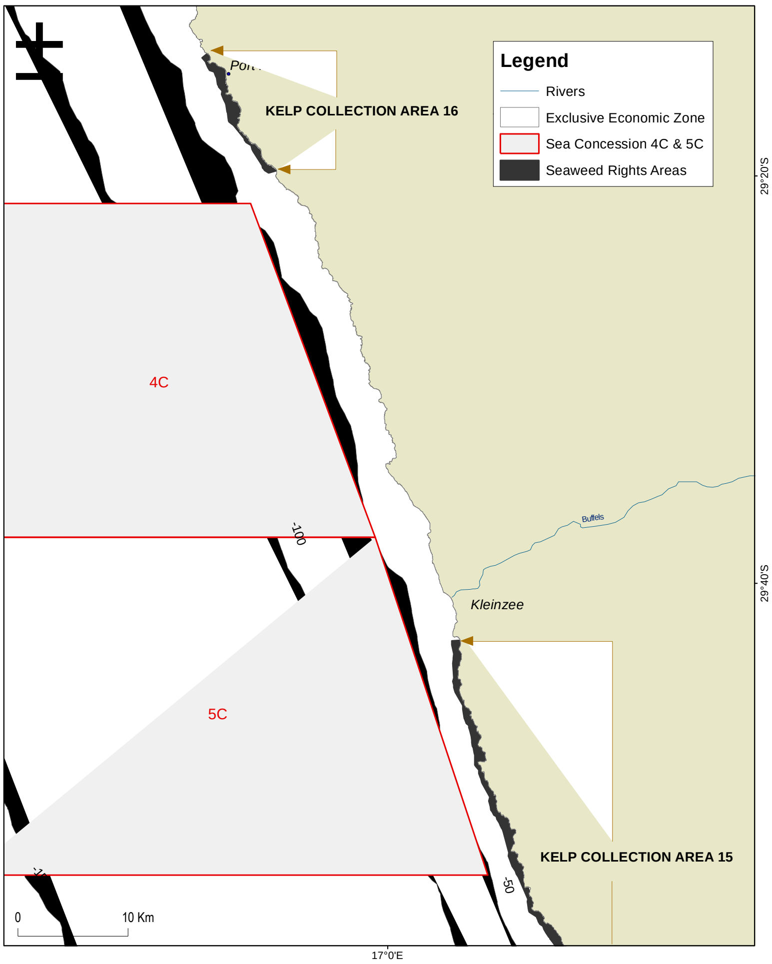

Figure 3.50: Location of seaweed rights areas in relation to Sea Areas 4C and 5C.

(Note that the Prospecting Right area excludes the Namaqua Fossil Forest Marine Protected Area located in Sea Area 4C).

Permit conditions stipulate that beach cast kelp may be collected by hand within these management areas and that kelp may be harvested using a diver deployed from a boat or the shore. Over the period 2000 to 2017, an average of 40.33 tonnes per annum of dry harvested kelp (beach cast) and 34.67 tonnes 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. The harvesting areas are not expected to coincide with the prospecting application area, which lies beyond the depth range at which divers could harvest kelp.

3.4 SUMMARY TABLE OF SEASONALITY OF COMMERCIAL AND RESEARCH FISHING ACTIVITY

The seasonality of each of the fishing sectors that operate in the vicinity of the prospecting application area is indicated in Table 3.13 – also presented is the relative intensity of fishing effort on a month-by-month basis.

Table 3.13: Summary table showing seasonal variation in fishing effort expended by each of the main commercial fisheries sectors in the vicinity of Sea Areas 4C and 5C.

Sector	Fishing Intensity by Month in the Vicinity of Sea Areas 4C and 5C 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
Demersal Longline	M	H	H	H	H	M	H	H	H	H	H	H
Large Pelagic Longline	M	M	M	M	H	H	H	H	H	H	H	M
Pole-and-line (tuna pole)	N	N	M	M	M	M	M	N	N	N	N	N
Traditional Linefish	N	N	M	M	M	M	M	M	M	N	N	N
West Coast Rock Lobster (nearshore)	M	M	N	N	N	N	N	N	N	M	M	M
Small-scale (linefish & rock lobster nearshore sectors)	M	M	M	M	M	M	M	M	M	M	M	M
Research survey (trawl)	M	M	N	N	N	N	N	N	N	N	N	N
Research survey (acoustic)	N	N	N	N	M	M	N	N	N	N	M	N

4 ASSESSMENT

4.1 NOISE EMISSIONS

4.1.1 DESCRIPTION OF IMPACT

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. The survey vessel would be equipped with a medium- to high-frequency multi-beam echo sounder (MBES), medium- to high-frequency sub-bottom profiler and medium- to high-frequency side scan sonar.

The likely geophysical survey equipment and its source frequencies, source noise levels and soft start capabilities are provided in Table 2.1 under the project description (section 2.1).

A description of the acoustic impacts on marine fauna due to the proposed geophysical prospecting and sampling programme is provided by Pulfrich (2023 – refer to section 4.2.1).

Sources of anthropogenic noise in the ocean include vessel traffic, multi-beam sonar systems, seismic acquisition, underwater blasting, pile driving, and construction. Elevated noise levels could impact marine fauna by:

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

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)[20]. The ASA Technical Report includes noise thresholds for mortality (or potentially mortal injury) as well as degrees of impairment such as TTS or PTS. 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). As surveys using the MBES, sub-bottom profiling and side scan sonar sources have much lower noise emissions compared with seismic airgun sources, no specific considerations have been put in place in developing assessment criteria for these.

Whereas experiments have been carried out to define the levels of sound that cause mortality, injury or hearing damage; it is more difficult to determine the threshold levels that cause behavioural effects, which are likely to take place over wider areas. Reactions of fish to different types of anthropogenic sounds have been reviewed by Hawkins et al. (2015), who concluded that more information is required on the effects of man-made sounds on the distribution of fishes and their capture by different fishing gears as effects differ across species, fishing ground and habitat type.

Due to the more deleterious effects of loud, low frequency sounds such as those emitted in seismic surveys, research has focused on these effects. Due to the paucity of research into the effects of geophysical survey tools on fish and crustaceans and their related fisheries, effects are inferred by comparing the sounds that these organisms produce and are capable of detecting, and evidence of noise thresholds that can cause them harm or disturbance such that their fishery might be affected.

In general terms, sound sources that have high sound pressure and low frequency will travel the greatest distances in the marine environment. Conversely, sources that have high frequency will tend to have greater attenuation over distance due to interference and scattering effects (Anon 2007). It is for this reason that the acoustic footprint of sonar survey tools (such as those De Beers has proposed using) is considered to be much lower than that of deeper penetration low frequency seismic surveys that are used for petroleum exploration and in addition have lower sound pressure levels. The proposed multibeam survey produces frequencies between 70 kHz and 455 kHz, with source sound levels ranging between 190 – 232 dB re 1 μPa at 1m and is capable of soft starts (refer to Table 2.1). Research into the effects of these multibeam swath bathymetry on fish and other fisheries-relevant organisms is lacking. However, as the frequencies produced fall well outside of the range of hearing of most marine

[20] 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

fish, it is assumed to have little impact on fisheries. Furthermore, the intensity of such high-frequency sound attenuates rapidly, meaning that any potential effects of the sound will be localised to near their source. The soft start capacity of this technology may encourage animals capable of detecting high frequencies to move out of the range of the sound.

Urchins exposed to three hours of one-second sweeps of 100 – 200kHz at 145 and 160 dB re 1µPa (within the range of multibeam echosounders) showed signs of physiological stress (Vazzana et aI 2020.) This suggests that invertebrates may be sensitive to high frequency sound, which might cause ecosystem effects on fisheries. However, urchins are less mobile than fish and crustaceans, which may be able to avoid noise disturbance, especially if soft starts are used.

Sub-bottom profilers typically used for mineral exploration include a variety of survey equipment that produce sound ranging from medium frequencies (boomer, sparker and mini sleeve-gun systems), to high (chirp and IXSEA) and very high frequencies (Innomar and Parametric systems). In contrast, the seismic airguns used by the Petroleum industry are high powered, low frequency. Some systems such as the boomer are capable of soft starts. Lower frequencies have the potential to travel large distances underwater and may interfere directly with fish and crustacean sound detection. The survey equipment proposed for use by De Beers in the prospecting activities is considered to be medium- to high-frequency.

A large-scale review of the impacts of the electromagnetic techniques used in oil and gas exploration (Buchanan et al. 2011). They found that most marine organisms are unlikely to be affected by these electromagnetic surveys, with the exception of elasmobranchs (sharks and rays), which are not relevant to the fisheries in this region. While some animals use electric or magnetic fields in navigation, they do not depend solely on these cues. The addition of electromagnetic surveys to the natural geomagnetic anomalies and range of natural electromagnetic sources was considered to be minor.

4.1.2 SENSITIVE RECEPTORS

Marine organisms tend to be able to detect sounds that fall within the range produced by their species, prey or predators. High frequency, ultrasonic sound (>20kHz) sound is less commonly produced by marine animals. Some cetaceans and mantis shrimps produce ultrasonic sound and there is evidence that some fish species are capable of detecting it.

Various different SBP equipment alternatives have been proposed (refer to Table 2.1), some of which produce an acoustic signal that would coincide with the hearing range of fish and crustaceans (refer to Table 4.1). At a frequency range of 200 Hz to 3 kHz and source levels of up to 229 dB re 1 Pa at 1m, the “sparker” method of sub-bottom profiling that would produce an acoustic signal that would be detectable by crustaceans and fish. The proposed multibeam survey produces frequencies between 70 kHz and 455 kHz, with source sound levels ranging between 190 – 232dB re 1 µPa at 1m. These frequencies fall well outside of the range of hearing of most marine fish; however, members of the genera *Alosa* and *Brevoortia* (shads and menhadens) have shown specialisations that enable them to detect ultrasound. The American shad (*Alosa sapidissima*) is an example of a clupeoid species that shows a behavioural response to ultrasonic frequencies. American shad have been reported to respond with changes in schooling behaviour at 200-800Hz and 25-150 kHz (Velez, 2015). Behavioural responses have also been shown by blueback herring (*Alosa aestivalis*) at a sonar frequency range of 110 kHz to 140 kHz at sound levels above 180 dB re 1 Pa (peak) (Nestler *et al*. 1992, in Popper *et al*., 2014).

Table 4.1: 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

4.1.3 IMPACT ASSESSMENT

The noise generated by the acoustic equipment utilized during geophysical surveys falls within the hearing range of most fish, and at sound levels of between 190 to 232 dB re 1 µPa at 1 m, will be audible for considerable distances (in the order of tens of km) before attenuating to below threshold levels (Findlay 2005). Similarly, the sound level generated by sampling operations fall within the 120-190 dB re 1 µPa range at the sampling unit, with main frequencies between 3 – 10 Hz. The noise generated by sampling operations thus falls within the hearing range of most fish, and depending on sea state would be audible for up to 20 km around the vessel before attenuating to below threshold levels[21].

The noise emissions from the geophysical sources are highly directional, spreading as a fan from the sound source, predominantly in a cross-track direction. Based on the rapid attenuation of high-frequency sound in the ocean, the spatial extent of the impact of noise on catch rates is expected to be localised. Based on the location of fishing grounds of the various fisheries sectors in respect to the prospecting application area, the effects of acoustic disturbance on catch rates would be considered to be of negligible significance for most sectors. However, in the case of the pole-and-line, traditional linefish, west coast rock lobster, beach-seine and gillnet fisheries, small-scale fisheries and fisheries research, the spread of sound into fishing grounds may affect catch rates. The impact on these sectors is assessed to be of very low magnitude and overall very low significance. No mitigation measures are possible, or considered necessary for the generation of noise by the geophysical survey methods proposed in the current project. The impact is considered to be highly reversible – any disturbance of behaviour that may occur as a result of survey noise would be temporary. Refer to Table 4.2.

Table 4.2: Impact of Survey Noise on Catch Rates.

1	IMPACTS OF MULTIBEAM, SUB-BOTTOM PROFILING AND SIDE-SCAN SONAR ON FISHERIES CATCH	
	PRE-MITIGATION IMPACT	RESIDUAL IMPACT
TYPE OF IMPACT	INDIRECT	INDIRECT
NATURE OF IMPACT	NEGATIVE	NEGATIVE

[21] Typical natural ambient noise levels in the study area are estimated to have overall root-mean-square sound pressure levels (RMS SPLs) in the range of 80 – 120 dB re 1 µPa, with a median level around 100 dB re 1µPa upon calm to strong sea state conditions (Li & Lewis 2020 in Pulfrich, 2021).

1	IMPACTS OF MULTIBEAM, SUB-BOTTOM PROFILING AND SIDE-SCAN SONAR ON FISHERIES CATCH	
	PRE-MITIGATION IMPACT	RESIDUAL IMPACT
SENSITIVITY OF RECEPTOR	MEDIUM	
MAGNITUDE (CONSEQUENCE)	VERY LOW	VERY LOW
INTENSITY	MEDIUM	MEDIUM
EXTENT	LOCAL	LOCAL
DURATION	SHORT-TERM	SHORT-TERM
SIGNIFICANCE	VERY LOW pole-and-line, traditional linefish, west coast rock lobster, beach-seine, gillnet fisheries, small-scale fisheries and fisheries research	VERY LOW
PROBABILITY	PROBABLE	PROBABLE
CONFIDENCE	MEDIUM	MEDIUM
REVERSIBILITY	FULLY REVERSIBLE Any disturbance of behaviour, auditory “masking” or reductions in hearing sensitivity that may occur as a result of survey noise below 220 dB would be temporary.	
LOSS OF RESOURCES	NEGLIGIBLE	
MITIGATION POTENTIAL	LOW	
CUMULATIVE POTENTIAL	CONSIDERING THE NUMBER OF SEISMIC AND GEOPHYSICAL SURVEYS RECENTLY CONDUCTED IN THE AREA, SOME CUMULATIVE IMPACTS CAN BE ANTICIPATED. HOWEVER, ANY DIRECT IMPACT IS LIKELY TO BE AT INDIVIDUAL LEVEL RATHER THAN AT SPECIES LEVEL.	

4.2 DISCHARGE OF SEDIMENT

4.2.1 DESCRIPTION OF IMPACT

The sampled seabed sediments are pumped to the surface and discharged onto sorting screens on the sampling vessel. The screens separate the fine sandy silt and large gravel and cobbles from the size fraction of interest, the ‘plantfeed’ (usually 2 - 20 mm). The fine sediments are immediately discarded overboard where they form a suspended sediment plume in the water column which dissipates with time. The ‘plantfeed’ is mixed with a high density ferrosilicon (FeSi) slurry and pumped under pressure into a Dense Medium Separation (DMS) plant resulting in a high density concentrate. The majority of the ferrosilicon is magnetically recovered for re-use in the DMS plant and the fine sediments (-2 mm) from the DMS process are similarly deposited over board. Furthermore, fine sediment re-suspension by the sampling tools will generate suspended sediment plumes near the seabed. The main effect of plumes is an increase in water column turbidity. It is noted that the sampling is not contiguous and therefore there will be a delay in time whilst the seabed tool is transferred to the new sampling site before additional sediment is released overboard with the next sample. The relevance of this in terms of effects on fisheries is the potential impairment of egg and/or larval development through high sediment loading.

4.2.2 SENSITIVE RECEPTORS

The taxa most vulnerable to increased turbidity and reduced light penetration are phytoplankton. Due to the location of the prospecting application area within the Namaqua upwelling cell, the abundance of phytoplankton can be expected to be seasonally high. Being dependent on nutrient supply, plankton abundance is typically spatially and temporally highly variable and is thus considered to have a low sensitivity. Pelagic fish likely to be encountered in the water column are highly mobile and would be expected to avoid elevated suspended sediment plumes in the water column. Likewise demersal fish would be expected to avoid elevated suspended sediment plumes near the seabed. These fauna are thus considered to have a low sensitivity.

4.2.3 IMPACT ASSESSMENT

Typically fisheries stock recruitment is highly variable and shows a strong spatial and temporal signal. For example, this variability would apply to the small pelagic species that comprise the largest commercial fishery by volume on the West Coast of South Africa. Spawning and recruitment of these small pelagic species as well as of many demersal species occurs primarily well to the south of Sea Areas 4C and 5C. 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.

The spawn products from these fisheries typically drift northwards with the prevailing Benguela Current and larval development mainly occurs nearshore and in bays along the West Coast of South Africa, referred to as nursery areas. These areas provide a suitable niche for development of juveniles of these species. Most of the species potentially impacted are broadcast spawners, with large volumes of spawn products being dispersed over large areas. This would apply equally, for example, to west coast rock lobster, hake and sardine.

Relative to the location of the nursery areas, the sediment plumes generated during benthic sampling would be predominantly dispersed northwards and offshore of the nursery areas. Whereas sediment plumes would result in a negative impact on stock recruitment, the impact on fish recruitment is considered to be of very low consequence and of overall insignificance due to the localised nature of the proposed sampling events in relation to fish nursery areas. Since the impact is unlikely to result in a significant impact on fish stock recruitment, mitigation against this impact is not considered necessary.

In terms of seaweeds, sediment plumes could significantly reduce the photosynthetic ability, spore settlement, and spore survival of *E. maxima* and *L. pallida*. The sediment plume would need to persist for an extended time for kelp populations within the concession area to be negatively affected. However, the sediment plume may enhance cumulative impacts of turbidity, as high amounts of turbidity characterise the West Coast. The high turbidity in the area is a result of the combination of the presence of sand on the seafloor, the hydrodynamic environment, and the cumulative effects of anthropogenic activities along the West Coast.

Table 4.3: Impact of Sediment Plume on Fish Stock Recruitment.

2	IMPACTS OF SEDIMENT PLUME ON FISH STOCK RECRUITMENT	
	PRE-MITIGATION IMPACT	RESIDUAL IMPACT
TYPE OF IMPACT	DIRECT	NO MITIGATION IS PROPOSED
NATURE OF IMPACT	NEGATIVE	
SENSITIVITY OF RECEPTOR	LOW TO MEDIUM	
MAGNITUDE (CONSEQUENCE)	VERY LOW	
INTENSITY	LOW	
EXTENT	LOCAL	
DURATION	SHORT-TERM	
SIGNIFICANCE	NEGLIGIBLE Demersal trawl, demersal longline, pole-and-line, small pelagic purse-seine, traditional linefish, abalone ranching, small-scale fisheries, seaweed, fisheries research	
	VERY LOW west coast rock lobster, netfish	
PROBABILITY	DEFINITE	
CONFIDENCE	MEDIUM	
REVERSIBILITY	FULLY REVERSIBLE	
LOSS OF RESOURCES	LOW	
MITIGATION POTENTIAL	NONE	
CUMULATIVE POTENTIAL	UNLIKELY	

4.3 EXCLUSION FROM FISHING GROUND

4.3.1 DESCRIPTION OF IMPACT

Under the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972, Part A, Rule 10), a 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 vessel operator would request a safe operational limit (that is greater than the 500 m safety zone) that it would like other vessels to stay beyond.

While the survey and sampling vessels are operational at a given location, a temporary 500 m operational safety zone around the unit would be in force, i.e. no other vessels (except the support vessels) may enter this area. A vessel conducting marine sampling operations would operate using dynamic positioning or typically operate on a 3 or 4 anchor spread with unlit anchor mooring buoys. For the duration of operations a coastal navigational warning would be issued by the South African Navy Hydrographic Office (SANHO) requesting a 1.5 nautical mile and 500 m clearance from the survey and sampling vessels, respectively. The safety zones aim to ensure the safety both of navigation and of the project vessel, avoiding or reducing the probability of accidents caused by the interaction of fishing boats and gears and the survey and sampling vessels.

The exclusion of vessels from entering the safety zone poses a direct impact to fishing operations in the form of loss of access to fishing grounds or displacement of fishing effort into alternative fishing grounds.

4.3.2 SENSITIVE RECEPTORS

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 (receptors) have been identified based on the extent of overlap of fishing grounds with the prospecting application area. The demersal longline, pole-and-line, traditional linefish, small-scale sectors as well as fisheries research surveys have historically operated within the prospecting application area and are all currently active to a lesser or greater degree.

Sensitivity herein refers to the ability of the fishing industry to operate as expected considering a project-induced change to their normal fishing operations. The sensitivity of a particular fishing sector to the impact of the safety / exclusion zone would differ according to the degree of disruption to that fishing operation. The current assessment considers this to be related to the type of gear used by the particular fishery, the mobility of fishing operations and the probability that the fishing operation can be relocated away from the affected area (the safety / exclusion zone) into alternative fishing areas. For instance, those that set fishing gear for extended periods (i.e. rock lobster traps anchored at seabed or drifting long-lines) are more susceptible to exclusion than those more mobile operations (i.e. trawl nets are towed directly behind the vessel).

Due to their mobile nature, the sensitivity of the pole-and-line, linefish and small-scale sectors is rated as low. The sensitivity of fisheries research surveys is considered to be medium and that of the demersal longline sector, high.

4.3.3 IMPACT ASSESSMENT

The exclusion of vessels from entering the safety zone around a vessel engaged either in survey or sampling poses a direct impact to fishing operations in the form of loss of access to fishing grounds.

Demersal trawlers operate on both the Namibian and South African sides of the maritime border but at a seabed depth range of approximately 200 m to 1000 m. The inshore extent of demersal trawl grounds is situated about 10 km from the offshore boundary of the prospecting application area and there is no direct overlap of the area with trawling grounds. The demersal longline fleet operates in similar areas; however slightly shallower than the trawler fleet and, in places, on hard grounds not accessible to trawlers. Namibian-registered 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 Sea Area 4C which runs along the maritime border with Namibia. The South African fleet of demersal longline vessels also operate at a similar depth range and there is minimal overlap of fishing ground with the offshore portions of the prospecting application area. Over the period 2018 to 2020, an average of 128 000 hooks per year were set within the prospecting application area yielding 21.9 tonnes of hake. This is equivalent to 0.47% of the overall effort and 0.47% of the overall catch reported nationally by the sector. Since survey and sampling would take place within a seafloor depth range of 70 – 160 m, there is no overlap expected with fishing operations of the demersal longline sector and no impact expected.

There is no overlap of the prospecting application area with fishing grounds of the midwater trawl and small pelagic purse-seine sectors, which are situated at least 330 km and 150 km, respectively, southwards of the prospecting application area.

In the vicinity of the prospecting application area, the South African fleet of the pelagic longline fishery targets fishing areas offshore of the 500 m bathymetric contour and the closest activity would be expected 50 km from the offshore boundary of the prospecting application area. However, the Namibian fleet of large pelagic longline vessels are permitted to target pelagic shark species in addition to tuna and therefore also operate in shallower waters inshore of the shelf break. The Namibian fleet would be expected to operate offshore of the 200 m depth contour adjacent to the South African maritime border and Sea Area 4C, which does not form part of the current prospecting focus area.

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. Tuna-directed fishing is not expected to coincide with the prospecting application area; however, a significant amount of snoek-directed fishing activity occurs inshore of the 100 m depth contour over the period March to July. Over the period 2017 to 2019, an average of 14 fishing events were reported having taken place within the prospecting application area yielding 48 tonnes of snoek. This is equivalent to 0.53% of the overall effort expended by the pole-and-line sector (inclusive of offshore fishing activity targeting albacore tuna) and 6.97% of the snoek catch landed by the sector. Vessels may therefore be affected by the navigational safety zone around the survey vessel. The impact is considered to be local in extent and of short-term duration. The magnitude of the impact on the sector is expected to be very low and, due to the low sensitivity of the sector, of overall negligible significance.

Boat-based fishing for linefish takes place in close proximity to launch sites at Port Nolloth and Doringbaai. Over the period March to September, snoek is targeted in nearshore waters. Although unlikely to extend into the prospecting application area, the possibility of fishing activity extending into the shallow water areas of the concession areas cannot be excluded. The impact is considered to be local in extent and of short-term duration. The magnitude of the impact on the sector is expected to be very low and, due to the low sensitivity of the sector, of overall negligible significance.

Although the prospecting application area coincides with the designated management areas of the nearshore west coast rock lobster, abalone ranching, netfish and seaweed sectors, the depths exploited by these fisheries are less than 50 m and therefore would not be expected to coincide with the areas of operation for the proposed survey and sampling activities.

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 fisheries for linefish and west coast rock lobster. Approximately 103 small-scale fishers are registered with the Port Nolloth fishing community co-operative. The small-scale fishery rights cover the nearshore area (defined in section 19 of the MLRA as being within close proximity of shoreline). Since the grounds fished by the nearshore rock lobster sector are situated inshore of the prospecting application area, fishing activity is not expected to be affected by the proposed survey and sampling activities. However, the impact of potential disruption of fishing activities for linefish species cannot be excluded and is assessed to be of very low magnitude and of overall negligible significance.

Research trawls are undertaken by DEFF on a national scale to establish the stock status of key commercial species. The demersal trawl survey would be expected to take place within the prospecting application 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 magnitude of the impact on the sector is expected to be very low and, due to the medium sensitivity of the sector, of overall very low significance.

Mitigation

A process of notification and information-sharing should be followed with key identified fishing industry associations including the SA Tuna Association; SA Tuna Longline Association, South African Deepsea Trawling Industry Association (SADSTIA), South African Hake Longline Association (SAHLLA), West

Coast Rock Lobster Association, South African Linefish Associations (various) and SA Marine Linefish Management Association (SAMLMA). Other key stakeholders: SANHO, South African Maritime Safety Association, representatives of small-scale local fishing co-operatives and DFFE Vessel Monitoring, Control and Surveillance (VMS) Unit in Cape Town. These stakeholders should again be notified on completion of the project when the survey/sampling vessel is off location.

The required safety zones around the survey and sampling vessels should be communicated via the issuing of Daily Navigational Warnings for the duration of the sampling operations through the South African Naval Hydrographic Office.

Timing

- The pole-and-line sector targets snoek seasonally in the vicinity of the prospecting application area during the period March to July. Timing of the survey and sampling activities to avoid this fishing period would eliminate the impact on the sector. However, it may not be technically possible to avoid undertaking prospecting operations during this time (e.g. due to restrictions in availability of the vessel of opportunity to undertake the work), thus the pre-mitigation impact significance remains as **NEGLIGIBLE**.
- The traditional linefish sector operates in close proximity to Port Nolloth and Doringbaai over the period March to September. Timing of the survey and sampling activities to avoid this fishing period would eliminate the impact on the sector. However, as noted above it may not be technically possible to avoid undertaking prospecting operations during this time, thus the pre-mitigation impact significance remains the same.
- A demersal research survey is undertaken each year within the prospecting application area over the period January/February. Acoustic surveys for small pelagic species are carried out twice a year and may be expected within the prospecting application area any time from mid-May to mid-June and from mid-October to mid-December. The most effective means of mitigation would be to ensure that the proposed prospecting activities do not coincide with the research surveys. Based on experience from previously undertaken prospecting activities, it would be possible to undertake prospecting activities at the same time as the research surveys provided DFFE had been engaged with beforehand. Thus, it is recommended that prior to the commencement of the proposed activities, De Beers consult with the managers of the DFFE research survey programmes to discuss their respective programmes and the possibility of altering the prospecting programme in order to minimises or avoid disruptions to both parties, where required. In the event that this is done, there would be **NO IMPACT** on research surveys.

Table 4.4: Impact of Temporary Exclusion of Fishing Operations.

3	IMPACTS OF EXCLUSION OF FISHERIES DURING SURVEY AND SAMPLING OPERATIONS	
	PRE-MITIGATION IMPACT	RESIDUAL IMPACT
TYPE OF IMPACT	DIRECT	DIRECT
NATURE OF IMPACT	NEGATIVE	NEGATIVE
SENSITIVITY OF RECEPTOR	MEDIUM fisheries research (trawl) LOW pole-and-line, traditional linefish, small-scale sector	
MAGNITUDE (CONSEQUENCE)	VERY LOW	VERY LOW
INTENSITY	MEDIUM	LOW
EXTENT	LOCAL	LOCAL

3	IMPACTS OF EXCLUSION OF FISHERIES DURING SURVEY AND SAMPLING OPERATIONS	
	PRE-MITIGATION IMPACT	RESIDUAL IMPACT
DURATION	SHORT-TERM	SHORT-TERM
SIGNIFICANCE	VERY LOW Fisheries research	NO IMPACT Fisheries research
	NEGLIGIBLE Pole-and-line, linefish, small-scale fisheries	NEGLIGIBLE Pole-and-line, linefish, small-scale fisheries
PROBABILITY	POSSIBLE	POSSIBLE
CONFIDENCE	MEDIUM	MEDIUM
REVERSIBILITY	FULLY REVERSIBLE	
LOSS OF RESOURCES	NEGLIGIBLE	
MITIGATION POTENTIAL	LOW	
CUMULATIVE POTENTIAL	CONSIDERING THE POTENTIAL FOR OTHER SEISMIC SURVEYS TO BE CONDUCTED IN THE AREA, SOME CUMULATIVE IMPACTS CAN BE ANTICIPATED.	

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 and sampling 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.

The systems are either towed, vessel mounted, pole mounted, AUV or Autonomous Surface Vehicle (ASV). Due to the higher frequency emissions utilised in marine diamond multi-beam and sub-bottom profiling operations, the associated sound pressure tends to be dissipated to safe levels over a relatively short distance. The anticipated radius of influence of multi-beam sonar would thus be significantly less than that for a deeper penetration low frequency seismic airgun array, such as those used by the Petroleum industry. Sound levels from the multibeam survey equipment would range from 190 to 232 dB re 1 μPa at 1 m. The multibeam's operating frequency range of 70 kHz and 455 kHz falls beyond the hearing range of most fish species. At a frequency range of 200 Hz to 3 kHz and source levels of up to 229 dB re 1 Pa at 1m, the "sparker" method of sub-bottom profiling that would produce sounds detectable by crustaceans and fish and would be audible for considerable distances (in the order of tens of km) before attenuating to below threshold levels. Similarly, the sound generated by sampling operations[22] falls within the hearing range of most fish and depending on sea state would be audible for up to 20 km around the vessel before attenuating to below threshold levels.

The emission of underwater noise from geophysical surveying and vessel activity would not be considered to be of sufficient amplitude to cause auditory or non-auditory trauma in marine fauna in the region. Only directly below the systems (within metres of the sources) would sound levels be in the range where exposure could result in trauma. As most species likely to be encountered within the prospecting application area are highly mobile, they would be expected to flee and move away from the sound source before trauma could occur. For most fisheries sectors, the effects of acoustic disturbance on catch rates would be considered to be of negligible significance. However, in the case of the demersal longline, pole-and-line, traditional linefish, west coast rock lobster, beach-seine and gillnet fisheries, small-scale fisheries and fisheries research, the spread of sound into fishing grounds may affect catch

[22] Sound levels of 120-190 dB re 1 μPa at the sampling unit, with main frequencies between 3 – 10 Hz.

rates and the impact on these sectors has been assessed to be of very low magnitude and overall very low significance.

Fishing vessels would be required to maintain a safe operational distance of 1.5 nautical miles from the survey vessel and 500 m from the sampling 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 prospecting application area. The impact of exclusion from fishing grounds was assessed to be of overall negligible significance to the pole-and-line, traditional linefish and small-scale sectors. The impact on the pole-and-line, traditional linefish and small-scale sectors can be avoided by timing the proposed activities to take place during periods of seasonal low fishing activity during October to February, inclusive. However, as noted above it may not be technically possible to avoid undertaking prospecting operations over this period, thus the pre-mitigation impact significance remains the same.

There is no impact of exclusion expected on the remaining commercial fisheries sectors viz, demersal 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 prospecting application 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). Survey and sampling operations that coincide with scheduled fisheries research surveys could result in a negative impact, local in extent and of very low magnitude and significance.

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

Fishery Sector	Discharge of Sediment		Noise Effects on Catch Rates		Temporary Safety Zone	
	Catch	Effort	Pre-Mitigation	Residual Impact	Pre-Mitigation	Residual Impact
Demersal Trawl	Negligible	Negligible	Negligible	Negligible	No impact	No impact
Mid-Water Trawl	No impact	No impact	No impact	No impact	No impact	No impact
Demersal Longline	Negligible	Negligible	Negligible	Negligible	No impact	No impact
Small Pelagic Purse-Seine	Negligible	Negligible	No impact	No impact	No impact	No impact
Large Pelagic Longline	No impact	No impact	No impact	No impact	No impact	No impact
Pole-and-Line	Negligible	Negligible	Very low	Very low	Negligible	Negligible
Traditional Linefish	Negligible	Negligible	Very low	Very low	Negligible	Negligible
West Coast Rock Lobster	Very Low	Very Low	Very low	Very low	No impact	No impact
Abalone (Ranching)	Negligible	Negligible	No impact	No impact	No impact	No impact
Small-Scale Fisheries	Negligible	Negligible	Very low	Very low	Negligible	Negligible
Netfish	Very low	Very low	Very low	Very low	No impact	No impact
Seaweed (Kelp harvesting)	Negligible	Negligible	No impact	No impact	No impact	No impact
Fisheries Research	Negligible	Negligible	Very low	Very low	Very low	No impact

Table 5.2 Summary of the proportion of overlap of fishing grounds with Sea Areas 4C and 5C.

Fishery Sector	% Overlap with Sea Area 4C & 5C		
	Catch	Effort	Comment
Demersal Trawl	0	0	No activity reported within the concession areas
Mid-Water Trawl	0	0	No activity reported within the concession areas
Demersal Longline	0.47	0.47	Minimal activity within the concession areas but no activity within the proposed survey and sampling areas
Small Pelagic Purse-Seine	0	0	No activity within the concession areas
Large Pelagic Longline	0	0	No activity reported within the concession areas
Pole-and-Line	6.97	0.53	Snoek catches reported within the concession areas, inshore of the 100 m depth contour. No tuna catches reported within the concession areas
Commercial or Traditional Linefish	unknown	unknown	No activity reported within the concession areas. However, due to comparatively poor spatial resolution of DFFE data records for this sector, fishing activity may occur within the inshore portions of the prospecting application area. Closest deployment sites are Port Nolloth and Hondeklipbaai.
West Coast Rock Lobster	0	0	No activity reported within the concession areas (fishing activity reported inshore of the concession areas)
Abalone (Ranching)	0	0	No activity reported within the concession areas (fishing activity reported inshore of the concession areas
Small-Scale Fisheries	unknown	unknown	Refer to commercial or traditional linefish, west coast rock lobster, netfish, seaweed sectors
Netfish	0	0	No activity reported within the concession areas (fishing activity reported inshore of the concession areas)
Seaweed (Kelp harvesting)	0	0	No activity reported within the concession areas (fishing activity reported inshore of the concession areas)
Fisheries Research	N/A	N/A	Concession areas coincide with research surveys for small pelagic species (recruitment survey) which occur from the coastline to the 200 m depth conour. Research surveys for demersal species take place across the full extent of the concession areas.

Mitigation

A process of notification and information-sharing should be followed with key identified fishing industry associations including the SA Tuna Association; SA Tuna Longline Association, South African Deepsea Trawling Industry Association (SADSTIA), South African Hake Longline Association (SAHLLA), West Coast Rock Lobster Association, South African Linefish Associations (various) and SA Marine Linefish Management Association (SAMLMA). Other key stakeholders: SANHO, South African Maritime Safety Association, representatives of small-scale local fishing co-operatives and DFFE Vessel Monitoring, Control and Surveillance (VMS) Unit in Cape Town. These stakeholders should again be notified on completion of the project when the survey vessel is off location.

The required safety zones around the survey and sampling vessels should be communicated via the issuing of Daily Navigational Warnings for the duration of the sampling operations through SANHO

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APPENDIX 1: 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.

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Education:

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

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

Relevant Professional Experience (selected)

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

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

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

ADDITIONAL INFORMATION

Major Projects - Summary

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

Aquaculture-Specific

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

Fishery Economics and Governance :

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

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

Other Projects Completed :

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

Marine Stewardship Council :

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

Lecturing and Document Preparation:

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

PUBLICATIONS

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

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

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

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

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JAPP, D.W. 1995 - The hake-directed pilot study conducted from 23 May 1994 to 31 May 1995. *Mimeo* 110 pp

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

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

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

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

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

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

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

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

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