A Review and Strengthening of the Spatial Management of South Africa's Offshore Fisheries

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by

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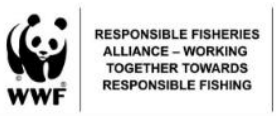

Executive Summary

Fisheries show spatial structure in stocks, fishing effort and catch, bycatch, conflict, ecosystem interactions and life history and behaviour of target and other species. There is evidence that spatial management can help with fisheries sustainability, stock recovery, resolution of user conflict, bycatch reduction and habitat management. The rationale behind identifying priority fishing areas for South African offshore fishing sectors is to propose important fishing grounds for formal protection and to provide a focus point for further spatial management. A priority fishing areas approach is not meant to determine an area where fishing is allowable, thus limiting the ability of fishers, rather it is used to maintain utilisation of a resource and preserve the ability to conduct fishing in that area. We show this approach to be more appropriate for some fisheries with definable fishing areas or, for fisheries with a strong species-habitat association but less appropriate for other more dynamic and less predictable fisheries, such as those which exhibit strong year-to-year variability in fishing patterns or with widespread fishing activity. The collection of tools available to apply spatial management in the context of South African fisheries are reviewed in this report with a focus on sector-specific management and additional work on cross-cutting issues and areas of potential conflict.

A target resource orientated approach is currently applied to the management of South African fisheries. Some of the offshore sectors reviewed in this report have conditions for spatial management that seem consistent with the overall management requirements of each sector. Broadly the aim of those measures is to manage the fishing effort in each sector to achieve different objectives that might include limitation of bycatch, protection of nursery areas and key spawning areas and reduction of user conflict. Spatial management measures applied to specific fisheries may be in need of revision or improvement to be consistent with improved understanding of the fishery dynamics (e.g. stock status, fishery operations) or in particular, needed for the implementation of an Ecosystem Approach to Fisheries (EAF). Whereas current measures are effective for sector-specific management there may be gaps in legislation relating to conflicting utilisation of the same resource and space.

Work has been undertaken in the past that involved monitoring the footprint of separate fisheries, predominantly as a means to prosecute effective spatial management. A composite report to investigate the existence of core fishing grounds and important areas within a fisheries operational range and nominate those areas for additional spatial management or protection has been lacking.

Identifying the critical spatial distributions of target species on a fishery sector by sector basis as well as any bycatch species that might be of “cross-cutting” significance, has allowed for the identification of potential priority fishing areas that may be pertinent to both management of the fishery itself as well as the stocks exploited. Mapping of available commercial catch and effort data has provided a baseline for the identification of fisheries that are suitable for further spatial management or protection. This report in conjunction with the mapping exercise also clarified that certain offshore sectors were well advanced with spatial management already in place governing the operations of those sectors. This included the movement of sector-specific vessels in response to the

dynamics of the species targeted, or in some cases responding to measures in place that ring-fenced the fishery footprint.

Each fishery sector reports to the Department of Agriculture, Forestry and Fisheries (DAFF) on catch and effort at different resolutions. Time-series data used in this report were available for varying periods of time, so for each sector fishing catch and effort were mapped according to the most appropriate resolution and time-scale. The baseline maps created in this way were presented to stakeholders during a one day workshop and formed the basis for discussions on the relative importance of different fishing areas. Key attributes of those areas that related to life-history stages of commercial species, operational characteristics of the fishery or user conflict issues were assigned to the priority fishing areas and used to inform the type of proposed further management (if any).

The fishing patterns for each of the offshore sectors are illustrated in this report and there are clear instances where the activities of one sector may be in conflict with another. The operational nature of fishing determines the degree which sectors will interact with the environment and with each other. Pelagic fisheries are not competing for fishing territory with demersal fisheries but conflict may arise when species targets overlap at certain times of year or in certain areas.

For demersal trawl and longline, overlap of operations on preferred demersal fishing grounds can result in gear fouling between demersal sectors and is an obvious source of conflict between these two sectors. Demersal longline and bottom trawl have significantly different potential impacts on habitat and as a consequence, also on the broader ecology of the demersal environment. While operational conflict is a spatial issue, it is not a priority management issue from a resource perspective. Species taken in the demersal trawl and longline sectors, in addition to hake, have no major cross-cutting issues, except possibly for kingklip. Both gear types have the ability to target kingklip, in particular known aggregations that occur seasonally and on preferred habitat type. In this context, the designation of a kingklip “spawning box” is appropriate, although in our view the temporal period of closure and location relative to known habitat-sensitive areas needs review.

There are a range of target, cross-cutting and bycatch species that frame this report in the context of competing resource utilisation and spatial management. The resulting potential for conflict amongst these sectors requires clear management decision-making protocols and operational management plans that take into consideration the interests of each sector and also the dynamics of the stocks exploited. Clear agreed procedures for conflict resolution and resource apportionment between these sectors is desirable. This would include fishing sectors outside of the “demersal” complex of fisheries and species exploited where conflict and or competition exists, e.g. linefish (kob) and small pelagic (horse mackerel).

Numerous other marine industries such as offshore renewable energy development, extraction activities for oil & gas or seabed mining (e.g. phosphate), aquaculture and marine transport are expanding and are increasingly in conflict with the fishing industry which has a firm historical and renewable base. This is particularly important in light of the likely future emphasis of the governance authority on social and economic factors. Comparative importance of offshore industries is likely to result in fast-tracking of the social and economic agenda resulting in some offshore sectors being given precedence over other renewable and established sectors.

To maintain the food and job security provided by the South African fishery sector and support the current and potential future activities of established fisheries, spatial management is critical. The identification and formalisation of Priority Fishing Areas (PFAs) and Fishery Management Areas (FMAs) is therefore crucial to ensure the long-term sustainability of fisheries and that the associated socio-economic benefits supported by the fishing industry are taken into account in the context of developing offshore industries. There may be a shared interest with the identification of critical biodiversity areas and the nursery areas and key spawning areas of commercial target species. The formal protection of the areas that support healthy commercial fish populations or ecological support areas would act primarily for the benefit of fisheries.

This report provides a template based on the best available information and is a reference document focusing on spatial and temporal catch and effort of the main offshore fisheries. As such, it provides a baseline for future spatial management of fisheries, in particular the need to take careful consideration of fishery-specific needs in the overall Marine Spatial Planning context.

We however acknowledge that commercial fisheries catch and effort information cannot be used in isolation to identify important areas for fisheries, further work is underway to explore additional metrics, such as socio-economic indices, to bolster support for future spatial management and protection of fisheries resources.

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Acronyms

AOI	Areas of Interest
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CH	Critical Habitat
DAFF	Department of Agriculture, Forestry and Fisheries
DFO	The Department of Fisheries and Oceans Canada
DMR	Department of Mineral Resources
EAF	Ecosystem Approach to Fisheries
EBFM	Ecosystem-based Fisheries Management
EBSA	Ecologically and Biologically Significant Areas
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EPBC	Environment Protection and Biodiversity Conservation Act (EPBC) 1999, Australia
ESA	Ecologically Sensitive Areas
FAO	Food and Agriculture Organisation of the United Nations
FMA	Fishery Management Area
FMP	Fisheries Management Plan
HAPC	Habitat Areas of Particular Concern

ICCAT	International Commission for the Conservation of Atlantic Tunas
IFMP	Integrated Fisheries Management Plans
IOTC	Indian Ocean Tuna Commission
LOMA	Large ocean management areas
MLRA	Marine Living Resources Act No. 18 of 1998
MPA	Marine Protected Areas
MPRDA	Mineral and Petroleum Resources Development Act, 2002
MSA	Magnuson-Stevens Fishery Conservation and Management Act 2007
MSC	Marine Stewardship Council
MSP	Marine Spatial Planning
NEMA	National Environmental Management Act, 1998
NEMICMA	National Environmental Management: Integrated Coastal Management Act, 2008
NEMPA	National Environmental Management: Protected Areas Act, 2003
NMFS	National Marine Fisheries Service
NOAA	North American Oceanographic and Atmospheric Organisation
PA	Precautionary Approach
PFA	Priority Fishing Area
QMA	Quota Management Area
RFMO	Regional Fisheries Management Organisation
SADSTIA	South African Deep-Sea Trawling Industry Association
SAFE	South Africa Fishing Ethically
SANBI	South African National Biodiversity Institute
SARA	Species at Risk Act 2002, Canada
SASMIA	South African Squid Management Industry Association
SCRL	South Coast Rock Lobster
SCRLIA	South Coast Rock Lobster Industry Association
SSUs	Special, Sensitive or Unique' species and habitats
TAC	Total Allowable Catch
TAE	Total Allowable Effort
TROM	Target Resource Oriented approach to Management
VMS	Vessel Monitoring System

1.0 Introduction – A Case for Spatial Management of Fisheries

Fisheries show spatial structure in stocks, fishing effort and catch, bycatch, conflict, ecosystem interactions and life history and behaviour of target and other species. There is evidence that spatial management can help with fisheries sustainability, stock recovery, resolution of user conflict, bycatch reduction and habitat management. Direct incentives include support for eco-certification and protection from threatening or exclusionary practices. As ocean activities expand and diversify the need for and benefits of spatial management are increasing.

Numerous other marine industries such as offshore renewable energy development, extraction activities for oil & gas or phosphate, aquaculture and marine transport are expanding and are increasingly in conflict with the fishing industry which has a firm historical base. To better effect the expansion of offshore activities, including the current and potential future activities of established fisheries, spatial management is critical. The identification of what can be considered Priority Fisheries Areas (PFAs) is therefore crucial to ensure the interests of both the fishing industry and the developing offshore industries is considered.

The offshore marine environment provides value to a variety of users. Extractive users fall into two categories: non-renewable in the case of mining and petroleum and renewable in the case of fisheries and renewable energy initiatives. The fishery sector can then be further divided into large-scale commercial fisheries and all other forms of fishing (from subsistence and small-scale enterprises to recreational fisheries and aquaculture).

There are also non-extractive activities that make use of the marine environment in a non-exclusive manner, for example: shipping, undersea cables, naval activities and tourism (Atkinson & Sink 2008[1]). The ocean provides important biodiversity value and ecosystem services that support the fishery and tourism sector.

Fisheries are dependent on resources that, by their transient nature, are dynamic in both time and space. Whereas marine traffic can be allocated specific routes (e.g. separation zones) and oil or gas wells are spatially fixed, the identification or allocation of demarcated areas for fishing is inherently more difficult. Drawing fixed lines on a map is not necessarily the most effective means of managing a fishery, species or its habitat in the marine environment. Threats to marine species are more complex and are difficult to contain or correct. Apart from cases of direct loss of habitat threatening marine species, often it is not changes to, or destruction of, the structural components of the marine habitat that cause a population to decline. More often it is functional factors like resource availability and trophic relationships that are disrupted by human activities.

Ingrained in the identification of areas of importance to fisheries for marine species must be a comprehensive understanding of the threats, both current and future, to the biophysical features of the habitat required by the species to carry out the life processes necessary for its survival. The spatial overlap of important habitats with fishing operations and understanding the value and

[1] Atkinson, L. & Sink, K. 2008. User profiles for the South African offshore environment. *SANBI Biodiversoty Series* 10. South African National Biodiversity Institute, Pretoria.

existence of habitat refugia outside of the fishing grounds are inherent components of spatial management decision making.

Spatial fisheries management in South African fisheries sectors is applied through different mechanisms including sector-specific permit conditions and through regulations, Acts and policy. Broadly the aim of these measures is to manage the fishing effort in each sector to achieve different objectives that might include limitation of bycatch, protection of nursery areas and key spawning areas and reduction of user conflict. Although this can be considered as a form of spatial fisheries management there is a need to identify important fisheries areas within (and outside) of the fishing grounds that would strengthen management of a particular fishery sector. The implementation of spatial measures to facilitate sustainable management of a particular fishery, or protection of the fishing grounds to protect the interests of the industry and the stocks they exploit is referred to as a Fisheries Management Areas (FMA). There are however few explicitly declared FMAs in South African fisheries sectors although historically FMAs are implicit in the management of many fisheries. Further, FMAs are distinct from Marine Protected Areas (MPAs) which have a different purpose. An FMA may be subsumed in an MPA where the objectives may be similar, such as protection of habitat which may in whole or part be deemed necessary for sustaining the fishery and also biodiversity.

The final designation of PFAs would need to have considered fisheries operational characteristics, social dependencies, economic contributions and also the range of non-fisheries industries that would be effected by or affect the legal legitimisation of those areas. This report focuses on the fisheries operational characteristics for selected South African offshore fishing sectors in order to provide a baseline on which to identify and build a case for formal protection of fisheries resource areas. The instruments through which this can be done would include the current governance tools, in particular through the Marine Living Resources Act (MLRA 1998) or by other pertinent legislative means such as the Marine Spatial Planning Bill.

This report seeks to review the current spatial management measures in selected offshore fishery sectors and analyse the key fisheries in the context of spatial patterns in recent catch and effort and the implications for the stocks. The sectors specifically considered are: 1) Hake Trawl (inshore and offshore), 2) Demersal hake longline, 3) Midwater Trawl, 4) Small pelagic purse seine, 5) Squid jig, 6) Large pelagic (longline and pole&line), 7) South Coast Rock Lobster, and 8) KZN Prawn trawl. It includes for each sector a) a broad overview of each fishery (history, stocks dynamics), b) existing spatial management (regulations, permit conditions) gear restrictions), c) an assessment of fishing patterns (commercial catch and effort, identification of important key fishing areas and their significance, target species, bycatch and those species of crosscutting interest between fishery sectors), d) any temporal measures (seasonality), e) habitat aspects (commonly encountered habitats, VMEs) and, f) any user conflict issues.

The report also provides an overview of the legal framework that is or could be applied to fisheries in South Africa and also examples of what is being done in other global fisheries. Future work will incorporate social (number of jobs) and economic (Rand-value) metrics when identifying priority areas for South Africa's commercial fisheries (see Appendix 6).

2.0 Global Review of the Legislative Framework for Implementation of Spatial Management

Management of fisheries resources are complex and challenging. Most fisheries have a suite of measures intended to balance commercial exploitation with long-term sustainability. With increasing pressure on commercial stocks, primarily through demand (population growth mainly), new issues are coming to the fore and alternative or additional management measures are needed. Further, fishery resources are confronted with increasing competition and threats associated with new growth areas in the blue (ocean) economy including oil and gas exploration, hydrocarbon infrastructure (oil fields, wells, oil rigs), seabed mining for minerals, increasing marine transport, and offshore mariculture. All of these activities, either independently or cumulatively impact biodiversity which is increasingly threatened by fishing practices and the demand for resources.

The conservation agenda is largely motivated by the need to preserve biodiversity and to achieve a balance between the benefits of rational (and sustainable) exploitation (be it fisheries or mineral extraction) and other non-consumptive industries such as eco-tourism. The fishing industries broadly recognise the need for change, or at least the need for sustainability of the resources they exploit. This is demonstrated through the global uptake in eco-labels[2], the application of Ecosystem Approach to Fisheries[3] and the Precautionary Approach to fisheries management[4]. Whereas historically fisheries were largely uncontained, they benefitted from abundant resources. As these resources were exploited, fisheries have effectively shrunk and new resources systematically discovered, in particular using increasing power and technology in deeper waters. The systematic introduction of fisheries measures to try and manage fisheries has been largely retrospective – often being implemented too late to effectively contain over-exploitation. In many instances, these measures included spatial tools. Therein lies a complex and contradictory element, understanding of resource dynamics is often a result of exploitation and effectively "testing" resource resilience.

In Southern African fisheries there is evidence of this, with many fisheries retaining historical spatial measures. The rationale for these measures and the extent to which they may or may not apply has not been clearly investigated. Typically, mature fisheries also identify issues related to species and stock structure. In South Africa, for example, the assumptions of a single species of hake were shown to be flawed with the discovery that in fact two species of hake existed (Botha, 1985[5]). The occurrence of both a shallow and deepwater species that was differentially targeted by the hake fisheries in both the Benguela and Agulhas ecosystems. This raised many issues, in particular on stock status and the impact different sectors (inshore and deepsea trawl, hake longline) were having on the stocks. Subsequent assessments also raised the question of the likelihood that not only did

[2] https://www.msc.org/

[3] Garcia, S.M.; Zerbi, A.; Aliaume, C.; Do Chi, T.; Lasserre, G. The ecosystem approach to fisheries. Issues, terminology, principles, institutional foundations, implementation and outlook. FAO Fisheries Technical Paper. No. 443. Rome, FAO. 2003. 71 p.

[4] FAO. Precautionary approach to capture fisheries and species introductions. Elaborated by the Technical Consultation on the Precautionary Approach to Capture Fisheries (Including Species Introductions). Lysekil, Sweden, 6-13 June 1995. FAO Technical Guidelines for Responsible Fisheries. No. 2. Rome, FAO. 1996. 54p

[5] Botha, L. 1985. Occurrence and distribution of Cape hakes *Merluccius capensis* Cast. And *M. paradoxus* Franca in the Cape of Good Hope area. *South African Journal of Marine Science,* 4. 23-35.

two species exist but in fact there were different stocks. This formed the basis for the initial spatial separation of the hake-directed fishing fleets based on both area and depth limitations.

National and Regional Ocean Policies are also being developed to resolve user conflict in the ocean space while at the same time enhancing sustainable resource harvesting. The implementation of Ocean Polices and Marine Spatial Planning (MSP) is summarised below. In particular we focus on identification of "Critical" or Priority Fisheries Areas" (PFAs) that can support Fisheries Management, normally in conjunction with a suite of other measures.

2.1 Australia

Australia's Ocean Policy, published in 1998, provided a framework for the integrated and ecosystem based planning and management of Australia's marine jurisdiction[6]. Marine bioregional planning with set objectives and strategies has been implemented to conserve biodiversity and ensure sustainable use of fisheries and other marine resources[7]. Five offshore bioregional plans have been developed. The plans do not cover state or territorial waters (i.e. the area covered is from 3nm offshore to the EEZ boundary at 200nm (Section 24, Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act)) but do include information about inshore environments and their interaction with species and habitats in the offshore marine area. Section 3A of the Fisheries Management Act, 1991 promotes ecologically sustainable development of fisheries while Section 17 specifies the need to develop Fisheries Management Plans. The identification of areas of key habitat and the allocation of limited fractions of an overall "recommended biological catch (RBC)" or total allowable effort (TAE) to those key habitat areas is one element of spatial management with a fisheries management area context.

The Regional Plans refer to **biologically important areas**: Those are areas that are *particularly important for the conservation of protected species and where aggregations of individuals display biologically important behaviour, such as breeding, foraging, resting or migration*. The behaviour of the species in a specific area indicates that there is a species-habitat interaction.

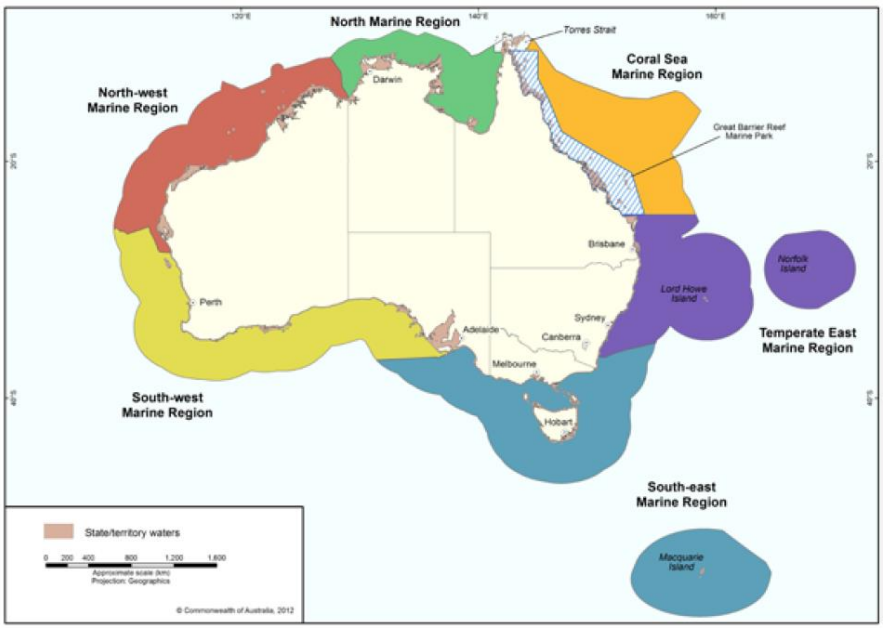

Figure 1: Commonwealth Marine Bioregions, Australia

[6] Biliana Cicin-Sain, David L. VanderZwaag, Miriam C. Balgos. 14 May 2015, *Appendix_C, from:* Routledge Handbook of National and Regional Ocean Policies Routledge.

[7] Environment Protection and Biodiversity Conservation Act (EPBC) 1999, Section 176

A register of critical habitat (CH) is maintained under the EPBC Act. The register lists habitats considered critical to the survival of a listed threatened species or a listed threatened ecological community. Biologically important areas are not protected under the EPBC Act whereas listed critical habitats are, to the degree that if a habitat occurs in or on a Commonwealth area and is listed in the register then it is an offence under the EPBC Act to take an action when it is known that the action significantly damages the critical habitat.

2.2 United States of America

Under the auspices of the Oceans Act, 2000 the National Policy for the Stewardship of the Ocean, Our Coasts, and the Great Lakes was published. The Policy, published in 2010, encompasses nine regions of the United States with nine priority objectives to promote a healthy and productive ocean zone[8]. The Magnuson-Stevens Fishery Conservation and Management Act, 2007 (MSA[9]) was reauthorized in 1996 and in the process, the loss of marine habitat as a long-term threat to the viability of U.S. fisheries was recognised[10]. Through the development of Fishery Management Plans under the MSA, the National Marine Fisheries Service (NMFS) requires, for Federally managed species, that Essential Fish Habitat (EFH), *"waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity"*, be identified[11]. EFH designation (Figure 2) elevates the requirement of other Federal Agencies, whenever they authorise, fund or carry out activities that may impact EFH, to consult with the NMFS in order to avoid, reduce or balance the impact of proposed activities on EFH[12].

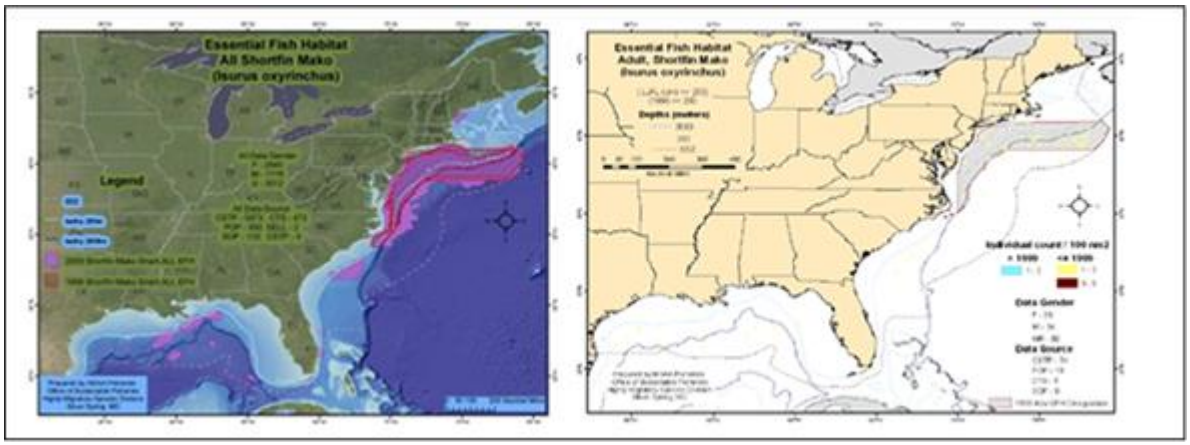

Figure 2: **Left: Essential Fish Habitat of combined neonate, juvenile and adult Shortfin Mako Shark in the Gulf of Mexico and Atlantic region of the United States of America[13]; Right: Essential Fish Habitat of Adult shortfin mako[14].**

[8] Biliana Cicin-Sain, David L. VanderZwaag, Miriam C. Balgos. 14 May 2015*, Appendix_C, from:* Routledge Handbook of National and Regional Ocean Policies Routledge.
[9] U.S. Sustainable Fisheries Act, 1996. Magnuson-Stevens Fishery Conservation and Management Act.
[10] NOAA 2016. Regional Use of Habitat Area of Particular Concern (HAPC) Designation. Prepared by the Fisheries Leadership & Sustainability Forum for the Mid-Atlantic Fishery Management Council. May 2016
[11] https://www.federalregister.gov/d/E9-13866/p-7
[12] NOAA 2007. Essential Fish Habitat and Critical Habitat: A comparison. NOAA, National Marine Fisheries Service
[13] (http://www.nmfs.noaa.gov/sfa/hms/shortfinmako/habitat.html)
[14] NMFS. 2006. Final Consolidated Atlantic Highly Migratory Species Fishery Management Plan. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Sustainable Fisheries, Highly Migratory Species Management Division, Silver Spring, MD. Public Document. pp. 1600.

Further, the eight regional fishery management councils and NOAA Fisheries Highly Migratory Species Management Division are responsible for designating Habitat Areas of Particular Concern (HAPCs). HAPCs are habitat areas or types which, based on the consideration of ecological function, sensitivity, exposure to development stress, and rarity are usually designated for a specific species or Fisheries Management Plan. Designation of HACPs requires a statement on how it may be impacted by fishing and non-fishing activities. During consultation with those agencies whose activities may impact on EFH, the presence of HAPCs within the proposed impact zone may be leveraged to support a more focused examination of mitigation measures.

A somewhat more impregnable defence for marine areas is the allocation of Critical Habitat (CH) under the Endangered Species Act, 1973. This is only applicable to species listed as endangered or threatened under the ESA and CH must be designated at the time (or within 1 year) of the species listing[15]. Critical habitat includes areas, *occupied or unoccupied* by the species, and the *physical as well as biological features* of those areas, which may require special management considerations or protection, that is essential for the conservation of the species. Any reasonable terms and conditions submitted by the NMFS during consultation become mandatory obligations that must be adhered to by any agency whose activities may impact on the CH.

A further example of fisheries orientated marine spatial planning in the USA is the Massachusetts Ocean Management Plan (2009 and revised in 2015). The plan established three types of management areas: Prohibited, Renewable Energy and Multi-Use. The overall plan was developed by specific working groups for fisheries, habitats, renewable energy, etc. In the Fisheries working group report, areas of high commercial importance to the fishing industry and high concentrations of recreational fishing were identified during plan development (Figure 3).

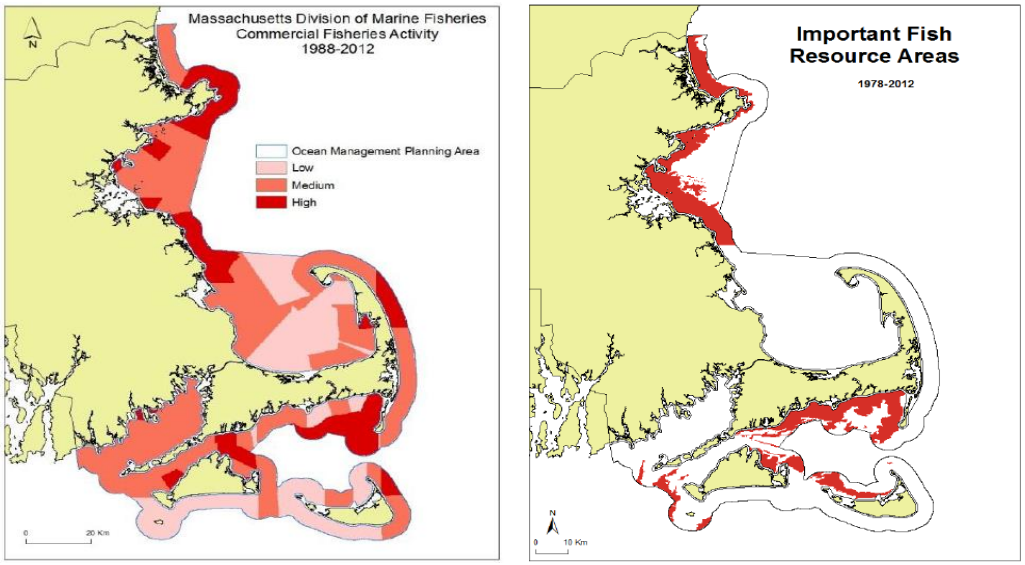

Figure 3: **Left: Areas of High commercial fishing by effort and value (Massachusetts Ocean Management Plan Update Fisheries Work group report 2014); Right: Important Fish Resource Areas[16]**

The plan is comprehensive in both its coverage of fisheries and sensitive species resources as well as thorough in its description and methodology used to map areas of importance. When designating

[15] http://www.nmfs.noaa.gov/pr/pdfs/laws/esa.pdf
[16] Fisheries Work Group Report. 2014 Massachusetts Ocean Management Plan Update. Executive Office of Energy and Environmental Affairs. Massachusetts Office of Coastal Zone Management.

the level of importance of different areas for commercial fishing the plan is transparent about the data limitations and cautions of using catch and effort information that does not take into account the relative social, economic or seasonal importance of some areas. The plan also designated 'Special, Sensitive or Unique' species and habitats (SSUs) within the plan area. SSUs include 'Important Fish Resource Areas', defined as areas of high importance to commercial and recreational fisheries as represented by trawl survey abundance data aggregated over time.

2.3 Canada

The Oceans Act, 1997[17]marked Canada as the first nation to develop a national oceans policy and laid the foundation for the 2002 Oceans Strategy as well as the development of federal Ocean Actions Plans (2005-2007). Integrated Fisheries Management Plans (IFMPs) for Canada's coastal and marine waters were met through planning efforts designed around six large ocean management areas (LOMA). The Department of Fisheries and Oceans Canada (DFO) uses IFMPs as planning frameworks to manage specific species in a given region through guidance towards conservation and sustainable use. IFMPs are not however legally binding documents, they are **public documents** used as a tool to guide fisheries managers and licensing conditions through two key functions:

- *Identification of the issues, objectives and management measures designed to ensure an orderly, economically viable, socially/culturally beneficial and sustainable fishery;*
- *Communication of basic information on a fishery and its management within DFO and to outside parties.*

Management issues are identified for the fishery which provides the foundation for development of fishery objectives; access and allocations; management measures; shared stewardship agreements and compliance plans. Ecologically and Biologically Significant Areas (EBSAs), Ecologically Sensitive Areas (ESAs), Marine Protected Areas (MPAs), Areas of Interest (AOIs) and *Critical Habitat* as listed by the Species at Risk Act, 2002 (SARA)[18], are some of the spatial priority areas described by the IFMP.

SARA is applicable to endangered or threatened species and defines **habitat for marine species** as *spawning grounds and nursery areas, rearing and recruitment areas, food supply systems, migration routes and any other areas on which aquatic species depend directly or indirectly in order to carry out their life processes, or areas where aquatic species formerly occurred and have the potential to be reintroduced*[18]. Comprehensive guidance tools and templates are available for developing IFMPs in a uniform format[19,20,21]. IFMPs are described as *evergreen plans* that remain in effect/as baseline management documents until revision is prompted.

[17] http://laws-lois.justice.gc.ca/eng/acts/O-2.4/
[18] SARA. 2002. Species at Risk Act S.C. 2002, c. 29. Published by the Minister of Justice at the following address: http://laws-lois.justice.gc.ca
[19] http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/ifmp-gmp/guidance-guide/template-app-a-ann-modele-eng.htm
[20] http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/ifmp-gmp/guidance-guide/preparing-ifmp-pgip-elaboration-eng.htm
[21] http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/ifmp-gmp/guidance-guide/summary-template-modele-resume-eng.htm

2.4 New Zealand

In New Zealand in 1983, a regional fisheries management framework was outlined with the intention of conserving the health of fish stocks, limiting access to fisheries whilst simultaneously promoting commercial and recreational fishing, limiting overcapacity and achieving maximum sustainable yields. The baseline for the work was the identification of 10 fisheries management areas (FMAs) and the development of a fisheries management plan for each – although in 1986 those plans were discontinued. The FMA boundaries do not align with statistical boundaries, although they were used as the basis from which a permit holders' catch history was calculated. Rather the boundaries and the FMAs themselves were an administrative construction reflecting the capacities of the fisheries management teams responsible for determining those catch histories (Figure 4).

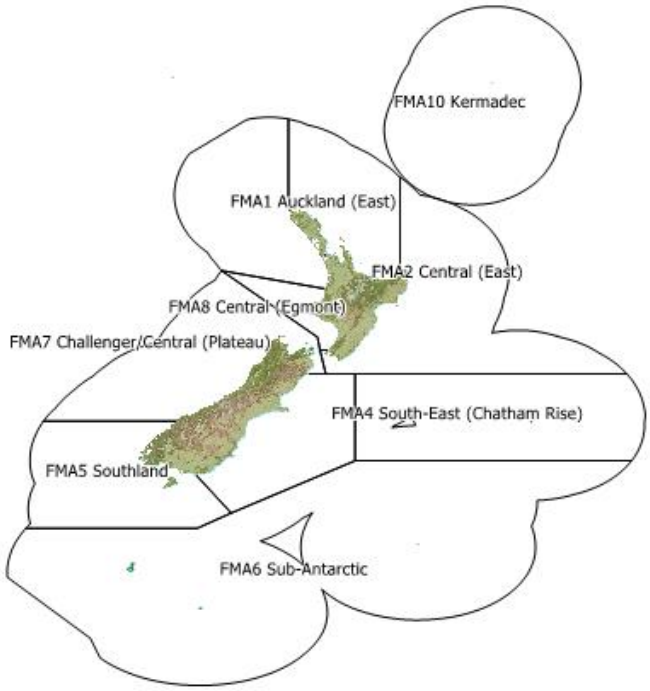

Figure 4: **Statistical Fisheries Management Areas. Outline of New Zealand General Fisheries Management Areas (FMA) (generated from NABIS (MPI)[22])**

Through the Fisheries Act, 1983 New Zealand became the first nation to comprehensively implement an Individual Transferable Quota (ITQ) system amongst its national fisheries[23,24]. The ITQ system was given effect by the 1986 Fisheries Amendment Act and set Total Allowable Catch (TAC) and Total Allowable Commercial Catch (TACC) limits for commercially targeted species that would be managed by the Quota Management System (QMS). The QMS was initialised in 1986 and is still (2018) the mechanism by which the vast majority of New Zealand's commercial catch is managed.

[22] MPI National Aquatic Biodiversity Information System. http://www.nabis.govt.nz/Pages/default.aspx (accessed 3 November 2017)

[23] Colman, J.A., J.L. McKoy and G.G. Baird. (1985). Background papers for the 1985 Total Allowable Catch recommendations. Fisheries Research Division, NZ Ministry of Agriculture and Fisheries. 259p

[24] Sissenwine, M. P. and P. M. Mace. (1992). ITQs in New Zealand: the era of fixed quota in perpetuity. Fishery Bulletin 90(1): 147-160.

Although purely administrative, the FMAs in New Zealand provide the scaffolding for the definition of Quota Management Areas (QMAs) that are designated for each stock in the QMS. Those QMAs may cover part of an FMA, a single FMA or multiple FMAs. Within each QMA the TACC is set annually by New Zealand's Ministry for Primary Industries and ITQs are measured as a percentage of the TACC rather than a set tonnage. Stock assessments enabled the identification of separate fish stocks based on the known biological distribution of each species and were the basis for determination of QMAs and TACs[25].

The ITQ system applied to each species within its defined QMA is an important component of ensuring the sustainability of the fish stock. Additional regulations may be needed to control the details of exactly where (not in breeding grounds), when (not during spawning), how (not using destructive techniques), and what (not too small) fish are caught[25]. Catch limits; catch splits by QMA; operational objectives; biological reference points; economic value rates; environmental interactions, indicators and regulations; as well as management actions and performance criteria are detailed in comprehensive Fisheries Plans for each of the main commercial species targeted in New Zealand Inshore and Deepwater fisheries.

The Fisheries Plans are suitably poised to inform the next stage in New Zealand's governance of its ocean space – or Marine Spatial Planning (MSP). There has as yet been no official development of area-based or spatial planning in the EEZ but, basic integrated management to complement existing legislation and regulate the effects of activities on the environment has been promulgated through the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act, 2012 (EEZ Act)[26]. The EEZ Act categorises types of activities as *permitted, discretionary* and *prohibited*. It does not manage fisheries, oil and gas permits, or shipping. It does however mandate a single agency to evaluate the effect of any activity within the EEZ and take into account any existing activities and legislation or marine plans in order to reduce conflict and minimise jurisdictional overlap[27]. These principles comprise: area-based ecosystem management; principled anticipatory management; integrated management of multiple activities; precaution; review, monitoring and adaptive management; and public engagement.

[25] Hendy, J., Kerr, S., & Straker, G. (2002). A Regulatory History of New Zealand's Quota Management System: setting targets, defining and allocating quota.
[26] http://www.legislation.govt.nz/act/public/2012/0072/76.0/DLM3955428.html
[27] Scott, K. N. (2016). The Evolution of Marine Spatial Planning in New Zealand: Past, Present and Possible Future. *The International Journal of Marine and Coastal Law*, *31*(4), 652-689.

2.5 Namibia

An example the use of FMAs in the African sub-region can be seen in Namibia. Namibia inherited severely overexploited fisheries at independence in 1990. Amongst the fisheries of most importance is the hake fishery which exploits the same hake species as found in South African waters; deepwater hake *Merluccius paradoxus* and shallow water hake *M. capensis.* This fishery has closed the area shallower than 200 m to all forms of trawling for hake. The rationale for this closure is unclear, however it is assumed the restriction is intended to protect juvenile hake from over-exploitation. A further measure, which would seem contradictory, was the limitation of hake freezer trawling to deeper than 350 m south of the 26°S latitude, primarily to minimise catching of recruiting juvenile deepwater hake from the southern Benguela (South African waters). There however remains uncertainty as to these spatial measures in the context of transboundary management of both the shallow and deepwater hake species that are transboundary between South Africa and Namibia, including the areas shallower than 200 m. Perhaps the most significant spatial management measure introduced by Namibia was after the discovery of orange roughy (*Hoplostethus atlanticus*) in Namibian waters in the mid 1990's. This species, whose distribution is both depth and habitat dependent, with a strong seasonal aggregating behaviour, is managed as four discreet areas or Quota Management Areas (similar to New Zealand) – see Figure 5. This fishery is directed at the outer Namibian shelf from 500 – 1500 m water depth for orange roughy and, to a lesser extent, alfonsino (*Beryx splendens*). Orange roughy is aggregated in four Quota Management Areas (QMA's) referred to as "Hotspot", "Rix", "Frankies" and "Johnies". Almost no fishing for this species takes place outside of the designated QMA's. The delineation of QMAs informs Environmental Impact Assessments (EIAs) in the proximity of the fishery[28]. Significantly, despite spatial management and quota limitation, the fishery has all but collapsed with only a small experimental allowance to monitor stock recovery.

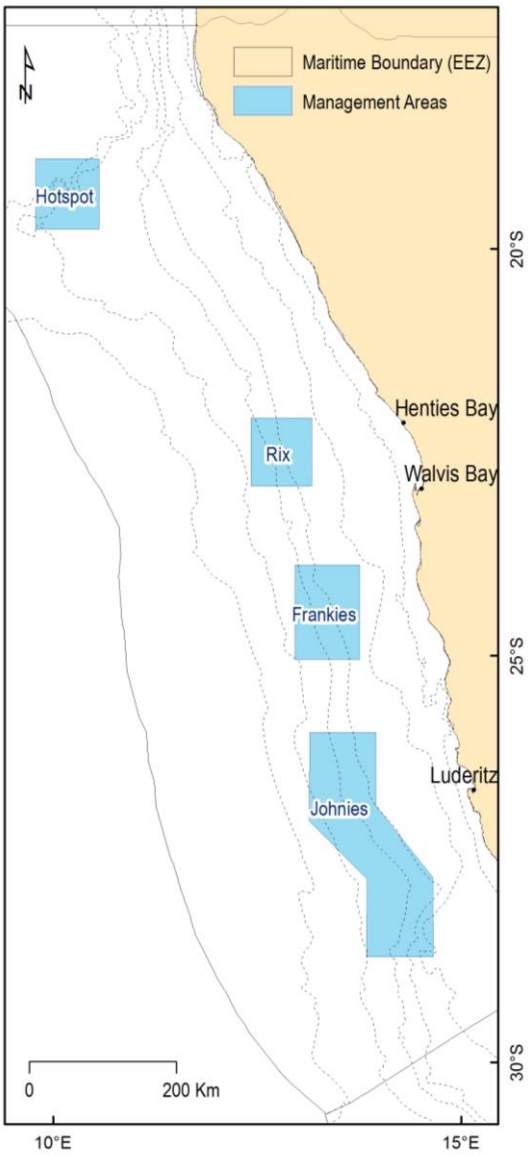

Figure 5: **Map showing the four Orange Roughy Fishery Management Areas (QMAs) introduced by Namibia in 1996 for the management of the fishery (map after Japp and Wilkinson, 2007[28])**

[28] Japp, D.W. and S. Wilkinson, 2007. Environmental Impact Assessment (Fisheries) prepared for CCA Environmental : Offshore Namibia Seismic Programme BHP Billiton

3.0 The Legislative Framework for Implementation of Spatial Management in South Africa

The spatial nature of ecosystems, natural resources and human demographics and diversity of activities implicitly suggests that there is a need for some form of spatial management. Fisheries and the resources they exploit are complex and incorporate both social interaction between humans, and the use of increasingly sophisticated technology to target living marine resources. Historically, fisheries management has followed a target resource oriented approach to management (TROM) rather than focusing on the broader ecosystems approach that considers the effect the removal of targeted stocks might have on the trophic structure and habitat. The gradual recognition of the need for an ecosystem approach to fisheries management in South Africa has taken root and, along with the established management approaches, EAF is now applied to fisheries not only in South Africa, but globally as well. Ecosystem-based fisheries management (EBFM) is fundamentally a spatially explicit approach with numerous benefits of spatial fisheries management having been demonstrated, including conservation benefits as well as improvements in stock status leading to increased catch rates and economic returns[29].

In South Africa, fisheries are managed through both output (TAC) and input controls (TAE) as well as through a complex set of regulations and permit conditions that include spatial and temporal measures. Technical management measures, such as gear and species restrictions are effected through legislation. The application of ecosystem-based measures is now broadly incorporated into the permit conditions of most commercial fishing sectors in South Africa. While EAF is implicitly considered in scientific and management working groups, the effectiveness of the implementation of these explicit measures as required in the permit conditions, remains to be demonstrated. An area of weakness in the ecosystem-based approach is the incorporation of spatial management tools. While spatial and temporal measures do exist, no detailed explanation on the rationale for them (specifically related to fisheries) is available. In some cases, historical spatial measures would seem outdated, while others need improvement or the application of new measures that are more consistent with the new ecosystem-based approach. This would include the advancement of research needs that specifically addresses, and critical review of, the place-based legislative tools for management in the ocean.

Reed[30] (2018) investigated spatial management options by reviewing current legislative tools for spatial management in South African marine environment (including fisheries). Seven marine-related Acts and Bills were reviewed, including the National Environmental Management Act, 1998 (incorporating Integrated Coastal Management and Marine Protected Areas components provided for in the Integrated Coastal Management Act, 2008 and Protected Areas Act, 2003 respectively), the Mineral and Petroleum Resources Development Act, 2002, the Marine Living Resources Act, 1998, the Draft Aquaculture Bill, 2016 and the Marine Spatial Planning Bill, 2017.

[29] Kerwath, S. E., Winker, H., Götz, A., & Attwood, C. G. (2013). Marine protected area improves yield without disadvantaging fishers. *Nature Communications*, *4*, 2347.

[30] Reed, J.R. 2018. A review of legal instruments to support spatial ocean management in South Africa. In: *Spatial management options for marine fisheries in South Africa: case studies of specific industries.* PhD thesis in preparation.

The review revealed ten spatial legislative tools that may be used to improve place-based management in the ocean (Appendix 5, pg. 106). Of these legal instruments, seven are seen to have relevance to fisheries management (Table 1). The implementation of these spatial management tools are either directly intended to improve fisheries management[31] or may be utilised for improved fisheries management; by spatially managing users in order to address spatial aspects of fisheries, such as catch and effort, priority economic areas, protection of resources exploited to sustain biodiversity, critical life history stages and recruitment (amongst others), prohibiting or restrict the granting of permits, rights and authorisations for specific activities in certain geographical areas[32] and mitigate user conflicts[33].

Table 1: Potential legislative tools for spatial fisheries management (as identified by Reed, 2018[30])

Act or Bill	Legislative tools relevant to spatial fisheries management	Implementation under legislative tool
National Environmental Management Act, 1998 (No. 107 of 1998) as amended in 2013 (No. 30 of 2013).	Environmental authorisation "no-go" areas for listed activities (Section 24(2A))	None
National Environmental Management: Integrated Coastal Management Act, 2008 (No. 24 of 2008)	Special management areas (Section 23)	None
National Environmental Management: Protected Areas Act, 2003 (No. 5 of 2003) as amended in 2014 (No. 21 of 2014)	Marine protected areas (Section 22A)	27 existing MPAs implemented with 22 proposed MPAs in the process of being implemented
Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002) as amended in 2008 (No. 49 of 2008)	Mining and petroleum resources "no-go" areas (Section 49)	None in marine environments. Section 49(1) notice published in 2014 to restrict granting of reconnaissance permits, technical cooperation permits, exploration rights and production rights related to shale gas hydraulic fracturing, in designated areas in the Karoo.
Marine Living Resources Act, 1998 (No. 18 of 1998) as amended in 2014 (No. 5 of 2014) and by Regulations Relating to Small-Scale Fishing in terms of section 19 of the MLRA, 1998 (published 08 March 2016)	Fisheries management areas (Section 15)	None
	Priority fishing areas (Section 17)	None
	Small-scale fishing areas and zones (Section 19)	In the process of being implemented
Draft Aquaculture Bill, 2016	Aquaculture development zones (Section 19)	None

[31] Section 15 and Section 17 MLRA; Section 22A NEM:PAA
[32] Section 24(2A) NEMA; and Section 49 MPRDA.
[33] MSP Bill, 2018

4.0 Results - Offshore Fisheries in South Africa

A selection of fisheries in the offshore fisheries sector within the South African EEZ was chosen for review. The selected fisheries are summarised in Table 2. Purposefully this report focused only on offshore fisheries as it was felt the complex inshore sectors, that included west coast rock lobster and other small scale fisheries, were beyond the scope of this exercise and should be dealt with separately. The methodology followed is described below.

Table 2: Offshore Commercial Fishing Sectors in South Africa under review

Sector	Areas of Operation	Main Ports in Priority	No. of Vessels (2015)	Rights Holders (2016)	Landed Catch (2016)	Target Species	Primary Bycatch
Hake deep sea trawl	West Coast, South Coast	Cape Town, Saldanha, Mossel Bay, Port Elizabeth	45	50	151 456 t	Deepwater Hake (*Merluccius paradoxus*), Shallow-water Hake (*Merluccius capensis*)	Sharks, Skates & rays, Teleosts (Monk, Kingklip, snoek, horse mackerel)
Hake/ sole inshore trawl	South Coast	Cape Town, Saldanha, Mossel Bay	31	18	6 956 t	East coast sole (*Austroglossus pectoralis*), Shallow-water Hake (*Merluccius capensis*), juvenile horse mackerel (mackerel (*Trachurus capensis*)	Sharks (*Galearrhinus & Mustelus* in particular), Linefish (silver kob, carpenter, panga, white stumpnose, gurnard, juvenile hsm, snoek)
Mid-water trawl	South Coast	Cape Town, Port Elizabeth	6	34	9 674 t	Adult Horse mackerel (*Trachurus capensis*)	Chondrichthyns (pelagic), ribbonfish.
Hake long-line	West Coast, South Coast	Cape Town, Saldanha, Mossel Bay, Port Elizabeth, Gansbaai	64	146	9 027 t	Shallow-water Hake (*Merluccius capensis*)	Kingklip (*Genypterus capensis*), Chondrichthyns
Large pelagic long-line	West Coast, South Coast, East Coast	Cape Town, Durban, Richards Bay, Port Elizabeth	31	30	7 492 t	Yellowfin tuna (*T. albacares*), Big eye tuna (*T. obesus*), Swordfish (*Xiphius gladius),* Southern Bluefin tuna (*T. maccoyii*)	Carcharhinid sharks, Albacore tuna
Tuna pole	West Coast, South Coast	Cape Town, Saldanha	128	170	2 809 t	Albacore tuna (*T. alalunga*)	Yellowfin tuna, snoek, yellowtail
Small	West	St Helena	101	111	399 612	Anchovy (*Engraulis*	Juvenile sardine,

Sector	Areas of Operation	Main Ports in Priority	No. of Vessels (2015)	Rights Holders (2016)	Landed Catch (2016)	Target Species	Primary Bycatch
pelagic purse-seine	Coast, South Coast	Bay, Saldanha, Hout Bay, Gansbaai, Mossel Bay			t	*encrasicolus*), Sardine (*Sardinops sagax*), Redeye (*Etrumeus whiteheadi*)	horse mackerel & sardine, Lanternfish, Lightfish
South coast rock lobster	South Coast	Cape Town, Port Elizabeth	12	13	735 t	SCRL (*Palinurus gilchristi*)	Octopus (*O. vulgaris*), slipper lobster (*Scyllarides spp*)
KwaZulu-Natal prawn trawl	East Coast	Durban, Richards Bay	5	6	181 t	Tiger prawn (Panaeus monodon) White prawn (Fenneropenaeus indicus) Brown prawn (Metapenaeus monoceros) Pink prawn (Haliporoides triarthrus)	Linefish (juvenile & square tail kob) Sharks, rays, skates Red prawn (Aristaeomorpha foliacea) Langoustines (Metanephrops mozambicus and Nephropsis stewarti) Red crab (Chaceon macphersoni) Rock Lobster (Palinurus delagoae)
Squid jig	South Coast	Port Elizabeth, Port St Francis	138	92	8 500 t	Cape Hope squid/chokka (*Loligo vulgaris reynaudii)*	

4.1 Spatial Mapping – data and statistical processing

Commercial catch and effort data for each sector was provided by the Department of Agriculture, Forestry and Fisheries (DAFF) through a formal PAIA (Promotion of Access to Information Act) request submitted by the South African National Biodiversity Institute (SANBI) for work to identify important fisheries areas. Each specific fishery reports on catch and effort at different resolutions. Data provided were also for varying periods of time, for each fishing sector catch and effort were mapped according to the most appropriate resolution and time-scale (Table 3). These data were then standardized and averaged into grids of either 10' (minutes) or approximating 10nm x 10nm or 20' (approximately 20nm x 20nm).

Certain of the datasets contained some very high values which would have masked the importance of moderate levels of influence. Data were therefore normalised using the formula:

$$p=d_1/d_{80},$$

where d_1 is the raw pressure data in a grid and d_{80} is the 80th percentile of the catch values for that data set, with resultant values over 1 being assigned a 1 value.

The compilation of the individual datasets into this consistent format and range was necessary to allow spatial patterns of intensity of different sectors to be compared and for cumulative scores of the importance of each area to be calculated, so that the priority areas of a low volume fishery is weighted with an equal importance as might be assigned to a fishery of significantly higher catch volume. Following data normalisation the highest 20% and 10% of the catch and effort values were assigned as being the potential priority fishing areas i.e. the 80^{th} and 90^{th} percentiles and the remaining area was denoted as broadly characterising the sector-specific spatial fishing area. The outputs from this data sorting allowed for preliminary analysis of each fishery sector into areas of more or less spatial importance (based on catch or effort). The baseline maps created in this way were presented to stakeholders for critique and formed the basis for discussions on the relative importance of different fishing areas.

Table 3: List of commercial fisheries sectors and date range of mapped data.

Sector	Data Range	Comment/ Scale resolution
Small pelagic purse-seine	2000 – 2016	Catch (tons) and effort (hours, no. of sets) at 10 x 10 grid resolution
Midwater trawl	2008 – 2016	Catch (tons) and effort (hours) at 10 x 10 grid resolution
Demersal trawl (inshore & deep-sea)	2008 – 2016	Catch (tons) and effort (hours) at 10 x 10 grid resolution
Demersal hake long-line	2000 - 2007	Catch (tons) and effort (hours) at 10 x 10 grid resolution
Large pelagic long-line	2000 – 2014	Catch (tons) and effort (number of hooks set) at 60 x 60 grid resolution
Squid jig	2012 – 2015	Catch (tons) at 10 x 10 grid resolution
South coast rock lobster	2006/7 – 2015/16	Catch (tons) and effort (no. of traps hauled) at 10 x 10 grid

4.2 Demersal trawl (deepsea and inshore)

Overview of the sector

Hake-directed trawling started at the beginning of the 19th century. At the time (1900) fishing effort was limited to side trawlers and steam-driven vessels[34]. Trawl effort was constrained by the power of the vessels and gear used. The fishery developed nearshore and operations rarely fished deeper than 300m. This of course changed over time as vessel capacity increased, technology improved and effort systematically moved into deeper water. Currently the trawl fleet regularly fishes in up to 800 m water depth. Hake is the primary target species and the fishery as a whole, is the most valuable fishing sector in South Africa.

The main target species are the two hake species (commonly referred to as "cape hake"). In the context of their spatial distribution, the deepwater species *Merluccius paradoxus,* is caught in waters deeper than 300 m, while the shallow water hake *M. capensis* is caught from 50-300 m. There is some overlap between these species in the depth range 250-350 m (approximately). Secondary or bycatch species make up an important component of the hake-directed trawl fishery, in particular monkfish (*Lophius vomerinus*), kingklip (*Genypterus capensis*) and snoek (*Thyrsites atun*). An important development in the hake fishery was the capping of catch using a Total Allowable Catch (TAC) which started in the mid 1970's. Later (in the 1990's) precautionary upper catch limits (called PUCLs) was set for both kingklip and monk.

When the fishery started the south coast (or Agulhas Bank) was one of the most important areas fished. It was in the nearshore that the Inshore Trawl sector developed, initially targeting sole (*Austroglossus pectoralis*), but also many other linefish species, making up a high bycatch which reflected the fish diversity on the Agulhas Bank. From mid-1980's the hake catch in the inshore became increasingly important as other stocks declined and "white fish" markets developed on a global scale. Currently (2018) the inshore trawl sector, although still important, has shrunk in size with only a few small sole-directed vessels and some larger hake-directed vessels. A fundamental management measure was the adoption of "boat limitation" which constrained vessel power and vessel length (max. 30 m).

In the deepsea sector (also referred to as the "offshore" sector) the fishery comprises of both freezer and wetfish trawlers (about 45 in total) operating primarily from Cape Town and Saldanha Bay. This fleet mostly catches deepwater hake and also has maintained Marine Stewardship Council (MSC) certification since 2004[35].

Stock Dynamics

Hake spawning areas have been difficult to accurately identify however there appear to be two areas of the western Agulhas Bank where hake spawn, namely inshore (100-300m deep) and offshore (400-1000m deep)[36,37]. In addition a hake nursery area off Cape Columbine has been

[34] Sink K.J, Wilkinson S., Atkinson L.J, Sims P.F, Leslie R.W. and Attwood C.G. 2012. The potential impacts of South Africa's demersal hake trawl fishery on benthic habitats: historical perspectives, spatial analyses, current review and potential management actions. *Unpublished report: South African National Biodiversity Institute.*

[35] https://fisheries.msc.org/en/fisheries/south-africa-hake-trawl/@@view

[36] Augustyn, C.J., Cockcroft, A., Coetzee, J., Durholtz, D. and C. van der Lingen Rebuilding South African Fisheries – three diverse case studies.(FAO in publ.)

proposed by several studies ([38,39,40]). Smith and Japp (2009)[41] collated available information mainly on collection of hake roe by the commercial fleet to infer the location of spawning of the two species, and suggested a number of "hotspots" generally located near or over the shelf edge for both species (*M. capensis* tending to spawn shallower than *M. paradoxus*), although aggregations of ripe *M. capensis* were also encountered in shallow areas on the Agulhas Bank and off the Orange River mouth. The paucity of "ripe-and-running" hake in catches made using demersal trawl gear suggest that hake spawn in the water column rather than in close proximity to the sea bed.

Regarding stocks, there are several potential stocks, although their existence is not conclusive. Historically the identification of hake stocks has shifted sequentially from the assumption that a single stock and single species existed in South African waters (in the Benguela and Agulhas ecosystems), to the separation of species (shallow and deep), to two stocks (Benguela and Agulhas) and more recently to a single deep-water stock that extends from South Africa into Namibia and shallow-water *M. capensis* stocks on the south coast, and west coast of South Africa and also in Namibia. These hypotheses have obvious implications for management and stock assessments, in particular in a transboundary context between South Africa and Namibia.

Current Spatial and Temporal Measures

The following spatial measures apply to the hake trawl fishery (Inshore and deepsea).

- Trawl permits are valid only in South African waters (excluding tidal lagoons, tidal rivers and estuaries), closed areas and marine protected areas as stipulated in Chapter 3 of MLRA Regulations
- No fishing shall take place within False Bay, north of a straight line drawn from the lighthouse at Cape Hangklip to the lighthouse at Cape Point
- In the area east of 020°E longitude, no fishing shall take place in water depths of less than 110m or within 20 nautical miles from the coast, whichever is the greater distance from the coast (Introduced in 1978) - East coast/Agulhas Sole (A. Pectoralis) distribution from 0-100m. 100-110m acts as a buffer zone. Protection of the Agulhas bank from heavily industrialised offshore demersal trawl and foreign trawl fleets.
- In the area west of 020°E longitude, no fishing shall take place within 5 nautical miles of the coast.

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[37] Durholtz, M.D., Singh, L., Fairweather, T.P., Leslie, R.W., van der Lingen, C.D., Bross, C.A.R., Hutchings, L., Rademeyer, R.A., Butterworth, D.S. and Payne, A.I.L., 2015. *Fisheries, ecology and markets of South African hake* (pp. 38-69). John Wiley & Sons.

[38] Sundby, S., Boyd, A.J., Hutchings, L., O'Toole, M.J., Thorisson, K. and Thorsen, A., 2001. Interaction between Cape hake spawning and the circulation in the Northern Benguela upwelling ecosystem. *South African Journal of Marine Science*, *23*(1), pp.317-336.

[39] Hutchings, L., Beckley, L.E., Griffiths, M.H., Roberts, M.J., Sundby, S. and Van der Lingen, C., 2002. Spawning on the edge: spawning grounds and nursery areas around the southern African coastline. *Marine and Freshwater Research*, *53*(2), pp.307-318.

[40] Stenevik, E.K., Verheye, H.M., Lipinski, M.R., Ostrowski, M. and Strømme, T., 2008. Drift routes of Cape hake eggs and larvae in the southern Benguela Current system. *Journal of plankton research*, *30*(10), pp.1147-1156.

[41] Smith, M., and Japp, D.W. 2009. A review of the life history of *Merluccis paradoxus* and *M. capensis* with emphasis on spawning, recruitment and migration. *Internal Report Prepared for the South African Deep Sea Trawling Industry Association (SADSTIA).*

- Kingklip Spawning Box (Figure 6)[42] : During the period 1 September to 30 November, no fishing shall take place between longitudes 24°E and 25^0 E and Latitudes within the quadrilateral described by lines joining the following four points:-

  A : 34.8 S24E; B: 34.63S 25E; C:34.73S 25E; D:34.95S 24E

- No fishing may take place outside of the areas defined as the "Hake Trawl Ring Fence" (this ringfencing relates to MSC conditions that restrict the trawl fishery to grounds that have been systematically fished in the past, where the benthos has already been altered).

Fishing Patterns

Trawling grounds for hake have been well described. There are clear areas of trawling intensity, as shown in Figure 6 and Appendix 1: *Figure 27*. The fishery has some very clear spatial signals (using the 90th percentile as described in para 4.1). These could be defined as PFAs as follows:

I. Area 1: Due west of Hondeklip Bay – this is an area known as the Karbonkel;
II. Area 2: Due west of Saldanha Bay – this is an area known as the Dassen Hole and is part of a feature known as the Cape Canyon;
III. Area 3: An extensive area extending from due west of Cape Town to due south of Danger Point, also referred to as “Browns Bank”;
IV. Area 4: An area due south of Cape Agulhas extending towards the southern-most part of the Agulhas Bank;
V. Area 5: South of Port Elizabeth and Cape St Francis in an area known as the Chalk Line;
VI. Area 6: A shallow area inshore between Mossel Bay and Struisbaai.

Habitat

The overlap of the trawl fishery with known habitat types has been described by both Wilkinson and Japp (2005)[43] and Sink *et al.* 2012[34]. Broadly, the trawl fishery focuses on benign trawling grounds – that being relatively flat areas or areas with low profiles, and of sandy substrate. These areas are preferred because of the low risk of fouling gear. The fishery does however extend beyond these areas, in particular to muddy substrates (area 5) where Agulhas sole is targeted, and in areas adjacent to “hard” ground where species that prefer rocky, coral or more diversified substrate types and niches occur. Wilkinson and Japp (2005) also described in detail the overlap of trawling intensity with substrate type (Figure 7).

The spatial distribution of trawling and in particular trawling intensity is of particular interest with regard to the protection of biodiversity and habitat types (Sink *et al*. 2012)[34]. The MSC certification conditions for the South African Deep-Sea Trawling Industry Association (SADSTIA) hake fishery also required that the impact of trawling on habitat be investigated and in this regard prompted the ongoing research on trawling impacts in the Karbonkel area on the west coast.

[42] Japp, D.W., Smith, M and S. Wilkinson. 2009. An overview of Marine Protected Areas in South Africa and alternatives for the application of offshore management areas. Unpub. Report . SADSTIA.
[43] Wilkinson, S., and Japp, D.W. 2005. Description and evaluation of hake-directed trawling intensity on benthic habitat in South Africa. In Cape Town: Fisheries and Oceanographic Support Services CC, pp. 69.

Cross-Cutting and Bycatch

The spatial mapping also attempted to identify crosscutting issues between fishery sectors. What was intended here was to identify areas that were fished by one sector that impacted on the target species in another sector, or, where a bycatch in a specific sector could be area-prioritised. For demersal trawl the following issues were identified:

Kabeljou (

I. *Figure 65*): This is a significant bycatch species in the inshore directed sole and hake trawl.

II. Horse mackerel (*Figure 51*): This is a frequently targeted species in demersal trawls and is a quota-managed species that impacts midwater trawl.

Squid (

III. *Figure 50*): Squid is a bycatch in demersal trawls, mostly juveniles and is used as a stock indicator for squid.

Snoek (*Figure 48*): This is a seasonally targeted species by the demersal trawl that has implications for the linefish sector (and can be an area of conflict).

IV. *Figure 43*): Kingklip are a main trawl bycatch that has historically been targeted by the trawl and longline sectors. Due to stock declines spawning aggregations were protected through a time-area closure area and a precautionary catch limit.

V. Monk (*Figure 62*): This is a key bycatch species in demersal trawl that is subject to a precautionary catch limit.

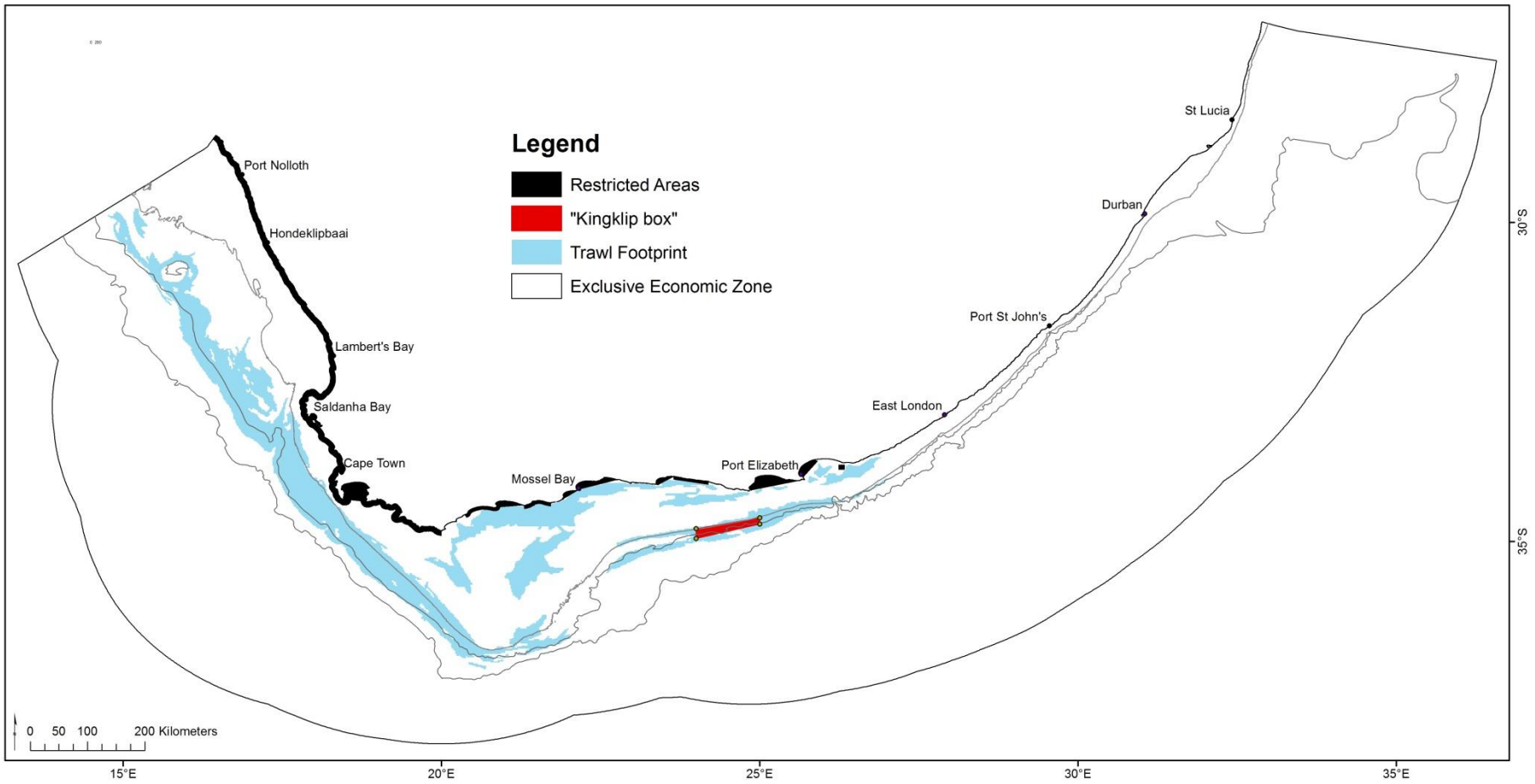


Figure 6: Spatial extent of the hake trawl fishery (light blue) showing the nearshore protected areas (black) and the kingklip spawning box (after Japp et al. 2009)

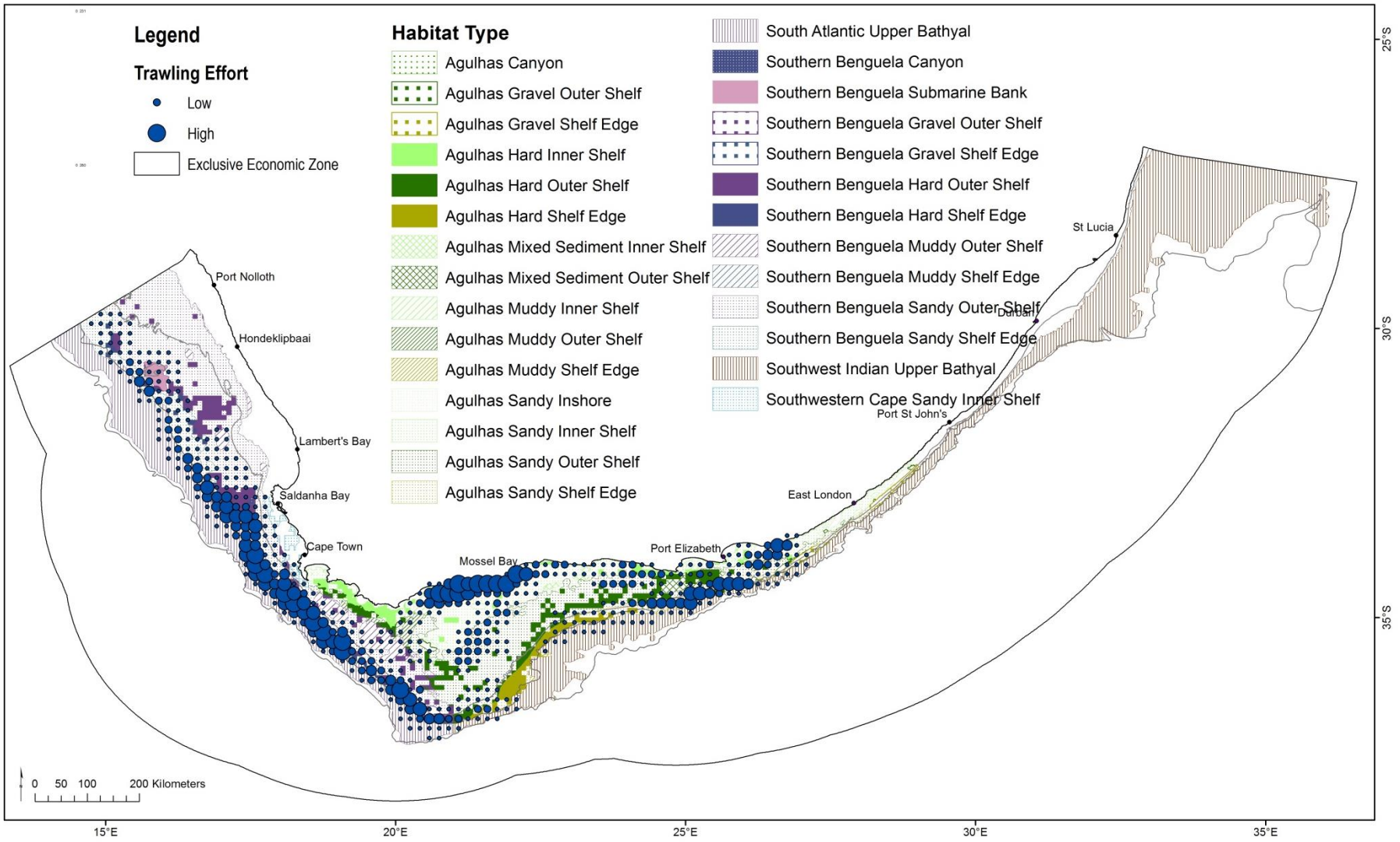


Figure 7: Distribution of hake-directed trawling effort around the South African Coast showing areas of highest trawling intensity overlaid on the known habitat types (after Sink et al., 2012[34]).

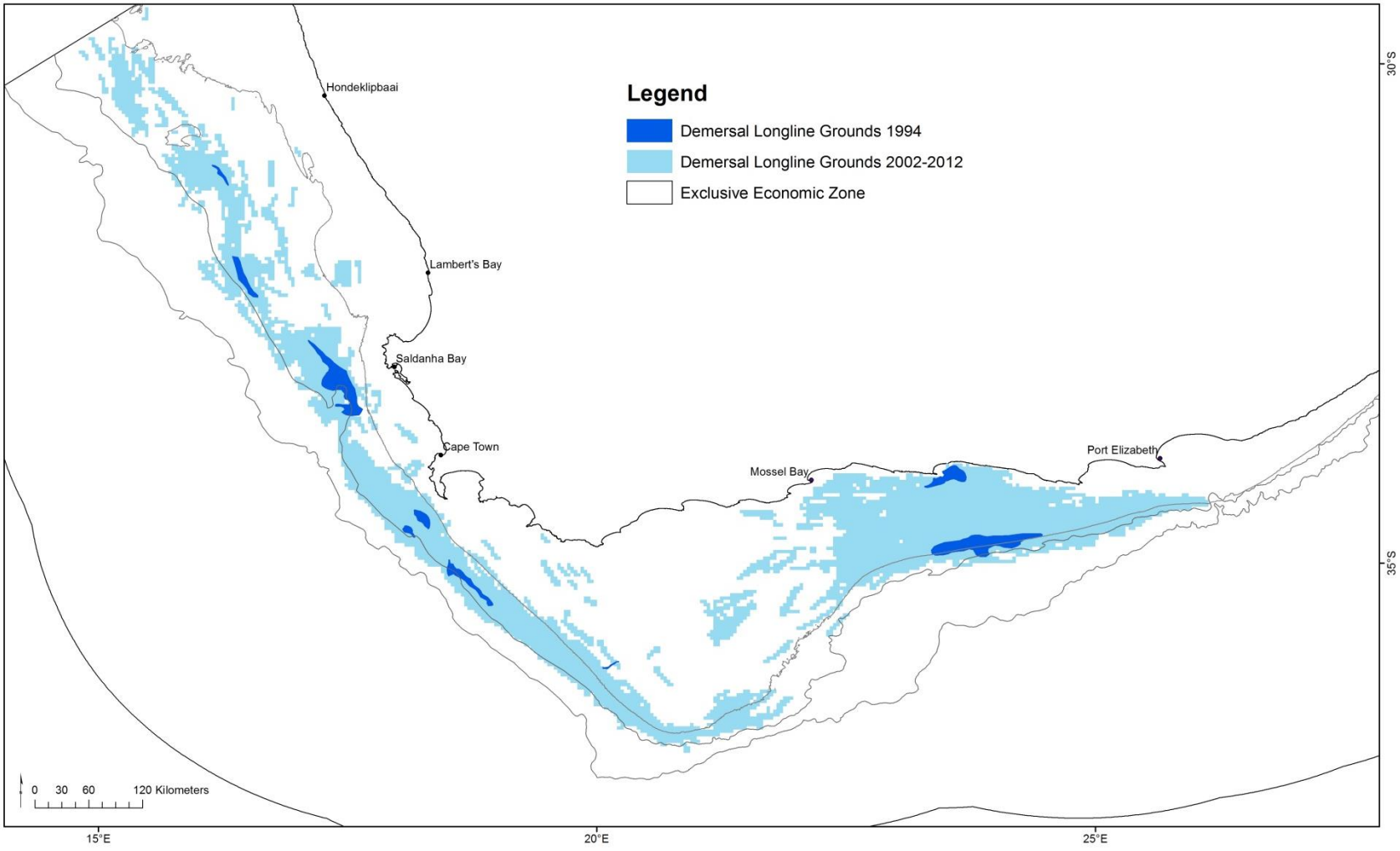


Figure 8: Consolidation of longline areas showing the expansion of effort from the 1994 experimental period to the total area as exploited between 2002 and 2012 (Wilkinson, CapMarine).

User Conflict

There are numerous areas of conflict between hake trawl and other users of the sea. These would include:

Trawl and Longline

Conflict between hake trawl and hake longlines arose with the introduction of hake-directed longlining and the gradual growth of the longline sector. The user conflict relates primarily to gear type with longline sets increasingly drifting onto trawl grounds, or more commonly hake longliners now setting gear on trawl grounds (Figure 8).

Trawl and Wellheads

Trawl nets can become entangled on wellheads (Figure 9) and other structures on the seafloor (either active or inactive structures). This has been comprehensively reported on by PetroSA (see Japp & Wilkinson, 2015[44]). This is an area of conflict which may expand, but which has been addressed between PetroSa and the trawling industry.

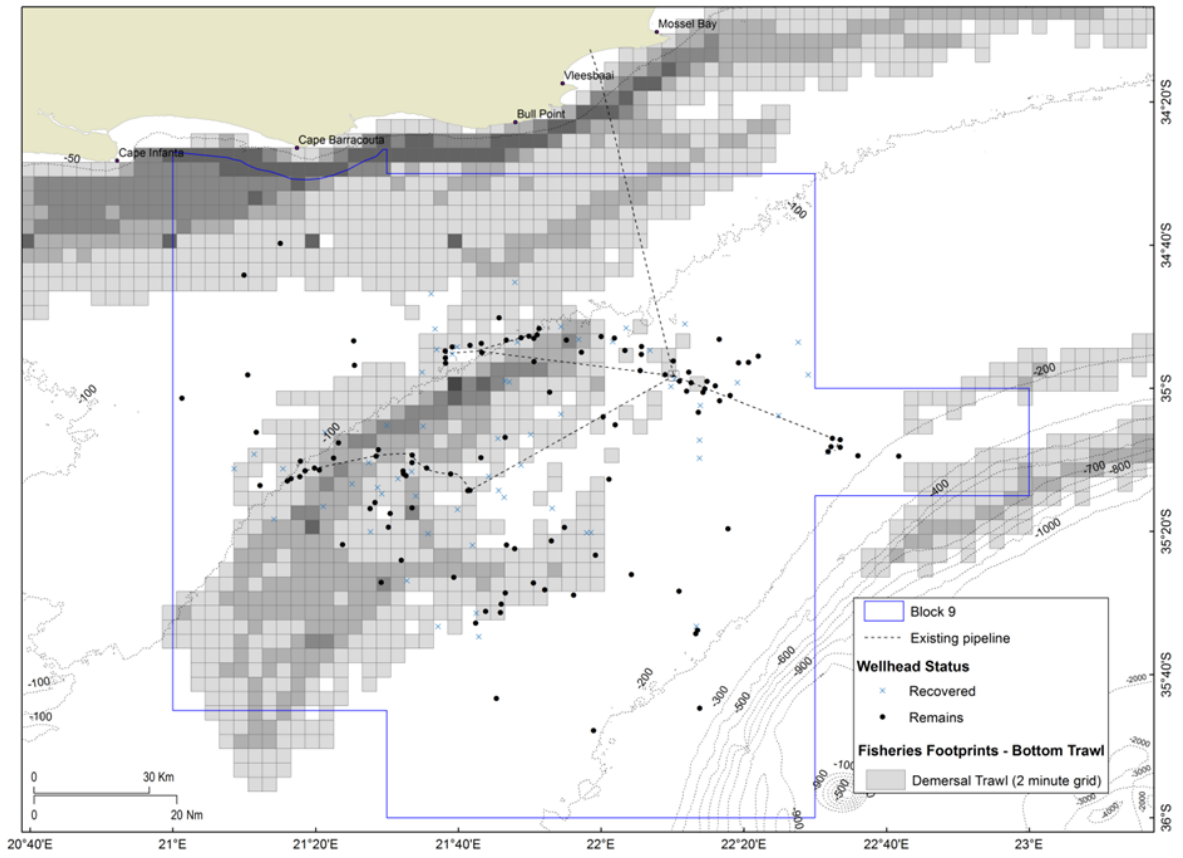


Figure 9: **Spatial distribution of the effort expended by the demersal trawl sector in relation to the wellheads in Block 9. Effort is displayed on a 2 x 2 minute grid as the average annual number hours trawled between 2000 and 2014 (after Japp & Wilkinson, 2015)**

[44] Japp, D.W and Wilkinson, S. 2015. Risk assessment of wellhead snagging on the Agulhas Bank (unpub. Report for PetroSA).

Seismic Surveys and well-heads

There is ongoing conflict between the trawling industry and the conducting of a) seismic surveys and b) well drilling. The concerns relate primarily to:

- Exclusion from fishing grounds (short-term or long-term)
- The actual impact the surveys or drilling and or establishment of oil and gas infrastructure might have on the trawling and the demersal trawl species fished.

These surveys, which can cover large areas (Figure 10) require mitigation and communication between the survey operators and the fishing industry.

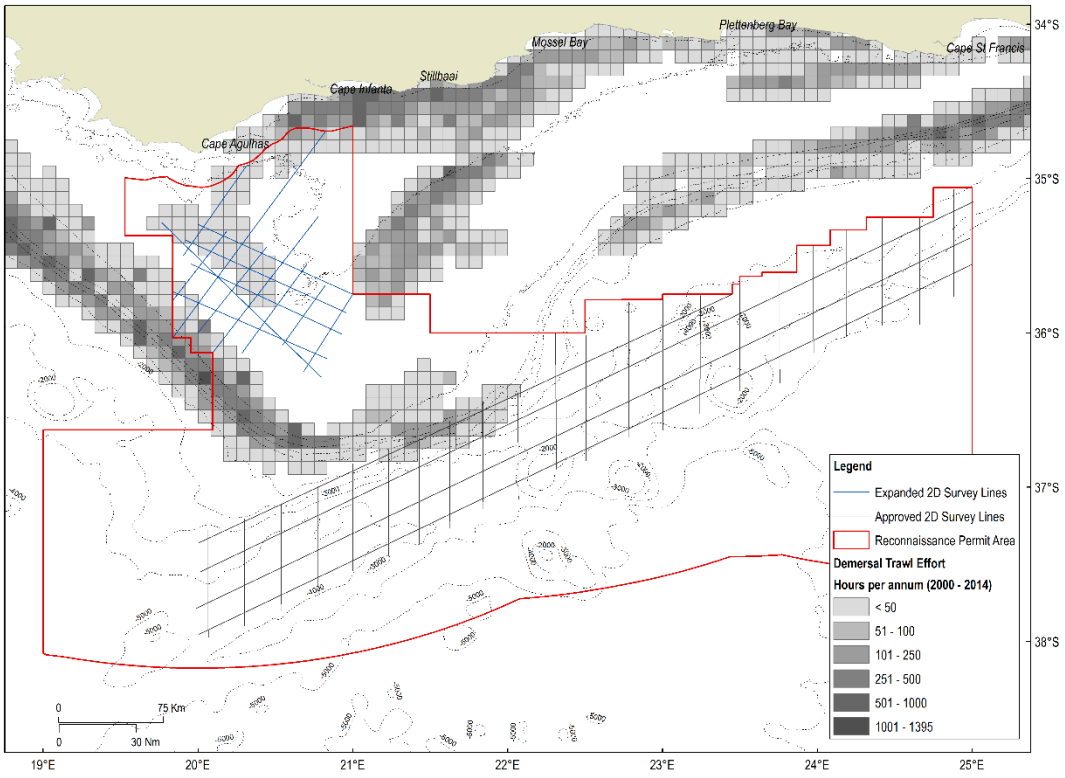


Figure 10: **Petroleum Geo-Services application for a reconnaissance permit to conduct a 2D seismic survey in relation to the average annual demersal trawl sector fishing effort for 2000 – 2014 (SLR Consulting 2015).**

Seabed Mining

Similar to oil and gas conflict, the development of mining activities offshore is increasing. Currently the principle sectors involved are marine diamond mining and exploratory surveys for phosphates. This is an area of considerable concern for the trawling industry because of:

- Exclusion from trawling areas
- Ecosystem impacts
- Potential reduction in allowable catches due to stock declines associated with ecosystem effects[45]

Brick and Hasson (2017) overlay annual demersal-trawl catch data, for the period 2000–2014, with marine phosphate prospecting areas. As evident by Figure 11, there is substantial overlap between the trawl grounds and marine phosphate prospecting areas. Between 2000 and 2014, on average, 77% of the demersal-trawl catch has fallen within one of the prospecting areas (Brick and Hasson, 2017). While there is potential for exclusion from mining areas and a very realistic threat of negative ecosystem impacts if large-scale mining were to take place, the current large areas assigned for prospecting are not indicative of the scale of future mining activities that would realistically be conducted at select locations within the prospecting rights areas (Figure 11).

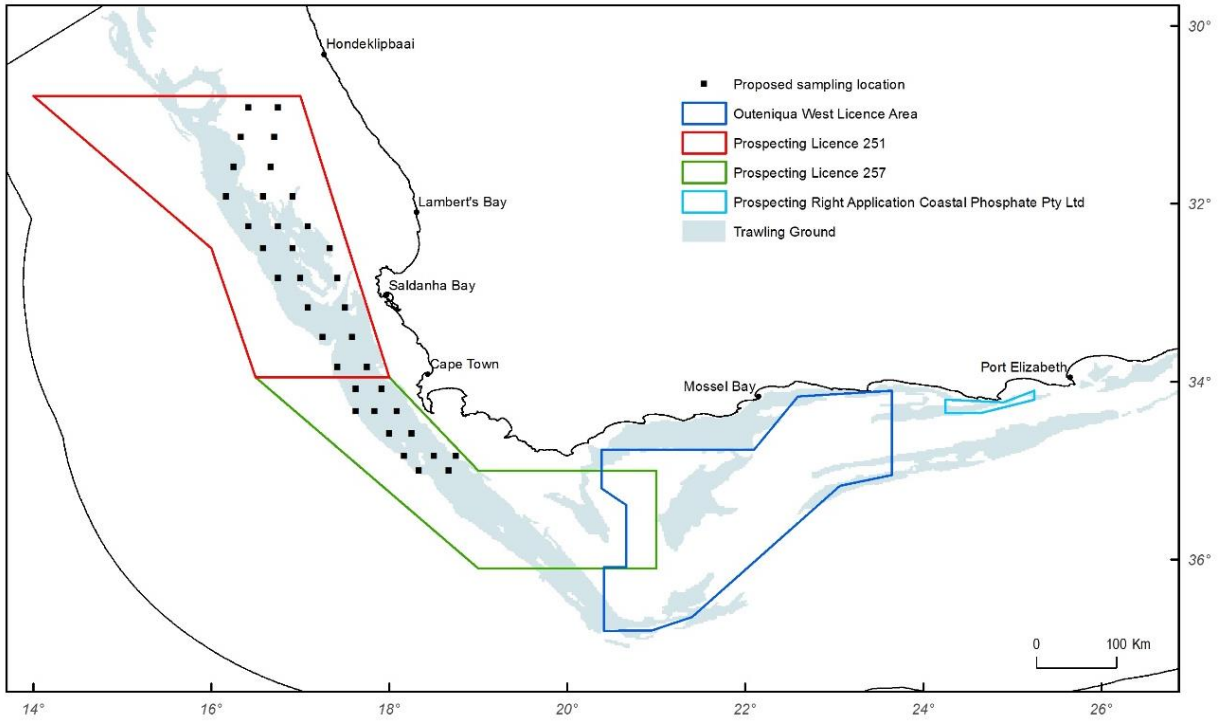


Figure 11: **Spatial distribution of the inshore and offshore demersal trawl sectors (trawl ringfence indicated by the blue shaded area) in relation to the offshore phosphate mining prospecting areas Green Flash Trading (251 & 257), the Outeniqua West License Area and the prospecting area granted to Coastal Phosphate (Pty) Ltd. Proposed sampling locations have been announced for license areas 251 and 257 as indicated on the map (Wilkinson, CapMarine)**

[45] See Brick, K. and Hasson, R. 2017. *Valuing the socio-economic contribution of fisheries and other marine uses in South Africa: A socio-economic assessment in the context of marine phosphate mining*. Environmental Economics Policy Research Unit, University of Cape Town: Cape Town; Currie, J. 2013. *Brief Overview of Potential Ecosystem Impacts of Marine Phosphate Mining in the Western Cape, South Africa.* WWF-SA: Cape Town.

Conclusions

- ✓ The current spatial measures for the fishery would seem consistent with the management requirements of the hake-directed trawl fishery.
- ✓ The proposed Namaqua National Park and Namaqua Fossil forest MPAs may make a contribution to the protection of hake nursery habitat but further consideration of protection of key life history areas may be needed as mining activities expand and diversify (see Appendix 4).
- ✓ The proposed Browns Bank and Cape Canyon MPAs may contribute to protection of hake spawning habitat (see Appendix 4).
- ✓ The identification of six Priority Fishing Areas provides no support for the introduction of any new spatial measures.

Suggested areas for further research would include:

- Verification of the kingklip spawning box – is the spatial and temporal closure consistent with the spawning aggregations and habitat protection.
- Hake spawning – this remains a largely unclear part of the biology of hake. Spawning aggregations occur, but these would seem associated with the fishery priority areas (hake specifically). If clear spawning areas could be identified, spatial and temporal area closures could benefit the fishery, but this would need to be tested;
- Habitat – the current habitat measures for hake (ring-fencing) would seem appropriate but could be strengthened if strong associations between habitat and hake distribution could be found;
- In the inshore, the priority area is primarily associated with sole / muddy or soft substrate. Bycatch of linefish has been identified as a concern in the fishery. The directed fishery for sole is currently under severe pressure and is declining – spatial measures that close areas in the inshore to improve recruitment and reduce pressure on the habitat is likely to be beneficial, but needs to be tested;
- Areas that give the main target species (offshore) some protection (either spatially or temporally) – this however needs to be scientifically tested whether the priority fishing areas identified for the trawl fishery and for specific species (monk, kingklip, snoek in particular) require spatial management with respect to both habitat impacts (in the case of kingklip = corals) and stock status (i.e. any indication that the fishery is impacting recruitment or spawning etc.)
- User Conflict: between trawl and longline has been persistent since the introduction of longlining. Measures (spatial and temporal options) to mitigate this conflict should be considered.
- User Conflict: Interaction and impact between trawl and offshore mining development will persist as the offshore mining sector continues to grow. A clear policy and or strategy, informed by impacts studies and potentially a strategic environmental assessment, are needed that identifies the key biological and economic fishing areas FMAs and ensures that rational decisions are made to minimise impacts on the fisheries.
- User Conflict: trawlers are excluded from areas 500 m on either side of submarine cables for telecommunications

4.3 Demersal hake longline

Overview of the sector

Hake-directed demersal longlining is a relatively new fishery, having started in the early 1990's. The fishery went through a trial experimental period between 1994-1996, was formerly adopted through medium term rights in 1998 and then full rights were applied in 2004 that were synchronised with the other hake sector, demersal trawl.

Hake longlining impact on the hake stocks and the fishing industry as a whole remains relatively poorly understood. Japp and Wissema[46] provided a brief overview of the hake longline experiment. One of the more important outcomes of the experiment was that the longline gear selectively caught proportionately larger hake than trawl gear, that the proportion of females was higher than in trawls and that trawl gear could be deployed in hard ground areas generally not accessible to trawls. These features of hake-directed longlining clearly differentiated the fishery from bottom trawl spatially. Further, as the fishery evolved, it became clear that the selective size characteristic of the fishery (i.e. ability to target large fish) was probably related to the access the fishery had to hard grounds not fished by the trawlers.

As the fishery developed, the grounds fished using longlines expanded (Figure 8) to a point where currently there is near complete overlap of the two fisheries. This has resulted in user conflict as pointed to in section 4.2 on demersal trawling. Further, the size of the longline-caught fish has also decreased, providing subjective evidence that the hake availability on the harder grounds initially fished by the longliners, has declined and the size distribution of hake in longlines is now similar to trawl (without the large juvenile component in the trawl fishery). The development of the hake longline in this manner provides evidence that the hard grounds not previously fished provided a form of sanctuary for larger adult and female hake. The longline fishery is however still a relatively selective fishery with a low bycatch.

The kingklip longline experiment which preceded the hake longline experiment between 1983-1989 also raised many questions around the spatial management of kingklip (Japp, 1989)[47]. The decline in the kingklip stock and the clear spatial separation of the longline fishery into areas where kingklip are targeted (Figure 12) strongly suggested the need for spatial management of the kingklip and resulted in the implementation of the "kingklip box"[48]. Further evidence now suggests that the east coast area, where large aggregations of kingklip were targeted, may be a preferred habitat for kingklip and in fact is an area of high biological activity (Sink pers comm.).[49]

[46] Japp, D.W. and J. Wissema. 1997. Brief overview of the hake-directed longline experiment from 1994-1996. Unpub report.

[47] Japp, D.W. Japp DW (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.

[48] DAFF, 2004. Declaration of a seasonally closed area off the South Coast to protect kingklip spawning aggregations. WG/08/04/D:K:15

[49] In the workshop undertaken to discuss the potential FMAs it was commented that the kingklip box is also an area of high fish diversity, large numbers of juvenile hake at times and diversity of deepsea corals and other flora and fauna

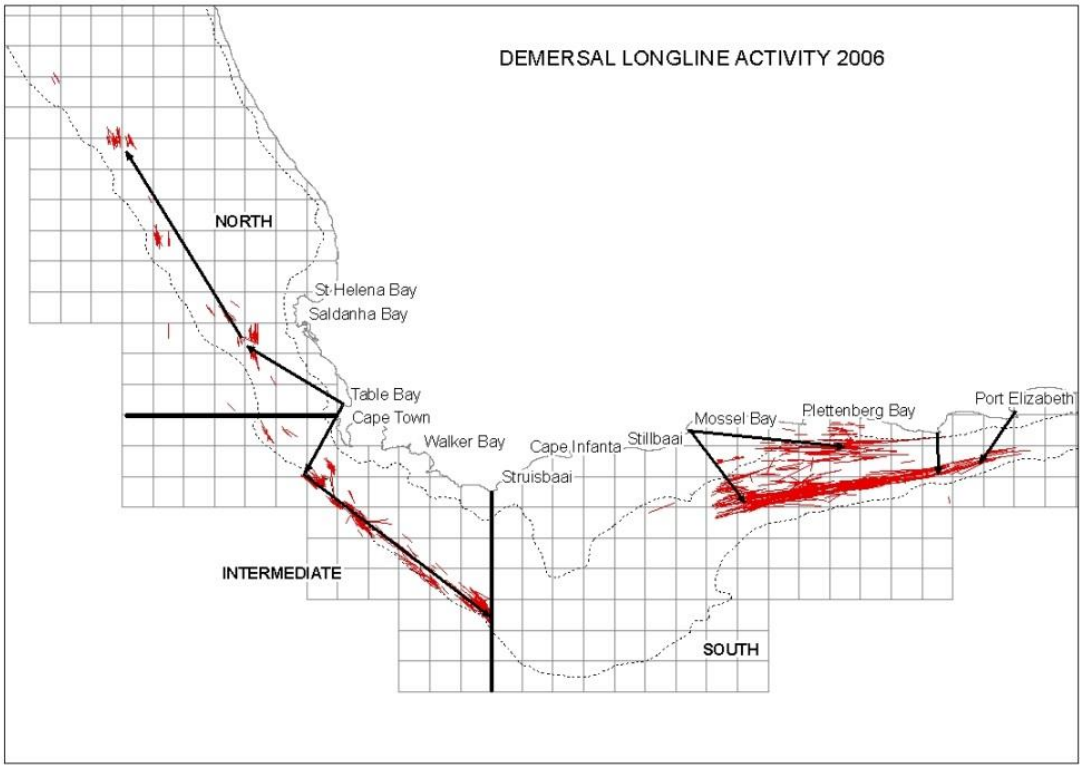


Figure 12: **Illustration of typical long-line directed effort in 2006 showing clear separation of fishing areas.**

Stock Dynamics

Stock issues relating to hake are similar for both trawl and demersal longline. Although longline-directed hake is the designated target species for the fishery and falls under the allowable catches and fishery measures for hake and hake trawl, kingklip remains the primary bycatch of the fishery. As with numerous other demersal stocks (e.g. hake) the stock structure of kingklip is somewhat uncertain. Abundance of kingklip is strongly area and habitat dependent and the existence of stocks that are habitat dependent with specific aggregating areas remains a fundamental question.

Current Spatial and Temporal Measures

The spatial and temporal measures applied to hake trawl also apply to the hake directed longline fishery. In the earlier years of the management of the fishery, area-based separation of hake longline was applied – i.e. splitting of the TAC between "East Coast" and "West Coast" and also inshore-offshore separation similar to the inshore and deepsea trawls. Separate rights are still (2018) allocated for the west and south coasts with the south coast fishery being restricted to inshore areas within 20 nm of the coast or in waters shallower than 110 m (whichever is furthest from the coast). The hake longline apportionment is less than 10% of the TAC and increasingly longline allocation is being converted to trawl. The fishery nevertheless remains a key part of the hake fishery, mostly because it has many rights holders with relatively small allocations.

As the longline fishery is not part of the MSC certification, it does not have the ringfence restrictions that apply to the trawl fishery.

Fishing Patterns

The identification of priority longline fishing areas (90th percentile) is shown in *Figure 31* and is not dissimilar to 2006 data shown in (Figure 12). The priority fishing areas are also similar to the trawl fishery as follows:

Area 1: Due west of Hondeklip Bay – this is an area known as the Karbonkle;

Area 2: Due west of Saldanha Bay – this is an area known as the Dassen Hole and is part of a feature known as the Cape Canyon;

Area 3 : An extensive area extending from due west of Cape Town to due south of Danger Point, also referred to as "Browns Bank";

Area 4: An area due south of Cape Agulhas extending towards the southern-most part of the Agulhas Bank;

Area 5: South of Port Elizabeth and Cape St Francis in an area known as the Chalk Line.

Habitat

The overlap of the hake longline fishery with benthic habitat types is similar to bottom trawl[50]. The exception is however that demersal longlines are also set over hard ground effectively extending the area fished with known habitat types as described by both Wilkinson and Japp (2005) and Sink *et al.* 2012[34]. Broadly, the longline has the ability to fish on both the trawl grounds (flat sandy areas mostly) and also on hard grounds (reef, high profile, hard). Longlining (which can set up to 20 000 hooks on a line and 20 km long) nevertheless has constraints. Gear is vulnerable to fouling, can be difficult to set and haul in strong currents and is regularly fouled by trawlers. Impacts on habitat by longlines is relatively low (compared to trawling) although gear loss is common.

Cross-Cutting and Bycatch

The spatial mapping also attempted to identify crosscutting issues between fishery sectors. For hake longline the only significant cross-cutting issue relates to kingklip (as discussed in the previous section).

The distribution of the kingklip priority areas is consistent between both the trawl and longline sectors (see :

Figure 43 and

Figure 44). Definition is lost to some extent in the spatial mapping as the localised distributions of kingklip are highly dependent on the concise setting of the longline and of trawl gear. Gear set on or near rough grounds produce higher catches (Da Gama pers comm.[51]). Catch rates of kingklip on trawl

[50] Massie, P., S. Wilkinson, and 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)." Prepared for WWF South Africa by Capricorn Marine Environmental Pty Ltd, Cape Town, 15 pp.

[51] Jose da Gamma – longline skipper

grounds are comparatively low compared to those of longlines (and trawls) on hard grounds[52].The need for improved habitat management or more permanent management measures in bycatch and habitat management for kingklip may warrant further investigation.

User Conflict

Refer to hake-directed trawling for similar areas of conflict. Longline gear, as with trawl gear, can overlap with offshore oil and gas and offshore mining activities (Figure 13). Impact on the longline sector is less intrusive than for trawl as the gear can be set over structures on the seabed.

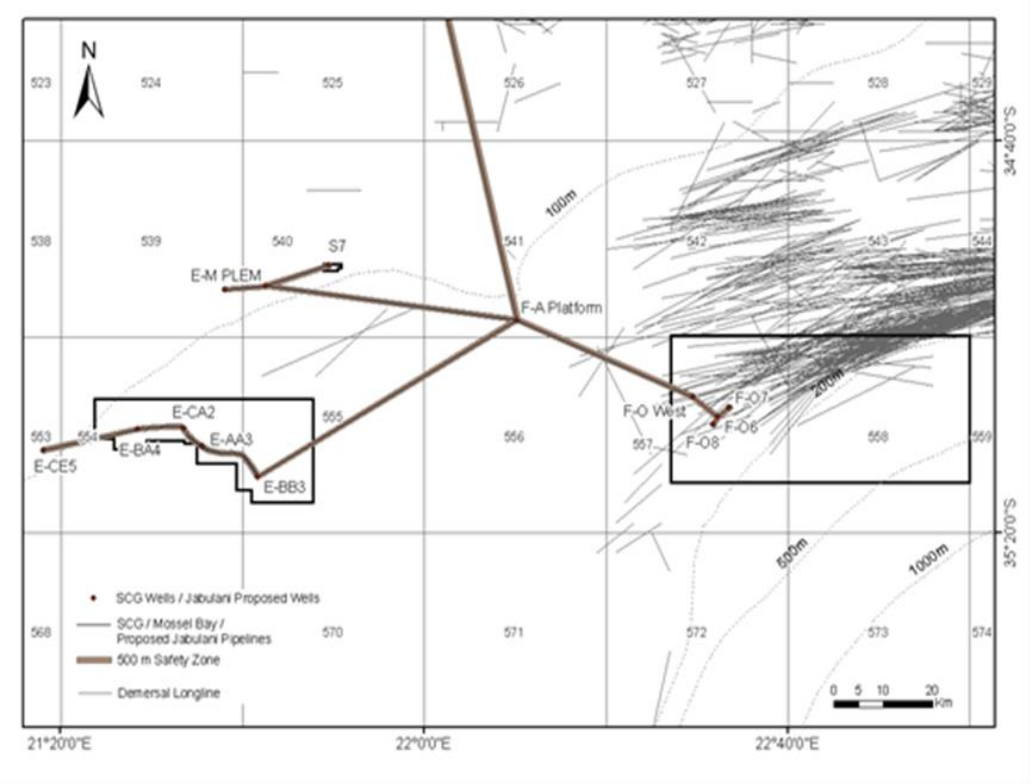


Figure 13: **Overview of the spatial extent of the Demersal Longline Fishery in Relation to the proposed FO Gas Field Development and the current South Coast Gas Development [53]**

Conclusions

- ✓ The current spatial measures for the fishery would seem consistent with the management requirements of the hake-directed longline fishery.
- ✓ The identification of five priority fishing areas provides no support for the introduction of any new spatial measures.

Suggested areas for further research are similar to trawl:

- Verification of the kingklip spawning box – is the spatial and temporal closure consistent with the spawning aggregations and habitat protection?

[52] Smith, M, Cochrane and D.W. Japp. 2013. Kingklip (Genypterus capensis) in the South African Hake-Directed Trawl Fishery. Extracted from: Review of Significant Bycatch and "Joint Product" Species in the South African Hake-Directed Trawl Fishery

[53] Japp. D.W. and S. Wilkinson. 2009. Proposed development of the F-O Gas filed in petroleum licence block 9. EIA prepared for PetroSA.

- Hake spawning – this remains a largely unclear part of the biology of hake. Spawning aggregations occur, but these would seem associated with the main fishing grounds (hake specifically). If clear spawning areas could be identified, spatial and temporal area closures could benefit the fishery, but this would need to be tested;
- Habitat – the identification of specific habitat for protection of kingklip and associated spawning aggregations is likely to be effective for the management of kingklip;
- User Conflict - Interaction and impact between trawl and offshore mining development will persist as the offshore mining sector continues to grow. A clear policy and or strategy are needed that identifies the key biological and socio-economic fishing areas and ensures that rational decisions are made to minimise impacts on the fisheries.

4.4 KwaZulu-Natal prawn Trawl

Overview of the sector

The fishery is managed using a Total Applied Effort (TAE) strategy, which limits the number of vessels permitted to fish on the inshore and offshore grounds. Currently there are five vessels operating within the inshore grounds and two vessels restricted to working in the offshore grounds. The fleet comprises steel-hulled vessels ranging in length from 25 – 40 m and up to a Gross Registered Tonnage (GRT) of 280 tons. Most vessels are single otter trawlers, deploying nets from the stern or side at a speed of two to three knots. Trawl net sizes range from 25 m to 72 m footrope length, with a minimum mesh size of 60 mm. The duration of a typical trawl is four hours. Trip lengths range from three to four weeks and vessels may carry a crew of up to 20. White prawn (*Fenneropenaeus indicus*, >80% of the catch), Brown prawn (*Metapenaeus monoceros*) and Tiger prawn (*Panaeus monodon*) make up the catch of the inshore fishery. The deep-water fishery targets pink prawns (*Haliporoides triarthrus*), red prawns (*Aristaemorpha foliacea*) and the langoustines (*Metanephrops mozambicus* and *Nephropsis stewarti*)[54].

Current Spatial Measures

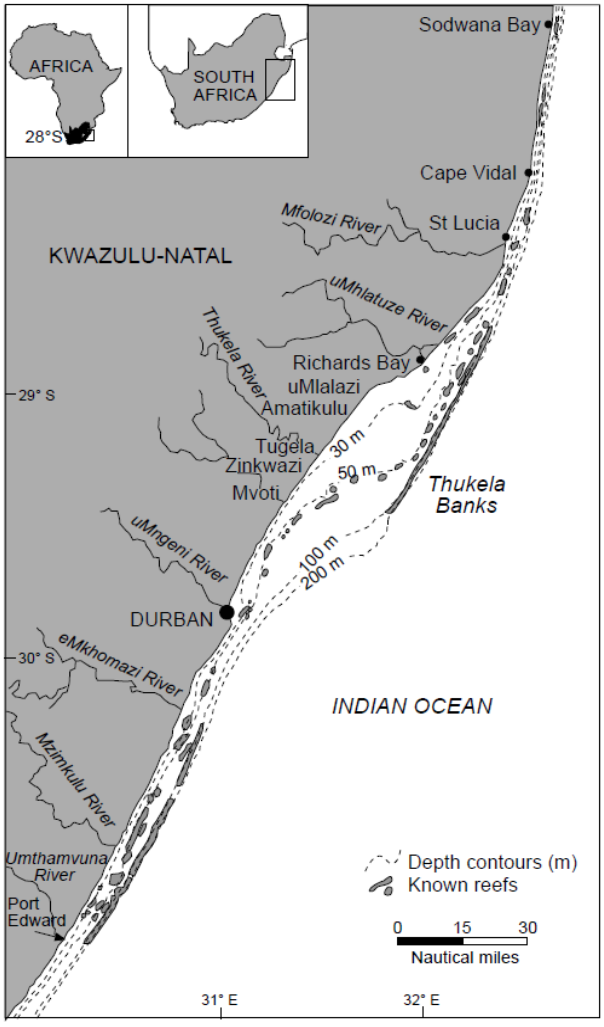
The crustacean trawl fishery is confined to the province of Kwa-Zulu Natal (KZN) on the east coast.

Table 4: Fishing and restricted areas for KZN Prawn Trawl Fishery, 2017 fishing season (DAFF, 2017)

	Permit Conditions: KwaZulu-Natal Prawn Trawl Fishery (Commercial Fishery)
	Fishing Season: 2017
3	Fishing Areas
3.1	According to this permit, the authorised vessel may only engage in fishing in waters adjacent to the coastline of the Province of KwaZulu-Natal (KZN), defined as the area, from the high-water mark, between, as a northern boundary, a line (110° true bearing) drawn from the lighthouse at Ponto do Ouro, situated approximately 1 nautical mile south of Ponta do Ouro, as indicated on chart SAN 134, and; as a southern boundary, a line (130° true bearing) drawn from the mouth of the Mtamvuna River, as indicated on chart SAN 130.
3.2	Fishing is prohibited on the Tugela Bank, defined as the area within 7 nm of the high-water mark, and between the northern boundary line (090° true bearing) drawn from the lighthouse at Cape St Lucia and southern boundary , a similar line drawn from the mouth of the Mvoti River, from September to February.
3.3	Fishing is prohibited in the St Lucia Marine Protected Area, defined as the area between the high-water mark and a line 3 nautical miles seawards of the high-water mark and between the northern boundary, a line (090° true bearing), drawn from the beacon marked N3, situated approximately 11km to the north of the Ngoboseleni Stream at Sodwana Bay and, as a southern boundary, a similar line drawn from the beacon marked N4, situated approximately 1km to the south of Cape Vidal

[54] Turpie JK, Lamberth SJ. 2010. Characteristics and value of the Thukela Banks crustacean and linefish fisheries, and the potential impacts of changes in river flow. *African Journal of Marine Science* 32: 613–624.

3.4	Fishing is prohibited in the Maputaland Marine Protected Area, defined as the area between the high-water mark and a line 3 nautical miles seawards of the high-water mark , and between, as a northern boundary, a line (090° true bearing), drawn from the beacon marked N7, situated at the South Africa-Mozambique border and, as a southern boundary, a similar line drawn from the beacon marked N3, situated approximately 11 km north of the Ngoboseleni Stream at Sodwana Bay
3.5	Permit Holders with inshore permits may fish the Tugela Bank from 01 March 2017 to 31 August 2017. Fishing is prohibited within 0.5 nautical miles of the high-water mark.
3.6	Permit Holders with offshore permits may not fish the area within 7 nm from the high-water mark, between the northern boundary, a line (090° true bearing) drawn from the lighthouse at Cape St Lucia and, as a southern boundary, a similar line drawn from the lighthouse at Green Point.



Fishing Patterns

Offshore vessels are not permitted to fish inshore, inshore vessels may, however, fish offshore. The boundary between the inshore and offshore fisheries is situated seven nautical miles from the shore between the St. Lucia lighthouse (28° 30.9'S 32° 24.0'E) and Zinkwazi Green Point (30°15.0'S 30° 46.8'E). The shallow water fishery operates at depths of 10-45m on the Thukela Banks, approximately 300 km^2 in extent, as well as on the smaller St. Lucia ground to the north[25]. The deep-water fishery operates at depths of 100-600 m along the shelf edge between Cape Vidal and Amanzimtoti, covering an area approximately 1000 km^2 (Figure 14).

Temporal Measures

Inshore trawling is seasonal due to seasonal variations in abundance of the target species as well as a mandatory closed period, while the offshore trawling takes place year-round. Fishing on the Tugela Bank is prohibited from September to February to protect juvenile squaretail kob (*Argyrosomus thorpei*)[37].

Figure 14: Location of the Thukela Banks off the coast of KwaZulu-Natal[54]

Habitat

For the shallow water fishery Champion (1970)[55] and De Freitas (1980)[56] recorded white prawn (*Fenneropenaeus indicus*) spawning activity on the Tukhela Bank and both assumed recruitment of larvae to be via southward Agulhas current transport from Mozambique. The Lake St Lucia and Richard's Bay areas were shown to be nursery grounds for white prawn[26,57]. Peak sub-adult emigration from the St. Lucia nursery grounds occurs in autumn and again in spring/summer[58]. Proposed local spawning populations further support the commercial penaeids off the east coast. These prawn species grow fast and have a life-span of approximately one year.

Larvae hatch during the second half of the year, and are transported by currents into estuaries along the KZN coast, where they remain up to the first quarter of the following year and grow into sub-adults. Sub-adult prawns move out of estuaries and recruit onto the mud banks, where they grow to maturity and reproduce. The importance of the estuarine and mangrove environments as nursery grounds has been emphasized, as well as the relationship between the amounts of fresh water runoff into those estuaries with catches been investigated by Turpie and Lamberth (2010).

The Tugela Banks are also known to serve as a nursery area for the endangered scalloped hammerhead shark (*Sphyrna lewini*), slinger (*Chrysoblephus puniceus*) and black mussel cracker (*Cymatoceps nasutus*), and five species of dasyatid rays[59]. The Banks serve as a spawning area for (amongst others) bull shark (*Carcharhinus leucas*), ragged-tooth shark (*Carcharias taurus*), king mackerel (*Scomberomorus commerson*), and as a spawning and migration route for sardine ('sardine run') ([60,61,62,63]). In addition the area offshore of St Lucia provides spawning habitat for spotted grunter (*Pomadasys commersonni*), natal stumpnose (*Rhabdosargus sarba*) and various perch and mullet species.

[55] Champion, HFB. 1970. Aspects of the biology of *Penaeus indicus* (Milne Edwards) with notes on associated Penaeidae occurring off Natal on the east coast of South Africa. In: *Proceedings of a SANCOR symposium: Oceanography in South Africa, 4-6 August 1970, Durban.* Pp. 1-17.

[56] DE Freitas, A. J. 1980. Penaeoidea of Southeast Africa. Ph.D. thesis, University of the Witwatersrand: 480 pp.

[57] Forbes, A.T. & Benfield, M.C. (1985). Aspects of the penaeid prawn fisheries in Natal. *South African Journal of Science* 81, 430-431.

[58] Benfield M.C., Bosschieter, J.R., & Forbes, A.T. 1989. Growth and emigration of *Panaeus indicus* (Milne Edwards) (Crustacea: Decapoda: Penaeidae) in the St. Lucia Estuary, southern Africa. *Fisheries Bulletin* 88, 21-28.

[59] Fennessy ST. 1994a. Incidental capture of elasmobranchs by commercial prawn trawlers on the Tugela bank, Natal, South Africa. *South African Journal of Marine Science* 14: 287–296.

[60] Haupt P. 2010. Conservation assessment and plan for fish species along the KwaZulu-Natal coast. MSc Thesis, Nelson Mandela Metropolitan University, South Africa.

[61] Harris JM, Livingstone T, Lombard AT, Lagabrielle E, Haupt P, Sink K, Mann B and Schleyer M. 2011. Marine Systematic Conservation Assessment and Plan for KwaZulu-Natal - Spatial priorities for conservation of marine and coastal biodiversity in KwaZulu-Natal. Ezemvelo KZN Wildlife.

[62] Sink KJ, Attwood CG, Lombard AT, Grantham H, Leslie R, Samaai T, Kerwath S, Majiedt P, Fairweather T, Hutchings L, van der Lingen C, Atkinson LJ, Wilkinson S, Holness S, Wolf T. 2011. Spatial planning to identify focus areas for offshore biodiversity protection in South Africa. Unpublished Report. Cape Town: South African National Biodiversity Institute.

[63] Ezemvelo KZN Wildlife. 2012. Focus areas for additional marine biodiversity protection in KwaZulu-Natal, South Africa. Unpublished Report - Jan 2012. Scientific Services, Ezemvelo KZN Wildlife: Durban. Pp 62.

User conflict

Teleost and chondrichthyan bycatch are significant in the fishery[59,64,65]. About 75% of the inshore catch and 70% of the offshore catch is discarded[66]. Fennessy (1994a) found a total of 108 species of teleosts caught by the inshore fishery at depths of 20-45 m, six of which accounted for 80% of the total by number. Chondrichthyans number 22 in the inshore bycatch, with an additional 4 species suspected to be caught and the fishery operates in what is recognised as a shark biodiversity hotspot[64,65]. Conflict between the crustacean trawl fishery and the commercial and recreational linefish sectors exists, whether the conflict is justified is less certain. Atkinson and Sink, 2008 reported that the only species in common between the linefish and trawl sectors was the squaretail kob and noted also that declining fishing effort on the inshore grounds has reduced this conflict.

Conclusion

- ✓ Bycatch and habitat issues are the concern for the fishery.
- ✓ The trawl grounds have been identified and effort is restricted both spatially and temporally by sector specific permit conditions.
- ✓ Additional bycatch limits could be considered for the sector to reduce conflict with commercial and recreational linefish-fishermen and also protect vulnerable marine species such as threatened demersal sharks.
- ✓ The proposed uThukela MPA may support habitat and bycatch management for this sector.

[64] Fennessy ST. 1994b. The impact of commercial trawlers on linefish off the north coast of Natal, South Africa. *South African Journal of Marine Science* 14: 263–279.
[65] C da Silva, AJ Booth, SFJ Dudley, SE Kerwath, SJ Lamberth, RW Leslie, ME McCord, WHH Sauer & T Zweig (2015) The current status and management of South Africa's chondrichthyan fisheries, African Journal of Marine Science, 37:2, 233-248, DOI: 10.2989/1814232X.2015.1044471
[66] Fennessy ST., & Groeneveld JC. 1997. A review of the offshore trawl fishery for crustaceans on the east coast of South Africa. *Fisheries management and ecology*, **4**, 135-147.

4.5 South Coast Rock Lobster trap fishery

Overview of the sector

The deep-water rock (or spiny) lobster (*Palinurus gilchristi*) is endemic to the south coast of South Africa where it occurs on rocky substrata at a depth range of 50 - 200 m between Cape Point and East London[67]. The stock is targeted by the commercial longline trap-fishery which has been in operation since 1974[68]. The fishery operates year-round, with the fishing season extending from 1 October to 30 September. Since 2000/1 the fishery has been managed using a combined TAC and TAE strategy, primarily to prevent under-reporting[69]. The TAC is based on an annual resource assessment, whereas the TAE is measured in fishing days allocated to each vessel. A vessel may fish until its fishing days expire or its quota is filled, whichever occurs first. There are currently seven vessels operating within the fishery which together landed a total lobster tail weight of 319 t in 2016/2017 of a set TAC of 331 t.

Catch and effort information is recorded by fishing grid-block, 10 x 10 nm in extent. A clustering analysis of grid-blocks based on the similarity of the CPUE trend and tag-recapture data showed substantial differences in certain regions[70]. These analyses resulted in a decision to move from a one stock assessment model to one that identifies three stocks and led to the definition of three sub-areas (A1E, A1W and A2+3) within the overall fishing grounds of the south coast rock lobster fishery. The fishing grid-block system and sub-areas are shown in Figure 15. A time series of TAC, TAE, annual landings and standardised CPUE of *P. gilchristi* by sub-area is listed in

Table 5 and shown in Figure 16, along with landings by FAO area. Catch and effort levels have historically at times risen above sustainable levels, but the fishery has responded to management action and the species is currently considered to be optimally exploited (DAFF, 2016). An OMP for recommending the TAC for south coast rock lobster was first developed and implemented in 2008. A number of further OMPs have been developed since for the management of this resource.

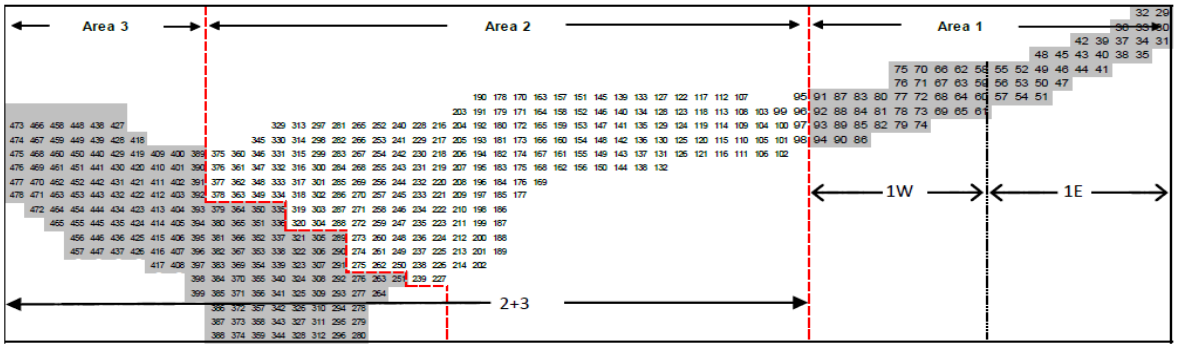


Figure 15: **South coast rock lobster fishing/catch report grids showing the discrete fishing sub-areas A1E, A1W and A2+3 (Source: Johnstone & Butterworth, 2017[70]).**

Table 5: South Coast rock lobster historical records of TAC, TAE and standardised CPUE by area (DAFF, 2017).

[67] Pollock D.E., Cockcroft A.C., Groeneveld J.C. and D.S. Schoeman. 2000. The fisheries for *Jasus* species in the south-east Atlantic and for *Palinurus* species of the southwest Indian Ocean. In *Spiny Lobsters: Fisheries and Culture.* Phillips, B. F. and J. Kittaka (Eds). Oxford; Blackwell: 105–120.

[68] Groeneveld J.C. and G.J. Rossouw. 1995. Breeding period and size in the South Coast rock lobster, *Palinurus gilchristi* (Decapoda: Palinuridae). *South African Journal of Marine Science*, 15:1, 17-23, DOI: 10.2989/02577619509504829

[69] Groeneveld J.C. 2003. Under-reporting of catch of South Coast rock lobster (*Palinurus gilchristi*) with implications for the assessment and management of the fishery. *Afr. J. mar Sci*. 25: 407–411.

[70] Johnston S.J. and D.S. Butterworth. 2017. Summary of South Coast rock lobster (*Palinurus gilchristi*) fishery. MARAM/IWS/2017/SCRL/BG1. MARAM, Department of Mathematics and Applied Mathematics, University of Cape Town, Rondebosch, 7701.

Season	TAC (t tail mass)	TAE (Allocated seadays)	Catch (t tail mass)	Standardised CPUE (kg trap^{-1})		
				Area 1E	Area 1W	Area 2 and 3
2004/2005	382	2 089	382	1.920	1.300	1.352
2005/2006	382	2 089	382	1.379	1.216	1.030
2006/2007	382	2 089	381	1.335	0.790	0.815
2007/2008	382	2 089	387	1.096	1.100	1.100
2008/2009	363	2 675	365	1.414	1.215	1.146
2009/2010	345	2 882	345	1.181	1.172	0.845
2010/2011	328	2 550	328	1.370	1.238	0.922
2011/2012	323	2 443	307	0.980	1.089	0.933
2012/2013	326	2 271	295	0.834	0.882	0.962
2013/2014	342	2 805	344	1.402	1.256	1.364
2014/2015	359	2 525	331	1.45	1.38	1.26
2015/2016	341	2 597	343	1.99	1.46	1.04
2016/2017	331	2 018	319	pending		

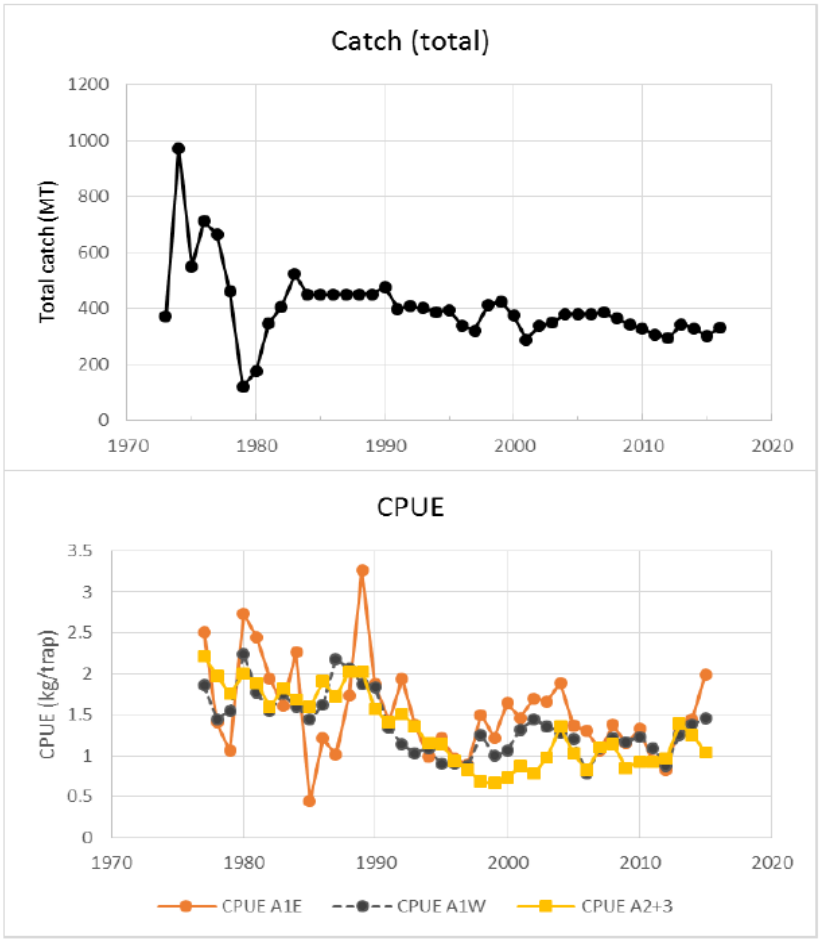


Figure 16: **Top- The total catches; Centre - CPUE for each fishing sub-area (Johnston & Butterworth, 2017).**

Current Spatial Measures

Vessels are restricted by permit conditions to operating in the area between parallel lines of longitude passing through the mouth of the Great Kei River and Cape Hangklip and bounded by the

South African Exclusive Economic Zone. Spatial restrictions as stipulated for the 2017/2018 fishing season are highlighted in Table 6.

Table 6: Spatial restrictions on the south coast rock lobster fishery as stated in the Permit Conditions for the 2017/2018 fishing season.

Section B: Permit Conditions: South Coast Rock Lobster Fishery	
Fishing Season: 2017/2018	
3	Fishing Areas and Restricted Areas
3.1	The Permit Holder shall only harvest South Coast rock lobster in the area between parallel lines of longitude passing through the mouth of the Great Kei River and Cape Hangklip and bounded by the South African Exclusive Economic Zone.
3.2	Should the Department reasonably suspect that the Permit Holder has fished for South Coast rock lobster outside the above described fishing area, the Department may initiate legal proceedings (which may include section 28 proceedings and or criminal proceedings)

Fishing Patterns

The fishery is restricted to a commercial sector as it is capital intensive and requires large-ocean going vessels (30m to 60m in length). Those that have on-board freezing capacity will remain at sea for up to 40 days per trip, while those retaining live catch will remain at sea between 7-10 days before discharging at port. There are currently seven vessels operating from the ports of either Cape Town or Port Elizabeth.

Fishing grounds extend between 20°E and 28°E at an approximate depth range of 50 m to 180 m. *P. gilchristi* is fished in two broad areas off the South Coast, where stocks are present in commercially viable quantities. The first is on the Agulhas Bank at an approximate offshore distance of between 70 km and 240 km, and the second is within 50 km of the shoreline between Mossel Bay and East London (see Figure 17). The fishery is restricted by permit conditions to operating within an area extending between the mouth of the Great Kei River and Cape Hangklip. The Agulhas Current restricts the fishery from operating within certain areas that experience strong current speeds.

Barrel-shaped plastic traps are set for periods ranging from 24 hours to several days. Each vessel typically hauls and resets approximately 2 000 traps per day in sets of 100 to 200 traps per line. They will set between ten lines and 16 lines per day, each of which may be up to 2 km in length. Each line is weighted to lie along the seafloor and will be connected at each end to a marker buoy at the sea surface.

The fishery operates year-round but has a seasonal pattern of relatively low effort over the period September and October (Figure 18).

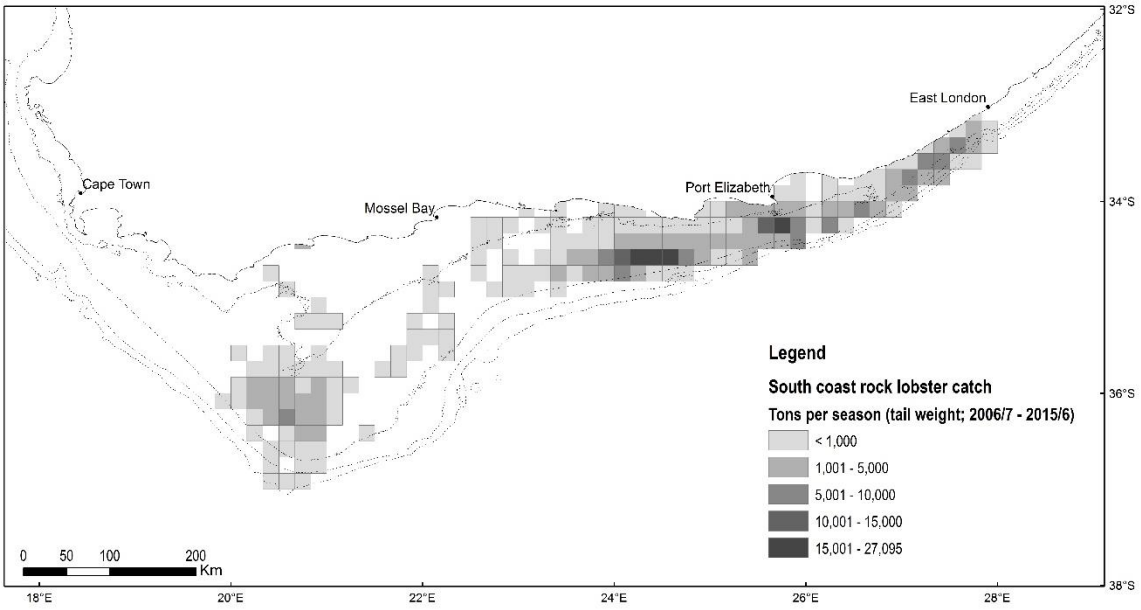


Figure 17: **Spatial distribution catch of rock lobster (average annual tail weight in tons) by fishing grid.**

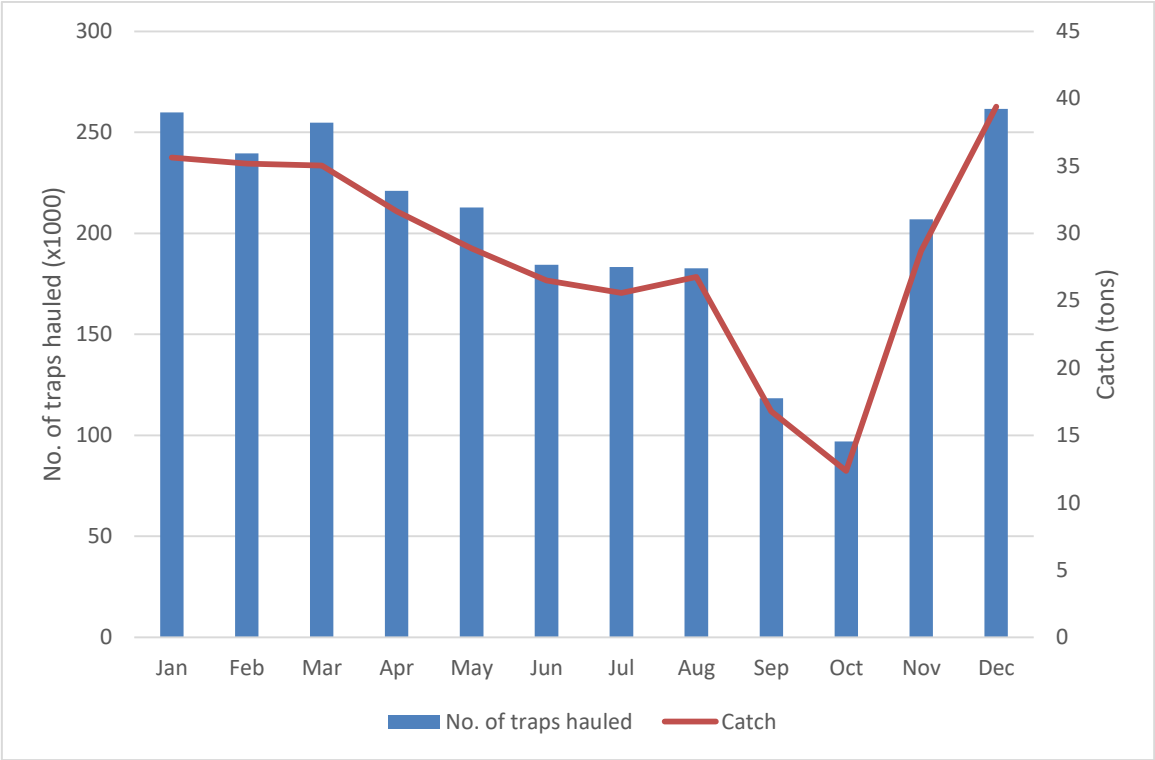


Figure 18: **Catch and effort by month over the period 2006/2007 to 2015/2016 (DAFF, 2017).**

Incidental bycatch of the fishery is largely dominated by *Octopus* spp. (likely *O. vulgaris*) and a small amount of slipper lobster (*Scyllarides elisabethae*), both of which are marketed. Figure 19 shows the catch of each of these species by year from 2006/2007 to 2015/2016.

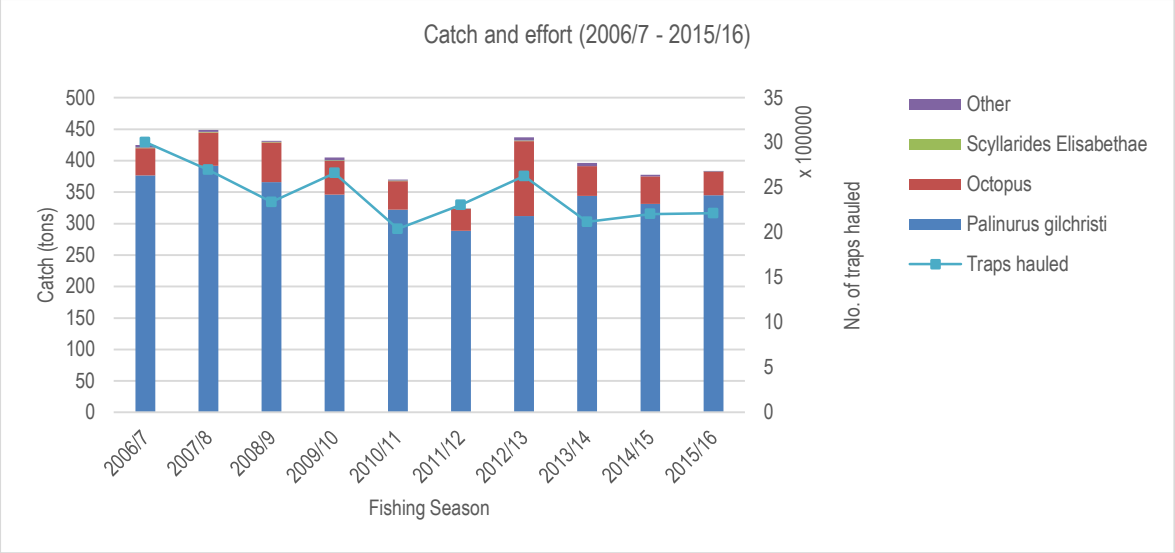


Figure 19: **Graph showing national catch recorded by the south coast rock lobster sector for fishing seasons 2006/2007 to 2015/2016. Annual effort expenditure is indicated as the number of traps hauled.**

Temporal Measures

There are no temporal management measures implemented for this sector. Fishing takes place year-round.

Habitat

Deep-water rock lobster is targeted on rocky substrata, at a depth range of 50 m to 200 m between Cape Point and East London[67]. It is assumed that the species spawns throughout its distribution as studies on breeding period[68] and fecundity[71] sampled the full range of the species and found females in berry at all sites and throughout the year. The peak in spawning occurs between July and November, although large females also bear eggs in March[67]. Juveniles migrate eastwards following westward dispersal of pelagic larvae by the Agulhas Current[72]. Lifetime egg production per recruit and fecundity are shown to be greater between the Agulhas Bank and Algoa Bay than at Port Alfred and that coincides with greater average lobster size and greater size at maturity[67;68]. The inshore area between Danger Point and Cape Agulhas is an important settlement area for juveniles, which migrate to adult habitats further offshore[72].

User conflict

There have been occasional reports of whales and turtles becoming entangled in rock lobster trap lines[1]. Trap loss, ghost fishing and anchor and trap damage to coral habitat have been raised as minor concerns for this sector.

[71] Groeneveld J.C. 2005. Fecundity of spiny lobster *Palinurus gilchristi* (Decapoda: Palinuridae) off South Africa. *Afr. J. Mar Sci.* 27:1, 231-238, DOI: 10.2989/18142320509504081.
[72] Groeneveld J.C. and G.M. Branch. 2002. Long-distance migration of South African deep-water rock lobster *Palinurus gilchristi. Mar. Ecol. Prog. Ser.* 232: 225–238.

The stock is targeted over rocky substrata using traps set on long-lines. There is little potential for conflict with trawl fisheries as rocky substrata are largely inaccessible to trawl gear. There is history of spatial overlap with the Petroleum and Gas industry where traps can run across seafloor pipelines (much the same as for the demersal hake longline sector, see Figure 13).

There is a high potential for conflict between the south coast rock lobster trap fishery and seismic survey vessels. Survey vessels tow a survey array just below the sea surface which would present a definite snagging risk to any demersal fishing gear that is connected to sea surface marker buoys via dropper lines. Gear fouling could result in costly downtime to the survey operation as well as damage to or loss of fishing gear. As such, any survey operation would require an area to be clear of fishing gear before transiting through the target area. Fishing vessels would be requested to clear the area of fishing gear prior to the survey vessel entering fishing grounds, which could lead to temporary displacement of vessels from favoured fishing areas and a possible loss of fishing time. There is currently no formal mechanism in place determining right of way for fishing activity over seismic survey operations.

Conclusion

- ✓ The strong habitat association of *P. gilchristi* infers that the resource has a predictable distribution and that the fishing industry has a vested interest in protecting important habitat for the species and maintaining access to associated fishing grounds.
- ✓ Identification of important resource areas that contribute to the SCRL fishery would provide support for further spatial management measures in the sector.
- ✓ Designation of priority fishing areas may help to resolve conflict between the fishery and seismic exploration activities by providing guidance or preference to the fishing sector or seismic operation accordingly.
- ✓ There is also overlap with phosphate mining prospecting areas and management should ensure that the sustainability of this fishery is not compromised by new mining endeavours.
- ✓ The proposed Agulhas Bank and Offshore Amathole MPAs may contribute to habitat protection and resource sustainability. Both proposed MPAs are zoned and accommodate this fishery in some portions of the MPA (see Appendix 4).
- ✓ The South Africa Fishing Ethically (SAFE) Sustainable Lobster initiative provides the industry with a template for sustainable resource use and a platform for stakeholder dialogue and conflict resolution.

4.6 Mid-water trawl

Overview of the sector

Cape horse mackerel (*Trachurus capensis*) are semi-pelagic shoaling fish that occur on the continental shelf off southern Africa from southern Angola to the Wild Coast. They exhibit a distinct diurnal vertical migration rising to feed on plankton in the water column, at which time adults from the population are targeted by the midwater trawl sector (Appendix 1: *Figure 34*, *Figure 35*). Horse mackerel are also caught as a bycatch in the small pelagic fishery (i.e. juveniles) and hake demersal trawl sectors along the west coast (Appendix 2: *Figure 51*, *Figure 52*). The midwater trawl sector is dominated by a single, large midwater trawler (the *FV Dessert Diamond*), which started operating on the south coast in 1997. The sector also consists of a number of smaller hake trawlers that carry dual hake and horse mackerel rights that enable them to target horse mackerel (primarily on the west coast) with midwater trawl gear opportunistically, in addition to fishing for hake at other times using demersal trawl gear.

Horse mackerel is managed using Total Allowable Catches (TACs) for the midwater trawl fishery, Precautionary Upper Catch Limits (PUCLs) for the small pelagic fishery and a Total Allowable Bycatch (TAB) for the demersal trawl fishery. Recommendations on allowable catches of horse mackerel are derived from application of an Operational Management Procedure (OMP), which provides rules to guide the determination of an annual, fluctuating TAC, which allows for increased catches during periods of high abundance and a decrease in TAC when abundance decreases[73]. The horse mackerel catch rates have been declining since 2013 (Figure 20).

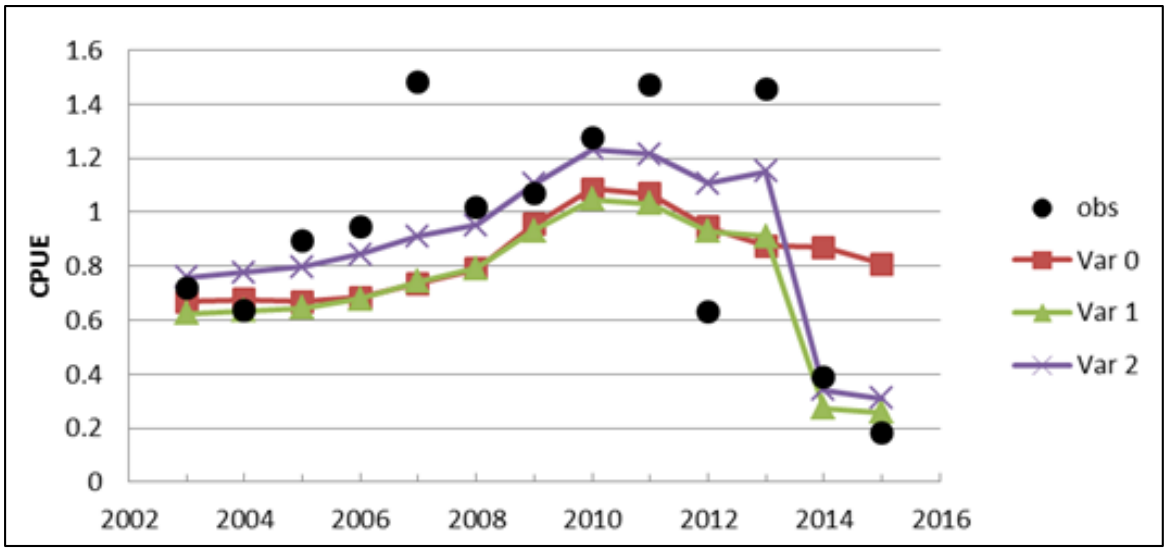


Figure 20: **Fits of the 2016 assessment model variants (scenarios) to the observed commercial CPUE from the Desert Diamond ("obs"). "Var 0" represents the base case model where no additional assumptions were made to account for the low 2014 and 2015 CPUE estimates. "Var 1" assumes a large reduction in catchability during 2014 and 2015, while "Var 2" assumed a once-off large natural mortality event in 2014 (Source, Johnston SJ and Butterworth DS, 2016)**

[73] Johnston SJ and Butterworth DS, 2016. Horse Mackerel projections. Demersal working group Document *FISHERIES/2016/OCT/SWG-DM/67.*

Current Spatial Measures

The *FV Desert Diamond* was, until recently, restricted to the south coast, east of 20° E (the Agulhas Bank). This spatial management measure was intended to constrain the fishery to catching only adult horse mackerel while protecting juvenile horse mackerel, which are found inshore and predominantly on the west coast. Currently, the *FV Desert Diamond* is doing trial trawls west of 20°E to test the availability of horse mackerel in an experimental area between the 20°E line of longitude and the line drawn due westwards from Cape Point (34°20'S). In addition to the existing permit conditions i.e. 100% observer coverage, no fishing in depths less than 110 m or within 20 nautical miles from the coast (Table 7), DAFF have also set conditions that include strict limitations on bycatch. Concerns regarding the likely increased bycatch within this experimental area were raised necessitating restrictions on key bycatch species, namely hake, sardine, redeye round herring, sunfish, Cape fur seal, heaviside dolphin, common dolphin, dusky dolphin, African penguin, turtles, requiem sharks, hammerhead sharks and manta rays. If the limits are reached for any one of these species, midwater trawling by the vessel would be suspended immediately and the historical spatial limits reinforced i.e. 20°E restriction (DAFF, 2017[74]).

Table 7: Fishing and restricted areas for vessels operating midwater trawl gear

Section B: Fishing Permit Conditions For: Hake; Sole; Horse Mackerel and Demersal Shark	
Fishing Season: 2017	
3	Fishing and Restricted Areas
3.1	This permit is valid only in South African waters (excluding tidal lagoons, tidal rivers and estuaries), closed areas and marine protected areas as stipulated in Chapter 3 of MLRA Regulations
3.2	No fishing shall take place within False Bay, north of a straight line drawn from the lighthouse at Cape Hangklip to the lighthouse at Cape Point
Section C: Sector Specific Permit Conditions: Horse Mackerel	
Fishing Season: 2017/2018	
2	Fishing and Restricted Areas
2.1	This permit is valid only in South African waters (excluding tidal lagoons, tidal rivers and estuaries) east of 020°E longitude
2.2	No fishing shall take place in water depths of less than 110m or within 20 nautical miles from the coast, whichever is the greater distance from the coast.
Section C: Sector Specific Permit Conditions: Hake/Horse Mackerel	
Fishing Season: 2017	
2	Fishing and Restricted Areas
2.1	This permit is valid only in South African waters (excluding tidal lagoons, tidal rivers and estuaries).

[74] DAFF 2017. Letter. Request to fish west of 20 degrees East on an experimental basis – directed horse mackerel.

2.2	In the area east of 020°E longitude, no fishing shall take place in water depths of less than 110m or within 20 nautical miles from the coast, whichever is the greater distance from the coast.
2.3	In the area west of 020°E longitude, no fishing shall take place within 5 nautical miles of the coast.
2.4	During the period 1 September to 30 November, no fishing shall take place within the "Kingklip Box"
2.5	No fishing may take place outside of the areas defined as the "Hake Trawl Ring Fence"

Fishing Patterns

The Cape horse mackerel is a highly nomadic species with its distributions largely driven by environmental conditions. The shoals are usually concentrated in a small area and migrate seasonally[75], greatly limiting this fishery. Juveniles are largely planktivorous, feeding on copepods in the water column near the surface (captured in the small pelagic seine-net fishery), whereas adults are opportunistic feeders preying on euphasids, polychaetes, crustaceans and other small fish in the midwater and benthic environs. Horse mackerel and Cape hakes of similar size feed on similar prey items resulting in the potential for interspecific competition between these species[76]. The midwater trawl fishery is focused on the Agulhas Bank, particularly on the shelf edge on the south and east coasts. It is only in these areas that viable catches of horse mackerel are made.

Five fishery priority areas for the midwater trawl fishery were identified during a spatial management workshop held earlier this year[77]. These include:

1. Area 1: east coast offshore of Port Elizabeth;
2. Area 2: south of Danger Point;
3. Area 3: Blues (20°E);
4. Area 4: Blues (21 - 22°E); and
5. Area 5: eastern Agulhas Bank

Temporal Measures

The midwater trawl sector operates throughout the year and thus there are no seasonal variations in catch landings. There is however, in addition to the TAC allocations, an effort limitation strategy imposed on the midwater trawl fleet (including the dual right holders). It was recommended that if an effort limitation was not adopted, the TAC would need to be substantially reduced to 10 000 t or less per year for the following 5 years to avoid the possibility of further stock reduction. However, in

[75] Sauer, W.H.H., Hecht, T., Britz, P.J & Mather D. (2003). *An economic and sectoral study of the South African Fishing Industry, vol. 2: fishery profiles*. Report prepared for Marine and Coastal Management by Rhodes University.
[76] Hampton, I., Boyer, DC., Penney, A.J., Pereira, A.F. & Sardinha, M. (1999). *Integrated overview of fisheries of the Benguela Current Region.* Thematic Report commissioned by the Benguela Current Large Marine Ecosystem Programme.
[77] Japp, D.W., Wilkinson, S., Norman, S., Sink, K. (2018). Spatial Management Workshop. Identifying priority fishery management areas in South African offshore fisheries.

order to avoid this drastic step, the implementation of an effort restriction of 388 days per annum, in addition to the TAC, introduced a safety margin. This is because if the resource abundance is low, there would inevitably be lower catch rates and the annual catch attainable in 388 days would automatically decline. With the effort limitation in place, spawning biomass is expected to recover (albeit at a slower rate) even if the TAC remains at 38 658 tonnes, the amount indicated by the OMP for 2016.

Habitat

The midwater trawl fishery is not considered to have significant impacts on habitat, provided the targeted fishery adheres to the definition of midwater trawling by not coming into contact with the sea floor.

User conflict and bycatch concerns

The midwater trawl fishing grounds overlap with both the demersal trawl fishery and the small pelagics fishery (*Figure 34*). Potential conflict among these different fishery sectors could exist should the quota holders be exclusive. In most cases however, small pelagic quota holders also have quotas for juvenile horse mackerel and demersal trawl fishers also have quotas for horse mackerel. This allows switches in the target species when conditions are viable for horse mackerel and limits conflict, as they are essentially the same fishers. Hake are also caught as a bycatch in the midwater horse mackerel trawl fishery. However, a management measure of reserving 500 tons of the annual hake quota for incidental catches in the midwater fishery has mitigated this potential conflict issue[78].

Cross-cutting bycatch species in the midwater trawl sector i.e. economically valuable species that are also caught by other sectors, can include many demersal fish e.g. hake, but is largely made up of mesopelagic species that migrate vertically in the water column and around the coast, such as redeye round herring (*Figure 45*), ribbonfish (*Lepidopus caudatus*), snoek (*Figure 47*), squid (*Figure 49*), sardine (*Figure 53*). Another key bycatch species or alternate target species that is found the midwater trawl fishery and not in high abundance in other sectors, is the chub mackerel (*Scomber japonicas*) (
Figure 64).

Midwater trawl fisheries tow their net at a higher speed than demersal trawl and for this reason have higher potential for entanglement of sea birds, sharks, dolphins and seals when near the surface[79]. Sea birds and small mammals are known to forage on fish escaping from trawl nets and frequently get tangled in the net as it is being hauled. Sunfish (*Mola mola*) are also known to be captured in midwater trawl nets as bycatch, although currently very little information exists on the frequency and extent of impact this has on sunfish populations. Fluctuations in abundance of the target species (horse mackerel) are thought to be largely driven by natural environmental variability, similarly impacting on small pelagic species.

[78] Japp, D. W. 2004. *Target Resource Oriented Management. (TROM) Reports (several fishery sectors)*. Prepared for Ecosystem Approaches to Fisheries Management, BCLME Project (LMR/EAF/03/01).
[79] Nel, D.C. 2004. *Bycatch of threatened sea birds, sharks and turtles in longline fisheries in the Benguela Large Marine Ecosystem (BCLME): an integrated approach*. Preliminary Report prepared by WWF for the BCLME.

Conclusion

- ✓ The current spatial measures for the fishery would seem consistent with the management requirements of the horse mackerel-directed midwater trawl fishery.
- ✓ The identification of five Priority Fishing Areas provides little support for the introduction of any new spatial measures as those areas already incorporate the management of target species, cross-cutting bycatch species and (to some extent) other key bycatch species that is the main areas of conflict for this sector.
- ✓ The existing management regulations[80] (Table 7), with particular reference to the spatial management measures for horse mackerel, are adequate.
- ✓ Further bycatch limitations, similar to those imposed for the experimental area, should also be considered for the east coast (east of 20°E).

[80] DAFF 2017. Permit conditions. Section C. Horse Mackerel

4.7 Small pelagic purse seine

Overview of the sector

Management of the small pelagic sector is probably the most complex of all the main commercial fisheries in South Africa. The importance of the sector cannot be underestimated. The three main species that fall under this management regime are the anchovy (*Engraulis encrasicolus*), sardine (*Sardinops sagax*) and round herring (*Etrumeus whiteheadi*). Collectively these species are often referred to as Lower Trophic Level (LTL) species as it is these species that are near the bottom of the food chain, providing food for many other species such as hake, snoek and the seasonal (migratory) tuna. There are other LTL species in South African waters, including the mesopelagic lantern and light fishes, which also provide feed for many demersal (bottom) and pelagic (surface) feeding fish. Adding to the complexity of the fishery is the catch of juvenile horse mackerel (*Trachurus capensis*).

The majority of the fleet of 101 vessels 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 dynamics of the stocks exploited are reflected in the nature of the fishery operations, both spatially and temporally. The fishery is multi-species with what can be defined as "target sectors" *viz*:

Target Fishery 1:	Sardine directed with anchovy, redeye and horse mackerel bycatch
Target Fishery 2:	Anchovy with juvenile sardine, redeye and horse mackerel
Target Fishery 3:	Redeye directed (with bycatch of sardine and horse mackerel)
Target Fishery 4:	Bait fishery for sardine

In combination these fisheries overlap spatially and seasonally, have limits on bycatch and other measures relating to mesh size, area controls etc. This would make spatial management a critical aspect of the management of the fishery. The current fishery management measures have evolved over time and those that remain in place were implemented in the early days of the fishery (see recent catch history in Figure 21).

More recently however there have been some important developments, in particular the management of purse seine catches in the vicinity of islands to protect penguin feeding grounds and also ongoing research on stocks.

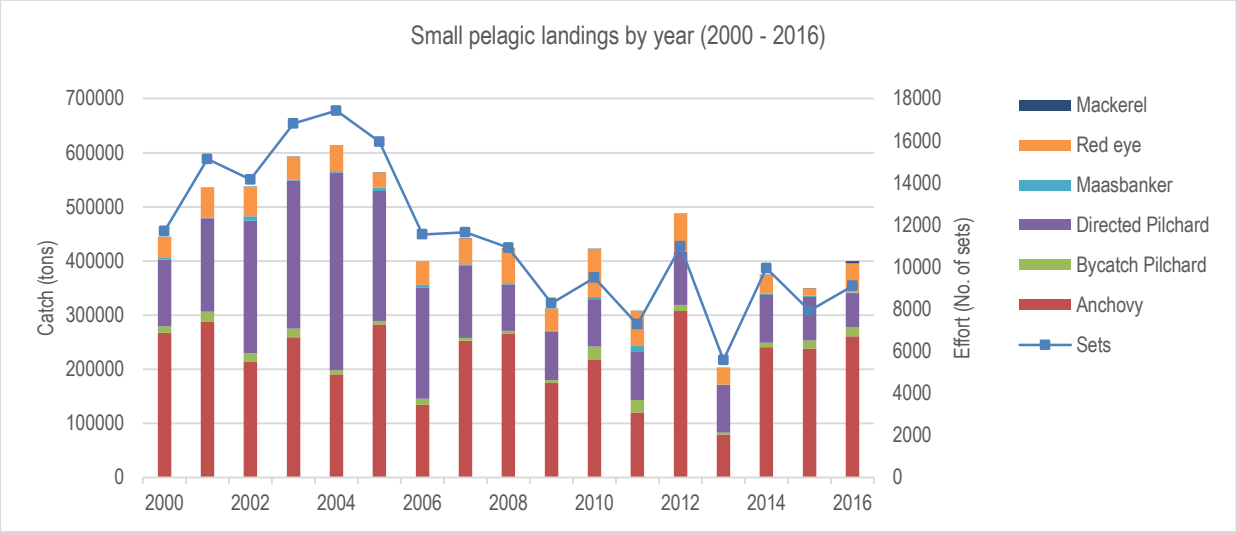


Figure 21: **Graph showing national catch of small pelagic species by the purse-seine fleet for the years 2000 to 2016. Annual effort expenditure is indicated as the number of recorded sets.**

Stock Dynamics

Spatial management and stocks

***Note**. We acknowledge that research on small pelagic stocks and spatial measures is advanced by the authors mentioned in the following paragraphs and make no alternative recommendations other than providing a rough description of the current state of knowledge of the work being undertaken*.

Despite many years of intensive research on sardine some uncertainty still remains about how many stocks of sardine exist. Current research suggests that that there are actually three distinct stocks of sardine: one each on the west coast, south coast and east coast (van der Lingen et al. 2015[81]). The west and south coast 'stocks' are the most important for the sardine fishery. These are not totally isolated from each other and there is thought to be movement of fish between them, with recruitment from the more productive 'west stock' to the 'south stock' thought to be particularly important for maintaining the productivity of the latter (Coetzee *et al., 2008)*[82].

The relatively recent awareness of different stocks and the relationships between them has important implications for management because it means that care must be taken not only to ensure that the stock as a whole is not over-exploited and reduced below thresholds at which future recruitment could be threatened, but also that the separate stocks are similarly maintained above critical thresholds. In 2015 and 2016 this was done through an informal agreement between DAFF and the fishing industry that the proportion of the TAC that could be caught west of Cape Agulhas would not exceed 70% and 45.6 %, respectively. In formulating this rule, the underlying rationale

[81] van der Lingen, C., Weston,L., Ssempa, N., and C. Reed. 2015. Incorporating parasite data in population structure studies of South African sardine *Sardinops sagax*. Parasitology: 142, 156–167.
[82] Coetzee, J. C., van der Lingen, C. D., Hutchings, L., and Fairweather, T. P. 2008. Has the fishery contributed to a major shift in the distribution of South African sardine? – ICES Journal of Marine Science, 65: 1676–1688.

was that overall sardine recruitment was primarily dependent on spawning products from the area to the west of Cape Agulhas reaching the West Coast nursery area. Hence it was considered there was a need to ensure a sufficiently large spawner-biomass in this western area. The economic and operational implications of a spatially divided TAC are profound, whether this is done directly by the Operational Management Procedure (OMP) or subsequently through a set of rules. Failure to take a spatial approach could, however, have major negative impacts on the resource and the ecosystem given the current spatial mismatch between the distribution of the sardine resource and the location of the major landing and processing facilities.

Potential adaptation by the industry is further complicated by likely variability in the distribution of the two stocks between the west and the south coasts, which could make planning of, for example, future infrastructure development difficult.

Interactions between fishing for small pelagic species and conservation of seabirds

The status of the African penguin (*Spheniscus demersus*) remains an urgent concern and the population numbers are continuing to decline. There are a number of factors considered to be contributing to the decline in penguin abundance, one of which is that pelagic fishing in the vicinity of islands used by penguins for breeding could be having a negative impact on the breeding success of penguins through resource competition. This possible impact is being examined through an experiment, initiated in 2008, that involves alternately opening and closing the areas around two pairs of islands, Robben and Dassen Islands on the West Coast and Bird and St Croix Islands on the south coast and testing to see whether there is a measureable difference in breeding success between those periods when an island is closed to fishing compared to when fishing is allowed in the vicinity. In parallel with this process, a complementary study of the economic impacts of closing the areas around Robben and Dassen Islands was undertaken (now completed) (Bergh et al. 2016[83]). The results from the study suggest that the cost to the fishery of alternately closing Dassen and Robben Islands would be between ZAR 9.5 million and 50 million per year with an average estimate of ZAR 24 million[83].

Current Spatial and Temporal Measures

The following spatial measures apply to the small pelagic fisheries. (Section B: Permit Conditions: Pelagic Fish Sardine & Anchovy Fishery: 2017). All Marine Protected Areas as declared under section 43 of the MLRA and all closed areas as declared under section 77 of the MLRA.

No person shall use any purse seine net for fishing or any other purpose in the following areas:

- "Voorsteklip" on the Plaat to the beacon marked M1 at Mudge Point, near Hawston; and
- The lighthouse on the southern breakwater in the fishing harbour of Gansbaai and a beacon marked M1 at Mudge Point, during period 1 December to 31 January
- Landward of a straight line joining Cape Vacca and The lighthouse at Cape St Blaize and Gericke Point and the lighthouse at Cape St Blaize;

[83] Bergh, M, Lallemand,P., Donaldson, T. and K. Leach. 2016. The economic impact of West Coast penguin island closures on the pelagic fishing industry. Unpublished report. FISHERIES/2016/JUN/SWG-PEL/18.

- Purse-seine fishing is prohibited within a 10.799 nm radius around St. Croix Island, with the centre of the island being used as the position. VMS guidelines are provided.
- Purse-seine fishing is prohibited within a 2.699 nm radius around Riy Bank, with the centre of the Riy Bank being used as the centre position. VMS guidelines are provided.
- Purse-seine fishing is prohibited within a 10.799 nm radius around Robben Island, with the centre of the island being used as the centre position. VMS guidelines are provided.

Even though the fishery management would seem complex, the spatial measures are relatively simple and focus on Marine Protected Areas. The fishery applies other measures to control catch, in particular limits on bycatch, TAC and Precautionary Catch Limits for some species e.g. Redeye Pilchard and juvenile Horse Mackerel.

The fishery catch reporting is also done on a smaller scale than the demersal trawl, it uses a 10'x10' grid allocation and has move on rules when bycatch of horse mackerel or other bycatch species (including juvenile sardine) is high.

Fishing Patterns

There is an established seasonal pattern that reflects the migration and inter-annual growth of the small pelagic resources exploited (Figure 22). The fishery operates throughout the year with a short break from mid-December to mid-January. 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 (*Figure 39*). 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 it is most active in the period from March to September (*Figure 38*). Round herring (a 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.

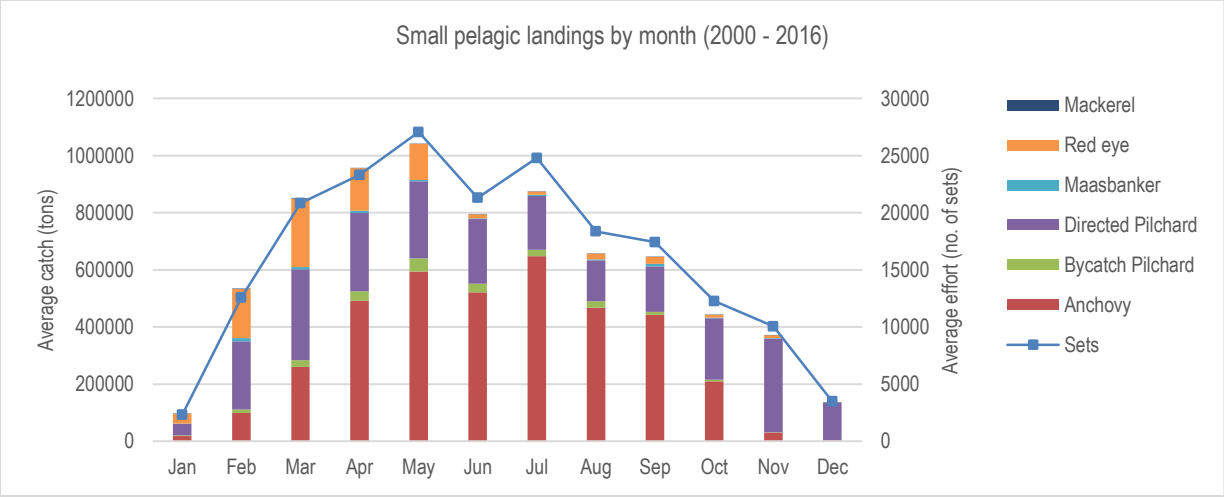


Figure 22: **Graph showing average monthly catch (tons) and effort (number of sets) reported for the small pelagic purse-seine fleet over the period 2000 to 2016.**

Identification of priority areas should therefore reflect each targeted fishery.

- For both the Anchovy and Sardine directed fisheries, applying the 90th percentile (catch and effort) shows that no clear priority areas can be identified other than that the fishery extends broadly along the west coast from St Helena Bay southwards to Gansbaai. There is a localised area around Mossel Bay (sardine) and to a lesser extent in Algoa Bay. It is difficult to infer spatial patterns from maps of annual catch and effort, although a seasonal breakdown is likely to be more informative as it will typically show the movement of the purse seine fleet around the coast as the small pelagic species migrate.
- For round herring (Red eye pilchard) there is some spatial signal suggesting concentrations north west of St Helena Bay (*Figure 46*). This species however is also distributed throughout the West Coast and onto the Agulhas Bank, and apart from the area mentioned, no particular priority area was identified.
- For horse mackerel juveniles in the small pelagic purse seine (*Figure 52*) again there is some spatial signal suggesting the species is targeted by the small pelagic purse seine sector, in particular in the Algoa Bay, Mosel Bay, Gansbaai and St Helena Bay areas. This points to the importance of localised distributions and nursery areas.
- For chub mackerel, a small bycatch in the fishery, local areas of high availability are noted NW of St Helena Bay, off Cape Point, off Mossel Bay and possibly Cape St Francis.

Habitat

No inference is made regarding the overlap of the small pelagic fishery with habitat as the purse seine gear is a surface / midwater gear and has no reported interaction with the substrate.

Cross-Cutting and Bycatch

The spatial mapping also attempted to identify cross-cutting issues between fishery sectors. What was intended here was to identify areas that were fished by one sector that impacted on the target species in another sector, or, where a bycatch in a specific sector could be area-prioritised. The significance of this is that the catch of some species (target or bycatch) can also be an important motivation for additional spatial management.

For the small pelagic, there are specific management measures in place to limit the catching of juvenile horse mackerel, in particular in the St Helena Bay area. The targeting of horse mackerel in this area is seasonal with high levels of availability from January through to March. The significance of this is the stock recruitment concerns – that is recruitment to the spawner-stock caught by the midwater trawl on the eastern part of the Agulhas Bank. Redeye, mackerel and some anchovy and sardine are also taken by the midwater trawl fishery on the Agulhas Bank. There is no clear spatial signal that can be used to inform further spatial management or understanding of these stocks.

User Conflict

As with other fishery sectors, the small pelagic fishery can be directly impacted by seismic surveys and will also be excluded from areas should offshore infrastructure be developed in areas fished for small pelagics. Of more concern than the short-term operational closures for the fishery, is the possible impact on the distribution of the shoaling small pelagic species and also the possibility of mortality of larvae and or adults associated with the airguns[93]. Some modelling of the possible impact has been undertaken, although this is still a crude analysis meant only to guide the environmental impact assessments.

Oil Drilling and Seismic Surveys

There is ongoing conflict between the small pelagic industry and the conducting of a) seismic surveys and b) well drilling. The concerns relate primarily to:

- Exclusion from fishing grounds (short-term or long-term)
- The actual impact the surveys or drilling and or establishment of oil and gas infrastructure might have on the small pelagic shoaling species.
- The possibility of oil spills is also an additional risk to not only the fishery directly but also the pelagic ecosystem a whole.

These surveys, which can cover large areas (Figure 23) require mitigation and communication between the survey operators and the fishing industry.

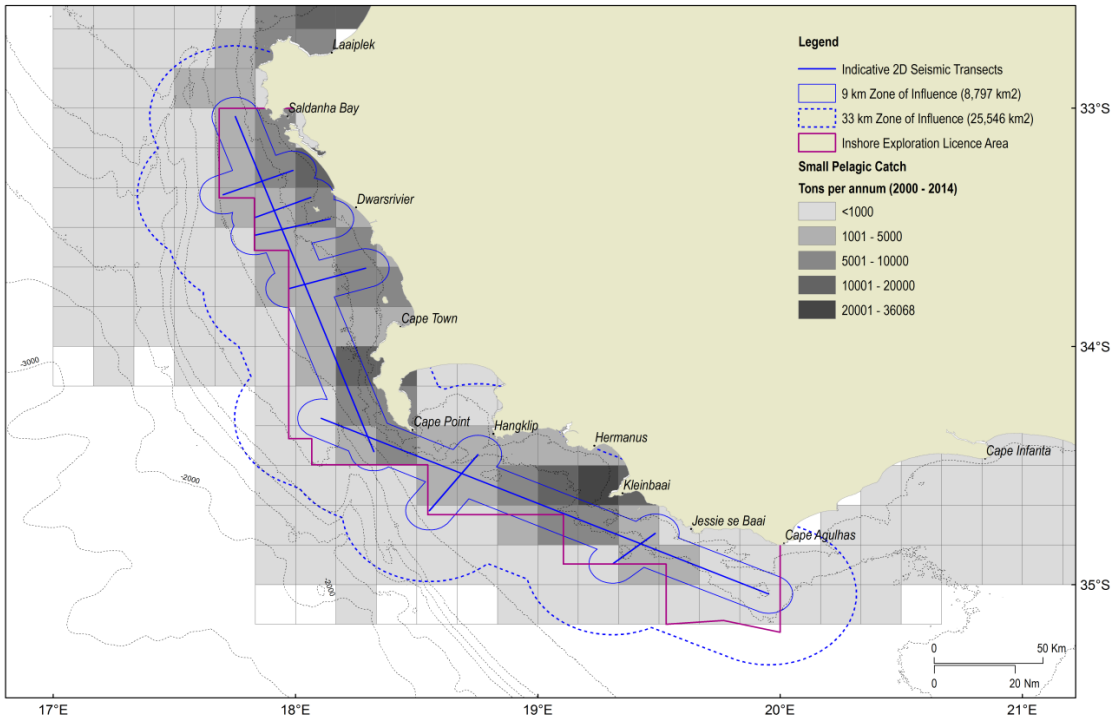


Figure 23: **Spatial distribution of catch reported by the South African small pelagic purse-seine fishery (2000 – 2014) in relation to the inshore exploration licence area and proposed 2D seismic survey transects. The 9 km and 33 km zones of influence around the proposed 2D transects are also indicated.**

Conclusions

- ✓ The current spatial measures for the fishery are limited to specific areas associated with MPAs and other localised measures to mitigate bycatch.
- ✓ Based on current stock uncertainty, there would seem scope for application of spatial measures related the management of these stocks in the future.
- ✓ There is also scope for more formal implementation of spatial measures to protect or better manage non-target of bycatch species, in particular horse mackerel, red eye pilchard and chub mackerel.

4.8 Squid jig

Overview of the sector

In about 1984 the commercial squid jig fishery was established and developed promptly driven by high demand and good catches.[84,85] Effort was initially concentrated on spawning aggregations inshore at depths of no more than 40 m. With vessel upgrades fishing effort shifted further offshore onto the feeding grounds, thus enabling catches to be made throughout the year[86]. The greater shelf region serves as feeding grounds for both adult and juvenile chokka[84]. Data from research trawl surveys spanning the years 1985-2008 indicate that chokka squid are not restricted only to shallow waters for spawning although the species does prefer the eastern Agulhas Bank for spawning and that the area of greatest spawning activity lies between 23° and 27°E[86]. Roberts et al 2012 also attempted to delineate the importance of inshore versus offshore spawning grounds (between 24.3 and 25.7°E) and found the former to be strongly favoured, with the contribution of inshore eggs and deep spawned eggs to total biomass estimated at 82 vs. 18% respectively.

Total allowable effort (TAE) is the main management measure in place for the fishery. The fleet is divided into vessel categories and a maximum crew complement is specified for each vessel category. Currently the fleet consists only of deck boats ranging in length from 10 to 20 m, with a crew capacity of 16–26. The current TAE set at 2423 crew and 138 vessels (DAFF Permit Conditions 2017/2018).

Current Spatial Measures

The fishery is excluded from Marine Protected Areas but otherwise is licensed to operate in the South African EEZ (as stipulated in permit conditions)

Table 8: The spatial restrictions imposed on the squid jig fishery as stipulated in Permit Conditions for the 2017 fishing season.

	Section B: Permit Conditions: Squid (Commercial Fishery)
	Fishing Season: 2017/2018
3	Fishing Areas and Restricted Areas
3.1	This permit is valid only in South African waters (excluding tidal lagoons, tidal rivers and estuaries).
3.2	The Permit Holder or any of its employees or agents shall not undertake fishing, or take or destroy any fauna or flora, or in any way disturb, alter or destroy the natural environment, or carry out any activity which may adversely impact on the ecosystems in Marine Protected Areas (MPA's) except where so permitted by the legislation.
3.3	A vessel is not allowed to enter; fish or carry fishing gear on board in any Marine Protected Area, or any other similar marine protected or conservation area

[84] CJ Augustyn, MR Lipinski, WHH. Sauer. 1992. Can the *Loligo* squid fishery be managed effectively? A synthesis of research on *Loligo vulgaris reynaudii.* South African Journal of Marine Science, 12, pp. 903-918

[85] WHH Sauer. 1995. The impact of fishing on chokka squid *Loligo vulgaris reynaudii* concentrations on inshore spawning grounds in the South-Eastern Cape, South Africa. South African Journal of Marine Science, 16, pp. 185-193

[86] MJ Roberts, NJ Downey, WH. Sauer. 2012. The relative importance of shallow and deep shelf spawning habitats for the South African chokka squid (*Loligo reynaudii*). ICES Journal of Marine Science,69, pp. 563-571

3.4	In the case of an emergency, the Permit Holder shall notify the Department before the fishing vessel enters or intends to enter into a Marine Protected Area or any other area closed for fishing. The notification shall describe the nature of the emergency and the reason requiring the vessel enter the MPA.
3.5	Fishing and the removal or disturbance of any marine life in the Tsitsikamma National Parks Marine Protected Area is prohibited. Fishing in other marine and estuarine areas controlled by the South African National Parks, is subject to regulations promulgated under the NEMPA

Fishing Patterns

Chokka squid is distributed from the border of Namibia to the Wild Coast. It occurs extensively on the Agulhas Bank out to the shelf edge, increasing in abundance towards the eastern boundary of the South Coast, especially between Plettenberg Bay and Algoa Bay[87]. The fleet operates out of St, Francis and Port Elizabeth and targets aggregations near those ports. Freezer vessels have longer range and have shifted eastwards some of their effort eastwards (*Figure 40*). Along the South Coast adult squid is targeted in spawning aggregations on shallow-water fishing grounds extending from Plettenberg Bay to Port Alfred between 20 m and 130 m depths. Fishing takes place at night using bright deck lights to attract the squid. The fishery targets spawning aggregations, the locations of which have been shown to be concentrated on inshore areas of the east coast (*Figure 24*). The fleet targets squid on the offshore grounds during winter and at times when there is high turbidity in the inshore grounds. Larger boats drifting on "parachute" are required to fish further offshore due to stronger currents and sea conditions.

The fishery has some very clear spatial signals (using the 90th percentile as described section 4.1). These could be defined as the Priority Fishing Areas as follows[77] :

1. Area 1: Agulhas Inshore – this area around Struisbaai to depths of 100 m;
2. Area 2: The Core grounds – Plett – Central – Port Alfred;
3. Area 3: Offshore of the Core grounds – winter fishing area/reserve biomass;

Cross-Cutting and Bycatch Species

As explained in Section 4.2, the spatial mapping also attempted to identify crosscutting issues between fishery sectors. For the squid jig fishery the following issues were identified:

Squid is a bycatch in demersal trawls (

I. *Figure 50*), mostly juveniles and the catches from the trawl sector are used as a stock indicator for squid.

II. Squid is caught by the midwater trawl sector (*Figure 49*) in Area 3 – the winter fishing grounds offshore or Port Alfred.

[87] Augustyn C.J. (1990). Biological studies on the chokka squid *Loligo vulgaris reynaudii* (Cephalopoda: Myopsida) on spawning grounds off the south-east coast of South Africa. S. Afr. J. mar. Sci. 9: 11-26.

Temporal Measures

In 1986, a 6-week selective closed season was introduced, with the main fishing grounds being closed to vessels not registered in the area. Since 1988, the fishery has been closed once a year for approximately four weeks over the spawning period[88]. Currently this closed period extends from 19 October to 23 November (Government Gazette, 2011). An additional 3 months from 1st of April to 1st of July (Permit conditions, 2017) is voluntarily enforced in winter to prevent the man-days from exceeding the maximum. This voluntary closure coincides with a drop-off in adult spawning activity and a consequently a reduction in catches as the targeted spawning aggregations are a seasonal occurrence reaching a peak between September and December[88].

Habitat

Shallow water and a rocky/sandy substrate combination provides ideal habitat for spawning squid to lay eggs. The substrate chosen for egg laying is mostly fine sand or flat reef, frequently in large and relatively sheltered bays, some spawning sites are used repeatedly within a particular year and in subsequent years[89] (squid come back to close to the exact some locations (fishermen's marks) the following year (Greg Christy pers comm)). The most important spawning grounds are between Plettenberg Bay and Algoa Bay, these having been linked to specific spawning habitat requirements[90,91]. Reverse current eddies allow for better retention of eggs and larvae in the core grounds. The deep water spawning grounds provide lower successful recruitment but are considered a "reserve" of squid for the fleet.

User conflict

There is some conflict with the demersal trawl sector that catches significant volumes of squid as bycatch in the inshore fishing grounds. In addition the midwater trawl sector (predominantly the Desert Diamond) catches chokka on the shelf edge offshore of Port Elizabeth – this component of the resource is considered as a surplus or reserve by the squid industry that they rely on during years of poor inshore spawning and recruitment.

There is a high probability of conflict with seismic exploration activity as the squid fishery has voiced concerns over the impact of the survey operation of the effects on squid. A recent regional 2D survey of the south and east coasts was undertaken. Figure 25 shows the location of the survey with respect to the squid jig fishing grounds.

Future proposed surveys are set to take place over the offshore grounds area that is considered by the sector as a source of cryptic or reserve biomass and recent applications to the Department of Mineral Resources (DMR) for seismic exploration have been met with legal objection from the squid jig fishing industry during the impact assessment phase.

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[88] BA Roel, KL Cochrane, DS. Butterworth. Investigation on the effects of different levels of effort and of the closed season in the jig fishery for chokka squid *Loligo vulgaris reynaudii*. In *Benguela Dynamics*. Pillar SC, Moloney CL, Payne AIL, Shillington FA, editors. South African Journal of Marine Science, 19 (1998), pp. 501-512.

[89] Sauer, W. H. H., Smale, M. J. and Lipinski, M. R. (1992) *The location of spawning grounds, spawning and schooling behaviour of the squid Loligo vulgaris reynaudii (Cephalopoda: Myopsida) off the Eastern Cape Coast, South Africa* Marine Biology , 114 (1). pp. 97-107.

[90] Roberts, M. J., & Sauer, W. H. H. (1994). Environment: the key to understanding the South African chokka squid (Loligo vulgaris reynaudii) life cycle and fishery?. *Antarctic Science*, *6*(2), 249-258.

[91] Roberts, M. J. (2005). Chokka squid (Loligo vulgaris reynaudii) abundance linked to changes in South Africa's Agulhas Bank ecosystem during spawning and the early life cycle. *ICES Journal of Marine Science*, *62*(1), 33-55.

The newly proposed Addo MPA is within the priority fishing areas of the squid sector but there has been negotiation with SASMIA that led to the development of controlled zones that will be open to the squid sector.

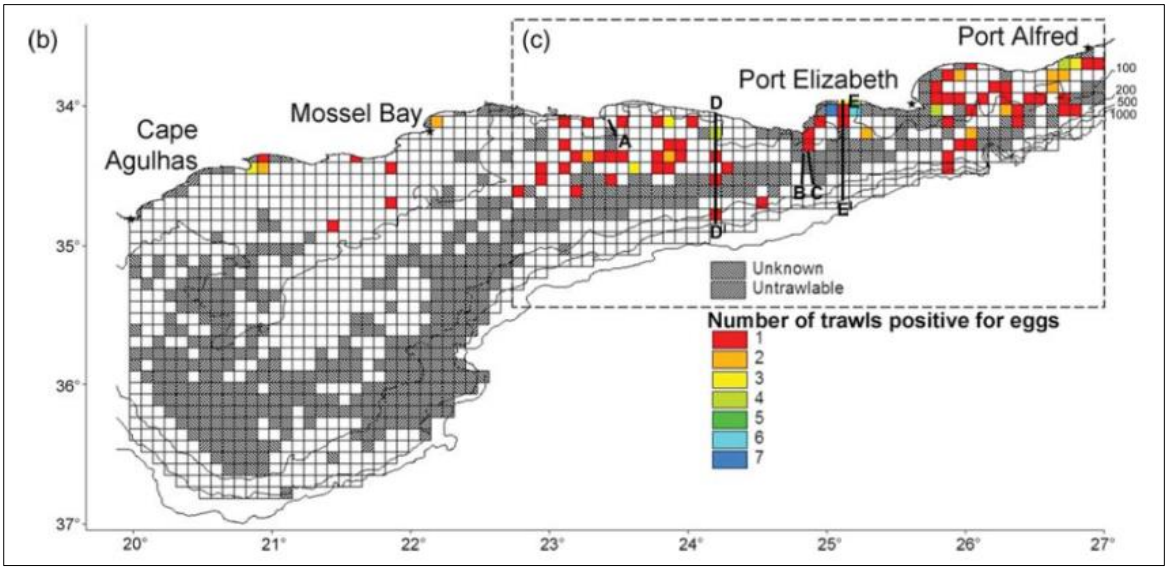

Figure 24: **The occurrence of chokka squid spawning as detected by eggs trawled during biomass surveys on the south coast from 1985 to 2008 (Roberts et al 2012[86]).**

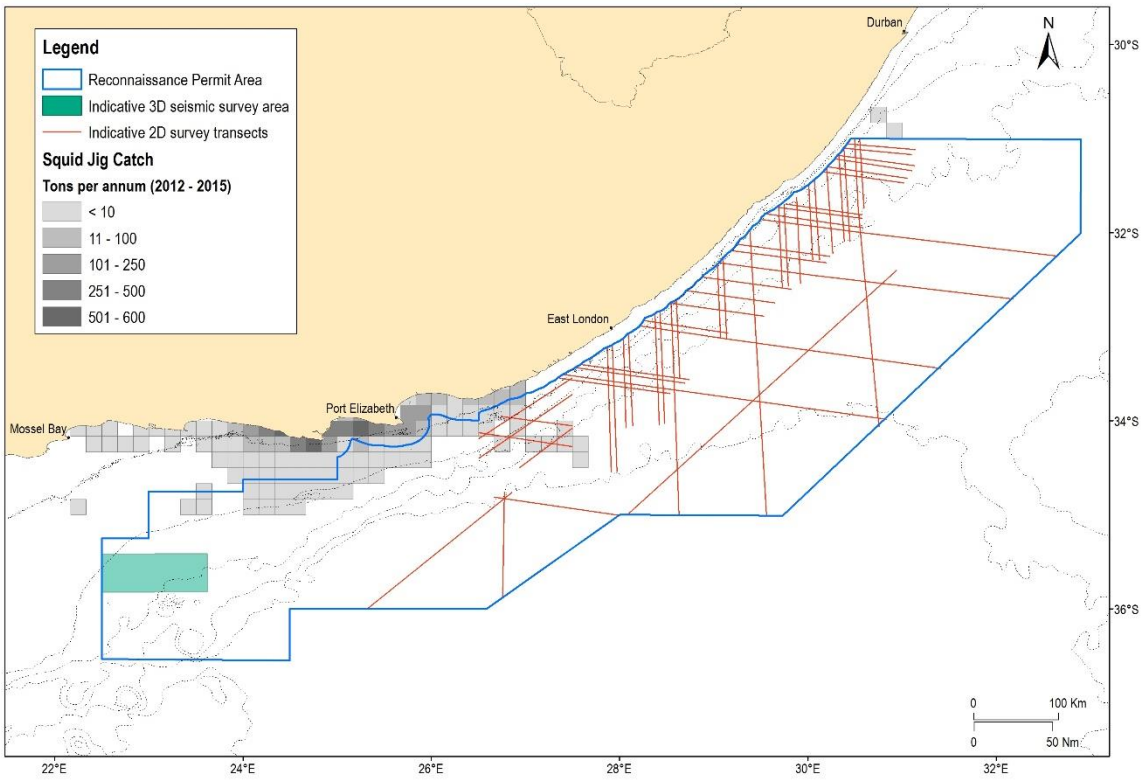

Figure 25: **Location of squid jig fishing grounds relative to a 2D survey that took place between January and May 2018 (SLR Consulting 2015)[92].**

[92] Japp D.W and S.J. Wilkinson. 2017. Environmental Management Plan for the proposed 2D and 3D Speculative Seismic Surveys off the South and East Coast of South Africa: Fisheries Assessment. CapMarine (Pty) Ltd

Conclusion

- ✓ The squid jig target fishery has very definite areas of operation that have not shifted dramatically since the 80's when the fishery began. Some seasonal and annual variation in the core grounds exists as a result of movement of spawning aggregations in response to sea temperature, turbidity and other habitat variables, however the primary areas of operation remain between Plett and Algoa Bay (as seen from spatial mapping of cumulative commercial catch and effort statistics[77]).
- ✓ The strong link between the spawning habitat and the target species delivers a predictable spatial pattern of fishing operations. This lends itself towards identification of priority fishing areas or life-history stage support areas within the permitted area of fishing.
- ✓ The proposed Addo Elephant National Park in Algoa Bay contributes to protection of squid spawning habitat and also accommodates squid fishing (see Appendix 4).
- ✓ Important fishing areas also exist outside of the core fishing grounds and that the fishery is dependent on during years or seasons of poor inshore spawning and recruitment – the offshore grounds illustrate this clearly.
- ✓ Additional nursery habitat was identified in False Bay that acts as a paralarvae catchment area. Those alternate grounds are subject to multiple user interests that create the potential for conflict.
- ✓ The identification of three Priority Fishing Areas provides some support for the introduction of new spatial measures.
- ✓ There is some indication that seismic activities have a negative effect on zooplankton that includes squid larvae[93] and further focused research should be undertaken in South Africa to resolve this. In addition the effects on spawning aggregations of squid in shallow-water areas needs further research to support legal objections filed to prevent future seismic surveys.

[93] Robert D. McCauley, Ryan D. Day, Kerrie M. Swadling, Quinn P. Fitzgibbon, Reg A. Watson and Jayson M. Semmens. 2017. Widely used marine seismic survey air gun operations negatively impact zooplankton. Nature Ecology and Evolution. Volume 1, 0195.

4.9 Large pelagic longline

Overview of the sector

Exploitation of large pelagic species in South Africa can be divided into four sectors, 1) pelagic longline 2) tuna pole & line 3) commercial linefishing (rod and reel) and 4) recreational linefishing. This chapter focuses on the pelagic longline sector, for which commercial catch and effort data are available, to interpret potential core fishing grounds and areas that may be designated for additional spatial management.

Fishing for tunas and swordfish with pelagic longline gear was initially attempted in the early 1960's, but interest quickly declined in favour of other more lucrative fisheries. An experimental fishery was licensed from 1997 to 2005 – this included predominantly swordfish-targeted vessels that experienced drastic declines in CPUE during the period. The commercial Pelagic Longline fishery was formalised in 2005, with the issuing of 18 swordfish-directed and 26 tuna-directed fishing rights valid for 10 years. The fishery was restricted to 50 permits (one permit per vessel) through Total Applied Effort (TAE) control.

In 2005 the shark longline sector was split into a demersal shark longline component, which predominantly targets soupfin and hound sharks, and a pelagic shark longline component (seven vessels), which predominantly targets shortfin mako and blue sharks. The pelagic component catches tunas and swordfish as bycatch. This fishery was split as a precursor to phase out the targeting of pelagic sharks due to the concern over the local stock status of some species and the poor performance on tuna and swordfish. The pelagic shark fishery operated under exemptions from 2005 until March 2011, when South Africa incorporated the pelagic shark fishery into the tuna/swordfish longline fishery. Six of the seven shark exemption holders were issued with tuna/swordfish rights in March 2011. These vessels are undergoing a phase-out period to reduce shark targeting and focus on tuna and/or swordfish catches. Pelagic sharks are currently managed as bycatch in the tuna and swordfish longline fishery.

In 2014 the decision was taken to no longer refer to the fleet as two different fishing strategies, tuna-directed and swordfish-directed, since the fishing behavior of the local fleet has been shifting from exclusive swordfish targeting to include tunas and sharks. The fishery is now referred to as the Large Pelagic Longline fishery and includes vessels that target tunas, swordfish and sharks as by-catch. The 10-year long-term rights granted in 2005 expired in February 2015. The new Large Pelagic Longline fishing rights were provisionally allocated in February 2017 for a period of 15 years.

The fishery has and continues to allow an interim period for foreign vessels to charter in this sub-sector as a means of skills development and a means of acquiring suitable vessels. Foreign vessels, mainly from Japan and Chinese-Taipei, fished in South African waters through the issuing of bi-lateral agreements in the 1970s, and re-negotiated these agreements in the 1990s until 2002 (Sauer et al., 2003). Joint-venture agreements with Japan have been underway since 1995, whereby these foreign-flagged vessels are permitted to fish under a South African Rights Holder. The vessel is required to adhere to South African legislation, including but not limited to, the Marine Living Resources Act (Act No. 18 of 1998) and Regulations promulgated thereunder, including Large Pelagic Longline sector specific policy. The catch from these vessels accrues to South Africa.

During the 2017-2018 fishing season 34 domestic South African registered vessels and three chartered vessels were authorised by DAFF to take part in the Large Pelagic Longline fishery. Apart from the National DAFF management measures the fishery is subject to the Conservation and Management Measures (CMMs) of the three tuna Regional Fisheries Management Organisations (RFMOs) to which South Africa is signatory. The applicable CMMs are listed in the permit conditions but do not impose any additional spatial restrictions on the sector.

Current Spatial Measures

The Permit Conditions for the sector restrict its movement to within the South African EEZ, unless operating in conjunction with a high seas vessel license. Special consideration is given to the KwaZulu-Natal coastline where vessels are restricted from setting lines within 20 nm from the coast. This condition is in place to protect known migratory routes for both sea turtles and whales, and in addition may be a means of reducing conflict with offshore prawn-trawl vessels. The conditions are updated annually at Large Pelagic Management Working Group Meetings hosted by DAFF and open to affected stakeholders that include representatives of Recognised Industrial Bodies (RIBs) and NGOs.

Table 9: Fishing and Restricted areas for the Large Pelagic Longline sector for the 2018/2019 fishing season.

Section B: Permit Conditions: Large Pelagic Longline Fishery	
Fishing Season: 2018/2019	
3	Fishing Areas
3.1	Valid in South African waters excluding tidal lagoons, tidal rivers and estuaries
3.2	Setting and retrieving of longlines can be conducted in the SA EEZ, excluding within 12 nautical mile area along the entire South African coastline
	excluding within 20 nautical miles along the KwaZulu-Natal coastline
	excluding within MPAs
3.3	Fishing will be permitted both east and west of 020°E after notification has been sent to the Department VMS Office
3.4	Fishing in SANPARKS areas is subject to regulations promulgated under the National Parks Act (Act. No. 57 of 1976) as amended.
3.5	No fishing is permitted within the EEZ of other countries

Fishing Patterns

The fishery operates extensively within the South African EEZ, primarily along the continental shelf break and further offshore. The industry can be divided into two distinct groups: the local and the foreign (bi-lateral agreement) owned vessels. The local longline vessels have gear configured to target swordfish[94] and the catches are split between the target swordfish and tropical tunas[95] (bigeye and yellowfin tunas) and bycatch species, the sharks (mako and blue sharks). Lines are set at

[94] Parker, D., Winker, H., West, W., Kerwath, S.E. 2017. Standardization of the catch per unit effort for swordfish (Xiphius gladius) for the South African longline fishery. SCRS/2017/138.

[95] Parker, D., Winker, H., West, W., Kerwath, S.E. 2017. Standardization of the catch per unit effort for bigeye tuna (Thunnus obesus) for the South African longline fishery. SCRS/2017/204.

night (to reduce seabird mortality) and depending on the vessel size, 700 – 1500 hooks are set per line. Stainless steel hooks and wire traces are prohibited to phase out targeting out large make sharks. The larger, generally foreign owned vessels target tropical tuna and southern Bluefin tuna and are able to fish further offshore and differ slightly in their gear setup. These vessels set up to 3000 hooks per set with a combination of fish and squid bait, using deeper branch lines and varying hook numbers per basket to influence the setting depth. The smaller longline vessels carry ice whereas the larger vessels have freezers.

The spatial distribution of cumulative effort (number of hooks set) by the large pelagic longline sector for the years 2000 to 2014 provides an approximation the extent of the fished area (*Figure 32*). Although not immediately apparent there is a degree of separation of the two fleets, small/domestic and large/foreign-flagged vessels, that can be seen when looking at the spatial distribution of catches of target and bycatch species (Appendix 3). The majority of catches taken in the north east of the EEZ, off Durban, are attributed to the joint-venture vessels (currently Japanese) that are capable of fishing in the turbulent waters of the Agulhas Current due to their larger size (~50m). These vessels have in recent years (since 2011) shifted their effort exclusively to the Indian Ocean part of the EEZ in response to the movement of southern Bluefin tuna (*Thunnus maccoyii*) and bigeye tuna (*T. obesus*).

The domestic component of the fleet historically fished out of Durban and Richards Bay Harbours but vessels now operate predominantly out of the Cape Town and Hout Bay Harbours. The vessels currently in operation are typically small fibreglass or wooden hulled and have a maximum range of two-weeks. This small size (~24m) and short range of vessels limits the extent of their operations. DAFF is focusing on development of this sector, with a total of 34 (out of a possible 50) vessels operating in the sector, following the completion of the 2015 FRAP and issuing of long-term Rights in 2017, there is scope for expansion.

Temporal Measures

The fishing season is defined as the period from 01 February to 31 January the following year. The fishery is largely dependent on sea conditions, more so the domestic vessels with short range and limited capacity to fish in rough weather. Although the fishery operates all year round the nature of the tuna resource, that forms a large proportion of the catch, is such that there are two distinct seasons of increased effort. Yellowfin (*T. albacares*), bigeye (*T. obseus*) and longfin (*T. alaunga*) tunas are seasonal migrants into South African waters that peak in abundance in May and October each year. Catches of southern bluefin tuna (*T. maccoyii*) all occur during the winter months between May and September (as seen in commercial catch statistics and observer records). There are however no temporal management measures currently in place guiding or restricting the large pelagic longline sector.

Habitat

The fishery operates in the offshore pelagic environment and there is no interaction of fishing gear with the benthic habitat.

User conflict

Drifting longlines can extend for up to 100 km. The lines are weighted and not visible on the surface except at the position of the floats and radio buoys. There is some conflict with the deep-sea demersal trawl fishery as a result of lines being "broken" when trawlers steam across set lines. Lines are retrieved by locating the nearest radio buoy which can sometimes require hours of searching. As the name suggests, longlines drift with the currents and their movement is unpredictable, lines can drift to shallow inshore areas where they are likely to become entangled with other sectors fishing gear and also with seismic survey gear that can result in conflict.[96]

Conclusion

- ✓ The nature of the highly migratory species (yellowfin, bigeye, longfin tunas, swordfish) targeted by the large pelagic longline sector and their sporadic availability do not lend support to the delineation of priority fishing areas for the sector. Tunas and billfish are predominantly driven by their search for suitable feeding habitat that is dependent on water temperature, salinity, colour and primary production that are the driving forces behind the absence or presence of their prey. The variable nature of the South African, Agulhas and Benguela convergence, oceanic environment means that the location of these fish is highly unpredictable. In addition the fish do not aggregate to spawn in South African waters but are present during feeding migrations from the tropics.
- ✓ Alternate target species such as blue shark (*Prionace glauca*) and shortfin mako shark (*Isurus oxyrinchus*) are less migratory and the presence of pregnant females and small/juvenile fish of each species in the catches lends support to the rationale that there is breeding habitat within the South African EEZ. Designation of this habitat as a fishery/ecological support area would contribute to the security of the sector but additional research needs to be undertaken in order to define the location of spawning for both shark species.
- ✓ Further spatial management measures are not immediately necessary for this sector and the current Permit Conditions are adequate to manage the fishery. South Africa is a Member of three tuna RFMOs (ICCAT/IOTC/CCSBT) a consequence of which is that the governance of this fishery is effected on primarily the regional level. South Africa is compliant with the CMMs of all three RFMOs and includes updates to the national annual permit conditions as changes are made at a regional level.

[96] Atkinson, L. & Sink, K. 2008. User profiles for the South African offshore environment. *SANBI Biodiversoty Series* 10. South African National Biodiversity Institute, Pretoria.

4.10 Tuna pole & line

Overview of the sector

Commercial catch and effort data was not available to map the spatial distribution of the tuna pole & line sector. The sector traditionally targets albacore or longfin tuna (*T. alalunga*) and operates in waters up to 1000 km off the south and west coasts[97]. Longfin are highly migratory and typically appear in South African waters from October to May, catches approximate to 4000 tons per annum, a significant volume in the south Atlantic Ocean. When available the sector will preferentially target yellowfin tuna (although some operators do not switch strategy from targeting longfin) which comprises on average 529 tons of the catch per annum.

Current Spatial Measures

The tuna pole & line sector is permitted to fish in South African waters outside of Marine Protected Areas.

Table 10: Fishing and restricted areas for the tuna pole & line sector and restrictions on live-bait fishing as per permit conditions for the 2018/2019 fishing season.

Section B: Permit Conditions: Tuna Pole & Line Fishery	
Fishing Season: 2018/2019	
3	Fishing Areas
3.1	The permit is valid in South African waters (excluding tidal lagoons, tidal rivers and estuaries) and may be used on the high seas in conjunction with a high seas vessel license.
3.2	The Permit Holder or any of his/her or its employees shall not undertake fishing, or take or destroy any fauna and flora, or in any way disturb alter or destroy the natural environment, or carry on any activity which may adversely impact on the ecosystems in Marine Protected Areas except where so permitted by the Minister in writing.
3.3	Fishing in other marine areas controlled by the South African National Parks, is subject to regulations, promulgated under the National Parks Act, 1976 (Act No. 57 of 1976) as amended.
3.4	No person shall use any purse-seine net for fishing for live bait or any other purpose in the following area:
(a)	East of Cape Point, east of 18°29.865' E.
(b)	Within a 10.799 nm radius around Dassen Island, with the light house at the centre of the circle.
(c)	All Marine Protected Areas and all closed areas as declared under section 77 of the MLRA and the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003).

[97] Parker, D., Winker, H., Kerwath, S.E. 2017. Standardization of the catch per unit effort for yellowfin tuna (Thunnus albacares) for the South African tuna pole and line (baitboat) fleet for the time series 2003-2016. SCRS/2017/206.

Fishing Patterns

Vessels in the pole & line sector target albacore tuna (*T. alalunga*) that appear seasonally in Cape waters. The bulk of the fleet operates out of Cape Town and Hout Bay harbours and fishes within a 100 nm radius of those locations. Smaller vessels typically conduct short trips of 5-7 days and have a specialised crew of 8-10 fishermen equipped with long poles and gaffs to haul tuna on-board. Effort is concentrated in the Cape Canyon area Figure 26b. Larger vessels with crew of 20 or more are capable of fishing further from port and operate along the entire west coast to the Namibian border targeting albacore. Coupled with throwing dead-, or in the case of larger vessels, live-bait in to the water, water is sprayed onto the surface adjacent to the boat to imitate the activity of a school of bait fish. Fish are drawn to the surface by the activity and gaffed from the water one at a time.

Yellowfin tuna are targeted seasonally when they appear close inshore, spatial mapping has been carried out by DAFF research scientists focusing on the yellowfin component of the catches indicating that the bulk of catches are taken within a single 1x1 degree grid block centred off Cape Town (-34°S, 18°E), Figure 26a. This is despite the fishery having a relatively high amount of effort further up the west coast of South Africa, where albacore are generally more abundant. When targeting yellowfin or bigeye tunas the vessels will troll lines, either baited or with artificial lures, behind the vessel at speeds of 6-9 knots.

Reporting of monthly catch statistics has been compulsory since 1985 and includes daily catch (kg) per species per boat. The fishing positions are also recorded and coded according to a 1×1 degree geographic position. Recently the reporting has been improved to fulfil international RFMO data obligations and to facilitate analyses and includes information on fishing hours, number of crew, use of life-bait, sea-surface-temperature and target.

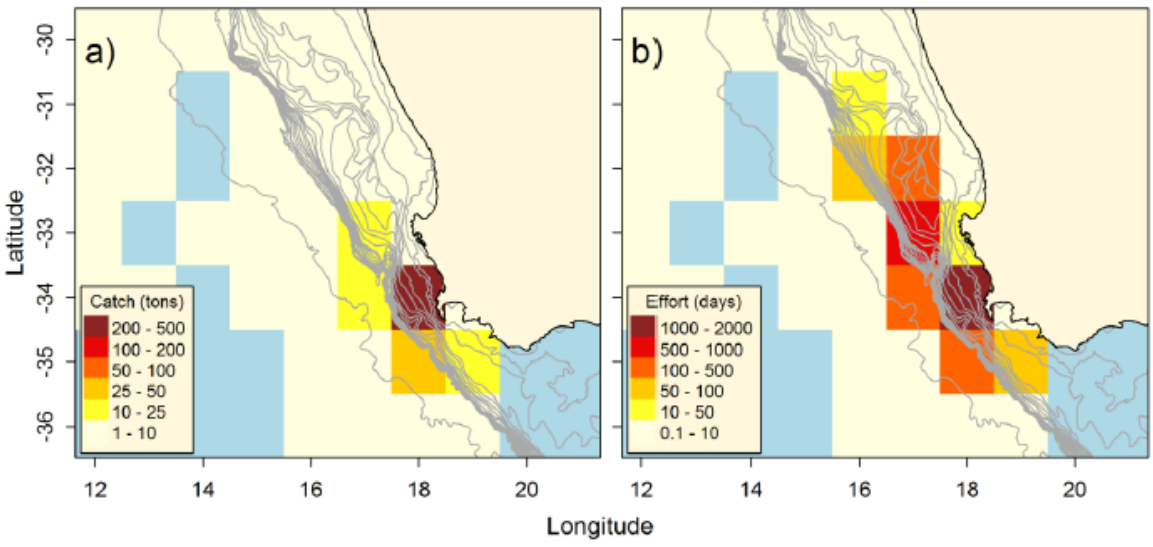

Figure 26: **Mean annual a) yellowfin tuna catch (tons) and b) tuna pole & line effort (boat days) at the 1x1 degree reporting resolution[97].**

Cross-Cutting and Bycatch Species

Bycatch in the tuna pole sector species includes snoek (*Thyrsites atun*) and yellowtail (*Seriola lalandi*) that are key targets of the commercial linefish sector. In times where tuna is not available both these species can be considered targets of the pole & line sector that then operates in direct competition with linefish fishermen.

Permit conditions allow that each crew member catch a total of 10 yellowtail per trip. However the permit conditions have recently been amended creating a temporary concession to improve South Africa's tuna catch performance by improving the economic feasibility of tuna vessels searching for tuna (particularly albacore) north of Cape Columbine. A maximum of four vessels may be nominated to qualify for the concession. The concession allows the Permit Holder to catch a maximum of 50 yellowtail per crew member per trip if the vessel has only fished north of Cape Columbine (i.e. north of 32^{o} 45' S) for that particular trip.

Temporal Measures

Fishing is permitted to take place throughout the year. The fishery is seasonal with vessels active predominantly between November and May and peak catches recorded from November to January. Effort fluctuates according to the availability of fish in the area, but once a shoal of tuna is located a number of vessels will move into the area and target a single shoal which may remain in the area for days at a time. The fishery is dependent on window periods of favourable conditions relating to catch availability.

Habitat

Like the pelagic longline sector the tuna pole & line sector operates in the pelagic environment and there is no interaction of fishing gear with the benthic habitat.

User Conflict

There is potential for conflict with other fisheries sectors that operate in the Cape Canyon area but the nature of the fishing operation does not generate conflict through gear interactions. The highly migratory resources that the sector targets are managed on a regional scale by the tuna RFMOs so the sustainability of the sector is largely dependent on the stock in the south Atlantic and southern Indian Oceans and compliance with catch limitations and CMMs by other Member nations targeting the same stocks.

Conflict with the traditional linefishery is being addressed through permit conditions and concessions to allow for targeting of yellowtail north of Cape Columbine but enforcing strict limitations on yellowtail in the traditional linefish areas of operation south of there.

The acknowledgement that core grounds exist for this sector is important as an example of territorial use rights when prioritising future developments that may encroach or exclude the pole & line sector from certain areas or at certain times of the year.

Conclusion

- ✓ The tuna pole & line sector currently and historically has had a very concentrated area of operation.
- ✓ The sector is dependent on highly migratory tunas that are managed by RFMOs. Further spatial management or recognition of priority fishing areas nearshore around Cape Town (Cape Canyon and Cape Columbine) within the South African legislative framework would likely benefit the sector.
- ✓ A clearer understanding of fishing positions reported at a higher resolution than 1 degree may help identify Priority Fishing Areas for this sector.

5.0 Overall Conclusions

The work done in this report provides a template based on the best available information and is a reference document focusing on spatial and temporal catch and effort of the main offshore fisheries in South Africa. As such, it provides a baseline for future spatial management of fisheries - in particular the need to take careful consideration of fishery-specific interests in the overall Marine Spatial Planning context. Identifying the critical spatial distributions of target species on a fishery sector by sector basis as well as any bycatch species that might be of "cross-cutting" significance has allowed for the identification of potential priority fishing areas that may be pertinent to both management of the fishery itself as well as the stocks exploited.

For each of the principal offshore fishery sectors in South Africa, the historical and current catch and effort has been spatially described. These results show that there are clear instances of overlap between fisheries in relation to operational areas, and in some cases potential areas of conflict. The operational nature of fishing determines the degree which sectors will interact with the environment and with each other. Pelagic fisheries for example are not competing for space with demersal fisheries due primarily to the nature of the gear deployed. Conflict may however arise when the species targeted may overlap at certain times of year or in specific preferred fishing areas.

For demersal trawl and longline, overlap of operations on preferred demersal fishing grounds can result in gear fouling between demersal sectors and is an obvious source of conflict between these two sectors. Demersal longline and bottom trawl have significantly different potential impacts on habitat and as a consequence on the broader ecology of the demersal environment. While operational conflict is a spatial issue, it is not a priority management issue from a resource perspective. The fundamental differences between these two demersal gear types, including the selectivity of the gears, habitat effects and bycatch, does however impact on the broader management of the hake-directed fishery, including the relative proportions of hake and bycatch of each fishery within the Total Allowable Catch for hake. Species taken in the demersal trawl and longline sectors, in addition to hake, have no major cross-cutting issues, except possibly for kingklip. Both gear types have the ability to target kingklip, in particular known aggregations that occur seasonally and on preferred habitat type. In this context, the designation of a kingklip "spawning box" is appropriate, although in our view the temporal period of closure and location relative to known habitat-sensitive areas needs review.

For other sectors, there are a range of target, cross-cutting and bycatch species that we have used to frame this report in the context of competing resource utilisation and spatial management. A case in point is the midwater horse mackerel resource that is exploited by demersal and midwater trawl sectors, the linefish fishery and the small pelagic purse seine sector. The resulting potential for conflict amongst these sectors requires clear management decision-making protocols and operational management plans that take into consideration the interests of each sector and also the dynamics of the stocks exploited. For example demersal resources are managed collectively by the Demersal Scientific and Resource Management Working Groups that include the inshore and offshore demersal trawl fisheries, the midwater trawl fishery and the demersal longline sector. A clear agreed procedure for conflict resolution as well as resource apportionment between these sectors is desirable. This would also include fishing sectors outside of the "demersal" complex of

fisheries and species exploited where conflict and or competition exists, e.g. linefish (kob) and small pelagic (horse mackerel). Issues relating to resource management between these sectors are largely dealt with on a needs basis by the Scientific and Management working groups at DAFF.

In the large pelagic sectors – that is pole and line and longline for tuna's and pelagic sharks, the highly migratory nature of the species exploited largely precludes them from spatial management. These sectors do however have a strong seasonal signal, which has no overlapping operational or conflict concerns related to the species and stock exploited. The boundaries between the two RFMOS (ICCAT and IOTC), while clearly defined, do have some major stock-related uncertainties, in particularly regarding the migration of yellowfin tuna between the two areas.

The squid sector is spatially ring-fenced and confined to the target areas for spawning aggregations of adult squid and has a well-established temporal pattern. There remains uncertainty regarding the recruiting dynamics on the Agulhas Bank. In this regard the cross-cutting aspects between the trawl and squid jig sectors are an important consideration. While the squid jig fishery distribution is largely habitat and depth dependent (noting that temperature and other environmental characteristics plays a role) and targets adults, the inshore and offshore trawl fisheries have bycatches of predominantly juvenile squid. Further, because of their preferred and restricted fishing grounds and the uncertainty related to recruitment processes, the squid jig fishery is potentially vulnerable to other user conflicts, in particular to exclusion from fishing areas due to hydrocarbon and seabed mining.

For the South Coast Rock Lobster fishery, the gear deployed is static and set on the seabed. The spatial signals shown in this report clearly highlight that the preferred fishing areas are well established, although effort is along a broad depth-dependent area on the Agulhas Bank. The spatial distribution of bycatch in this fishery, while it is a relatively small volume (bycatch) shows the importance of species-habitat association. While this study does not go as far as defining habitat and species interactions, that association has important correlations with the current offshore spatial mapping process. Species such as rock lobster, octopus and slipper lobster appear to have preferred areas that are most probably substrate-dependent, which need consideration in not only the context of the management of the fishery but also the habitat type on which the fishery depends and may impact.

For the midwater trawl sectors there are already spatial measures in place. As with small pelagic, the midwater trawl is assumed to have no bottom habitat impacts. The main cross-cutting issue between these two sectors relates to adult and juvenile horse mackerel. This is an issue already well considered in both the demersal and pelagic working groups at DAFF. While there remains uncertainty relating to the number of horse mackerel stocks and also as to the recruitment between the two fisheries and the association with the "biological" recruitment process between West and South Coasts, the established management regime would seem appropriate and precautionary.

The small pelagic sector has no direct spatial measures in place. The fishery operations have evolved closely with the natural dynamics of the two main stocks exploited (anchovy and sardine). The pelagic sector is not without spatial issues however. In recent years user conflict between penguins and the fishery has prevailed and is being addressed. The primary concern is the declining penguin populations and the relative locality of the penguin feeding grounds which are fished by the purse seine fleets for their preferred prey (sardine and anchovy). Again this is an area of research

highlighted by the Pelagic Working Group and which has resulted in spatial measures on a trial basis (exclusion of the purse seiners from areas around the island breeding colonies).

Numerous other marine industries such as offshore renewable energy development, extraction activities for oil & gas or seabed mining (e.g. phosphate), aquaculture and marine transport are expanding and are increasingly in conflict with the fishing industry which has a firm historical and renewable base. This is particularly important in light of the likely future emphasis of the governance authority on social and economic factors. Comparative importance of offshore industries is likely to result in fast-tracking of the social and economic agenda resulting in some offshore sectors being given precedence over other renewable and established sectors.

To better effect the expansion of offshore activities, including the current and potential future activities of established fisheries, spatial management is critical. The identification of Priority Fishing Areas (PFAs) and Fishery Management Areas (FMAs) is therefore crucial to ensure the long-term sustainability of fisheries and that the associated socio-economic benefits supported by the fishing industry are taken into account in the context of developing offshore industries. In addition, the report recognises that there may be a shared interest between identification of critical biodiversity areas and the protection of nursery areas and key spawning areas of commercial fishery target species. The formal protection of those areas can act primarily for the benefit of fisheries. The report acknowledges that commercial fisheries catch and effort information cannot be used in isolation to identify important areas for fisheries, further work is underway to explore additional metrics, such as socio-economic indices, to bolster support for future spatial management and protection of fisheries resources.

Appendix 1: Priority Fishery Maps for Target Fisheries

Note: Some maps represent cumulative catch/effort for the time series while others are average annual catch/effort. Cumulative: Demersal trawl, Hake longline, Midwater trawl, Large pelagics, Squid & SCRL. Average annual: = Small pelagic purse seine.

Demersal Trawl: Hake

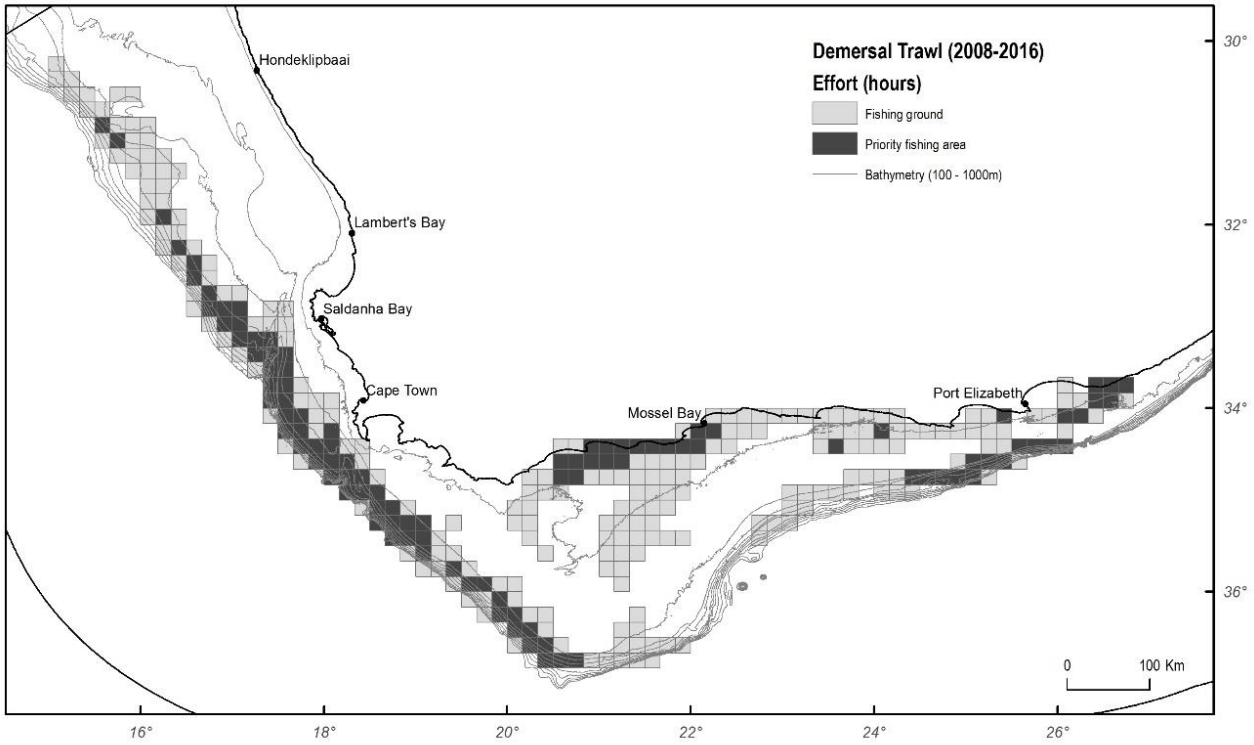

Figure 27: Spatial distribution of effort expended by the inshore and offshore demersal trawl sectors for the years 2008 to 2016 (DAFF). Priority fishing areas are those where the value of d1/d80 = 1 or higher (grid values of >2674 hours (cumulative) of a maximum grid value of 18981 hours). Grids with a value of d1/d80 < 0.05 were not shown (grid values of <135 hours).

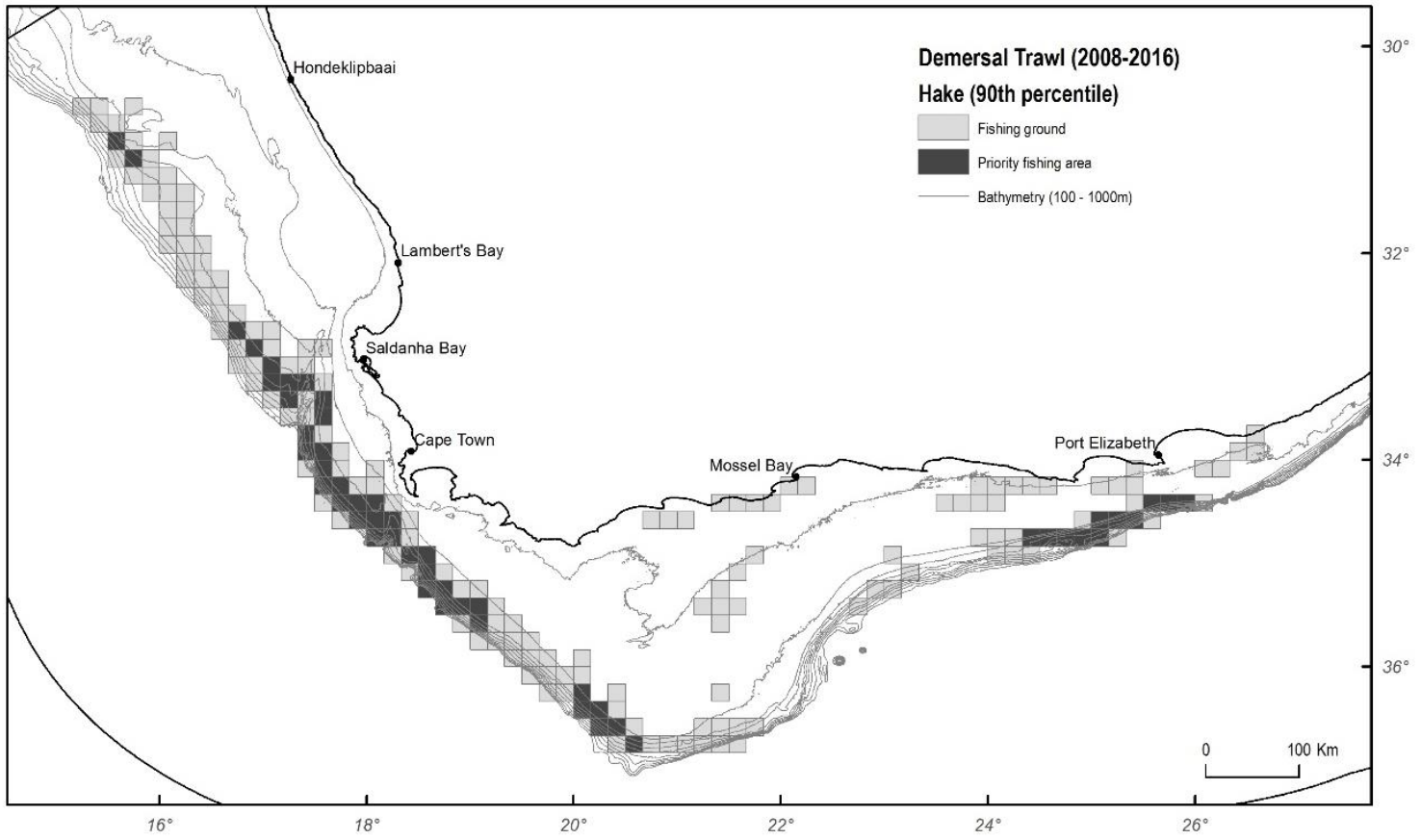

Figure 28: Spatial distribution of hake landed by the inshore and offshore demersal trawl sectors for the years 2008 to 2016 (DAFF). Priority fishing areas are those where the value of d1/d90 = 1 or higher (grid values of >7183 tons (cumulative) of a maximum grid value of 32971 tons). Grids with a value of d1/d90 < 0.05 were not shown (grid values of <360 tons).

Demersal Trawl : Sole

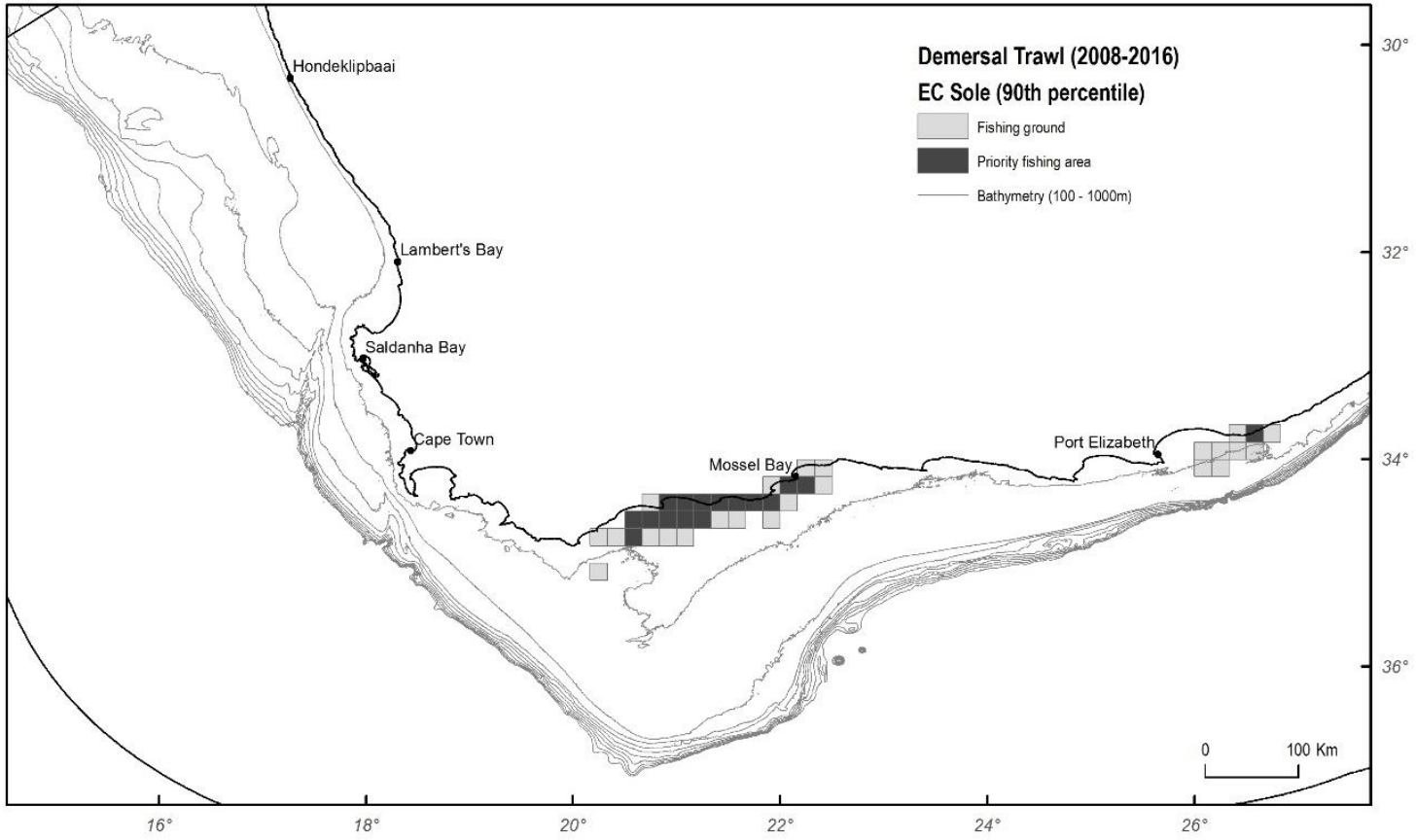

Figure 29: Spatial distribution of east coast sole landed by the inshore and offshore demersal trawl sectors for the years 2008 to 2016 (DAFF). Priority fishing areas are those where the value of d1/d90 = 1 or higher (grid values of >63 tons (cumulative) of a maximum grid value of 298 tons). Grids with a value of d1/d90 < 0.05 were not shown (grid values of <3.2 tons).

Hake Longline

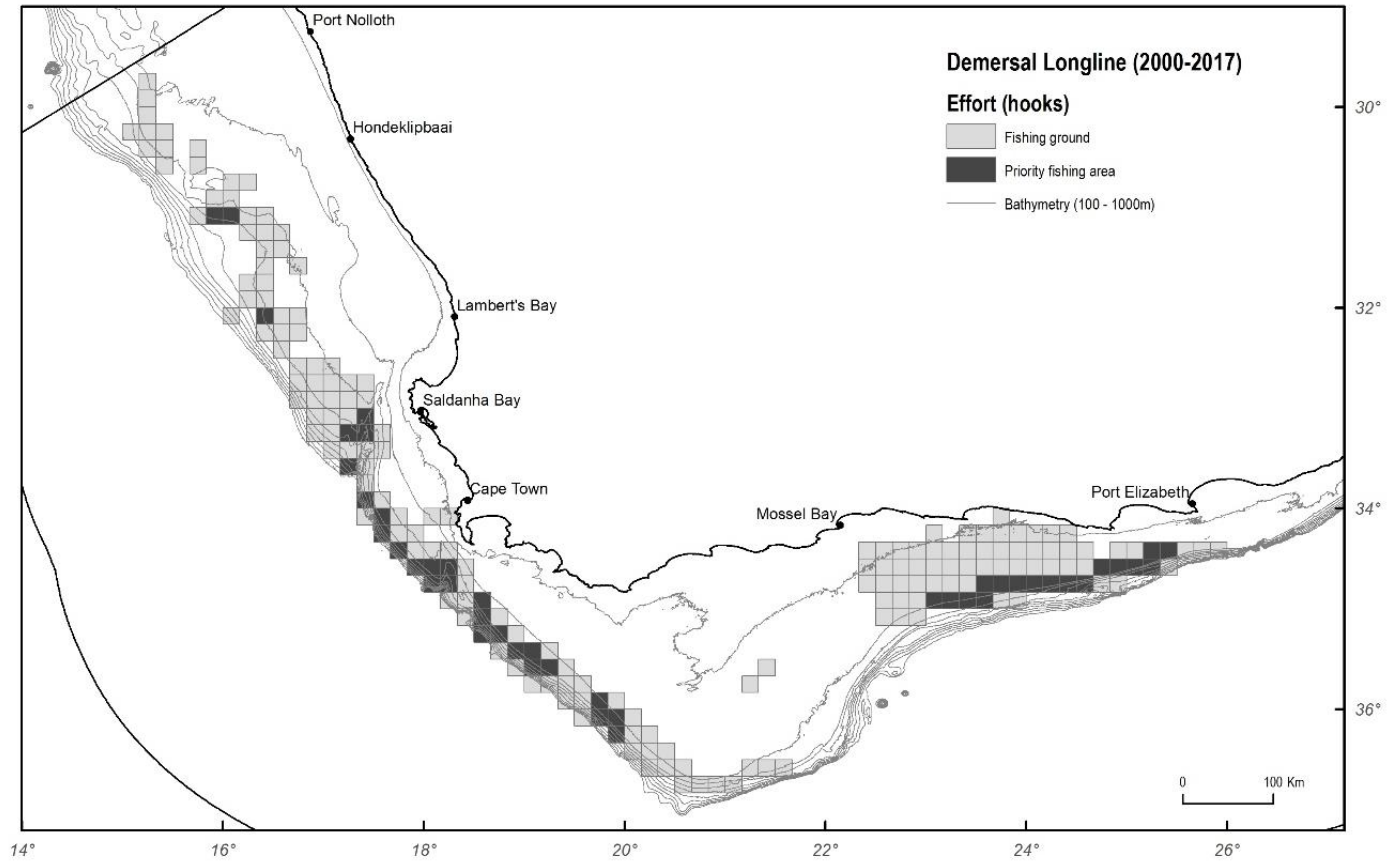

Figure 30: Spatial distribution of effort expended by the demersal longline sector for the years 2000 to 2017 (DAFF). Priority fishing areas are those where the value of d1/d90 = 1 or higher (grid values of >3.7 million hooks (cumulative) of a maximum grid value of 32.2 million hooks). Grids with a value of d1/d90 < 0.05 were not shown (grid values of <187597 hooks).

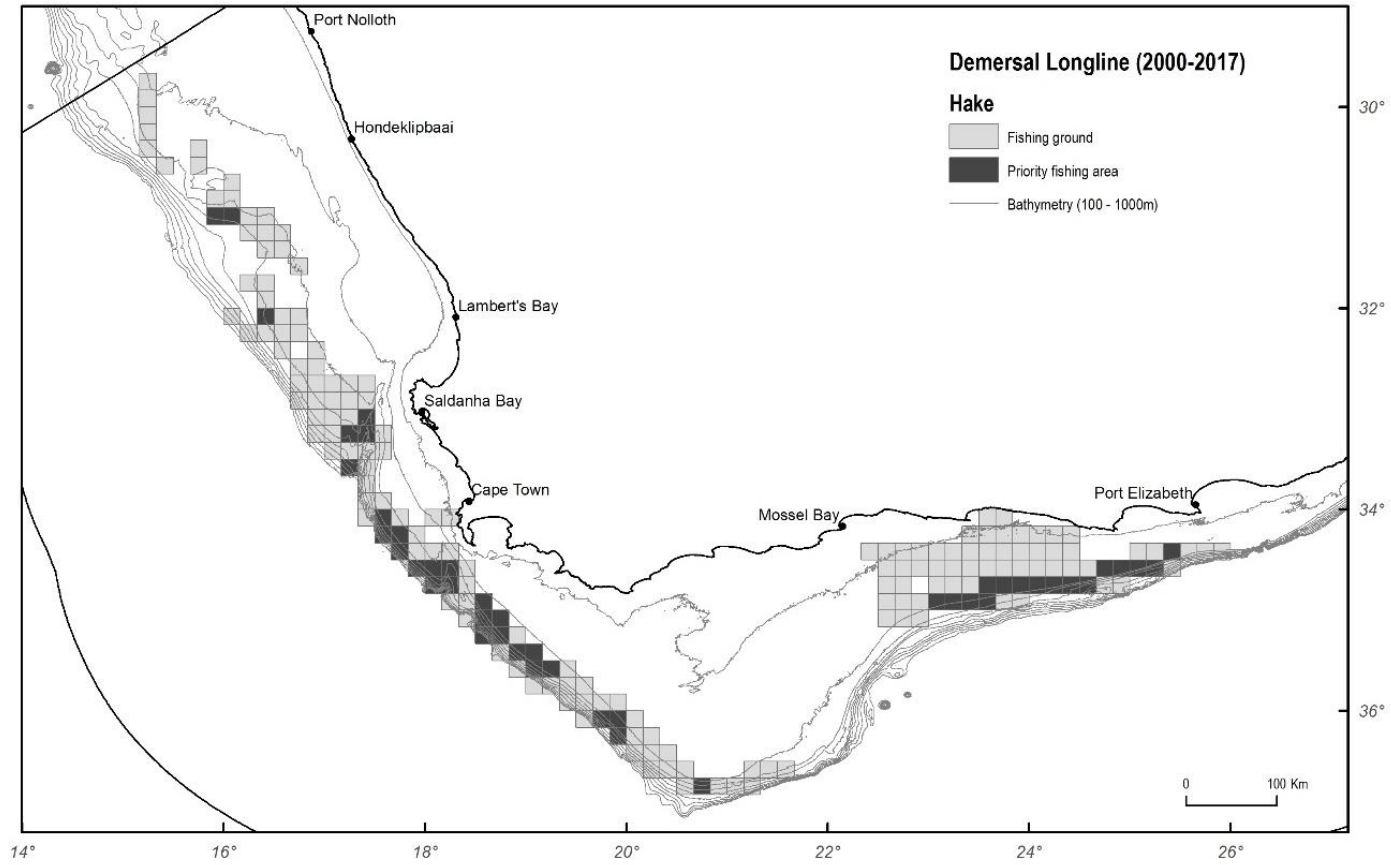

Figure 31: Spatial distribution of hake landed by the demersal longline sector for the years 2000 to 2017 (DAFF). Priority fishing areas are those where the value of d1/d90 = 1 or higher (grid values of >923 tons (cumulative) of a maximum grid value of 8898 tons). Grids with a value of d1/d90 < 0.05 were not shown (grid values of <47 ton).

Large Pelagic Longline

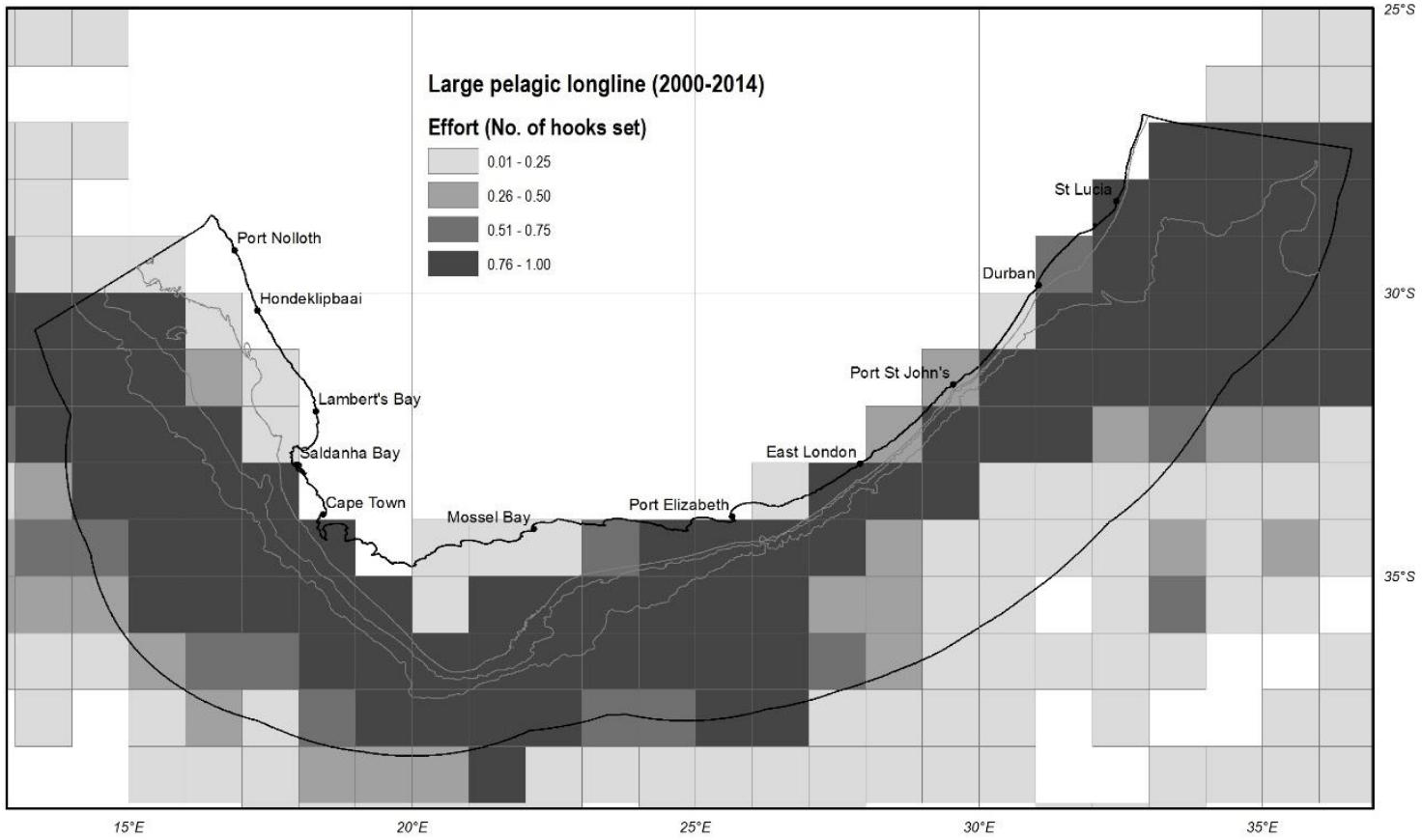

Figure 32: Cumulative effort (number of hooks set) by the large pelagic longline sector for the years 2000 to 2014 (DAFF). Values were normalized to a 0-1 range using the formula d1/d80, where d1 is the raw data in a 60' grid and d80 is the 80th percentile of the values for that data set, with resultant values over 1 being assigned a 1 value. The 200 m, 500 m and 2000 m depth contours are shown.

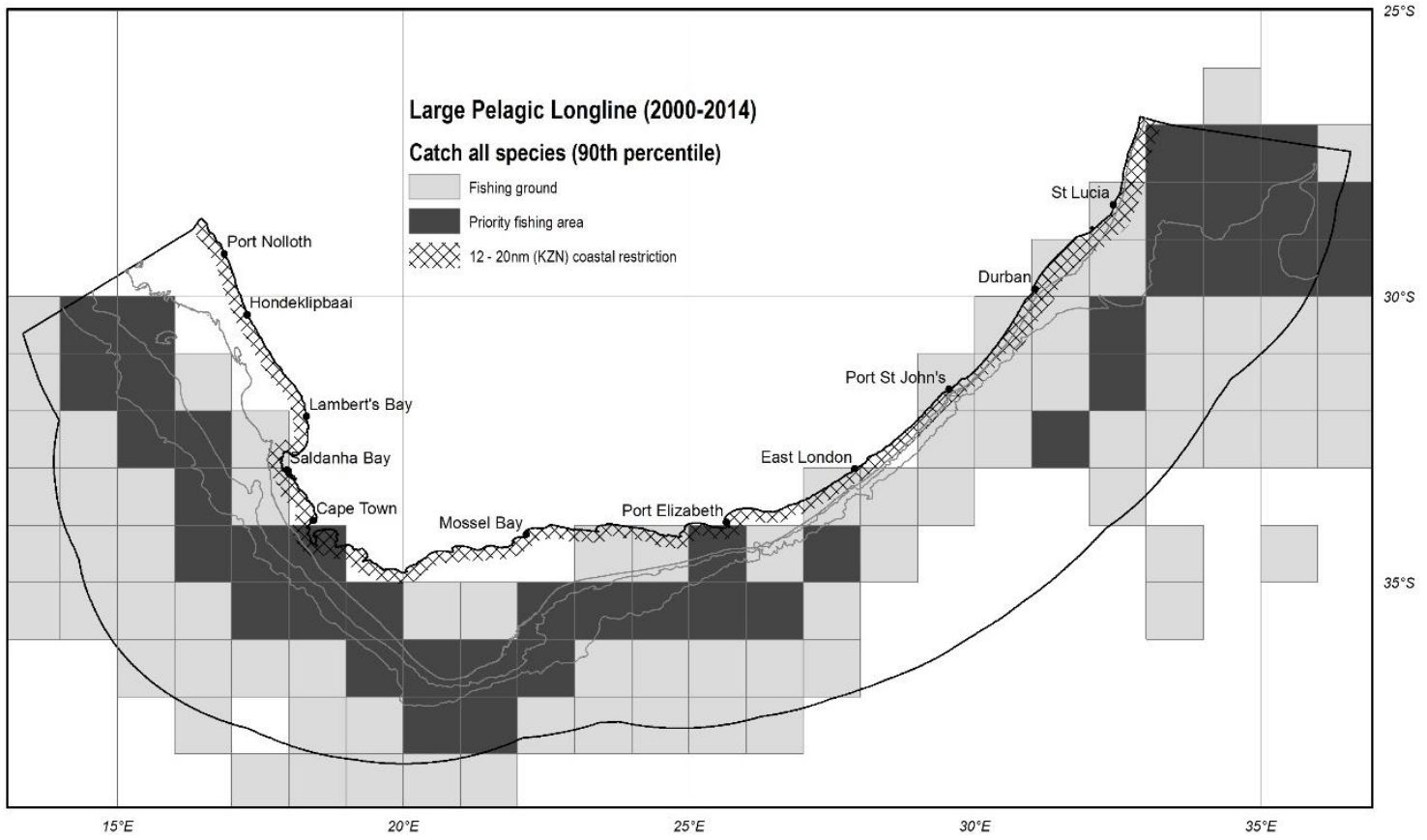

Figure 33: Spatial distribution of all species landed by the large pelagic longline sector for the years 2000 to 2014 (DAFF). Priority fishing areas are those where the value of d1/d90 = 1 or higher (grid values of >214 tons (cumulative) of a maximum grid value of 3572 tons). Grids with a value of d1/d90 < 0.05 were not shown (grid values of <11 tons).

Midwater Trawl

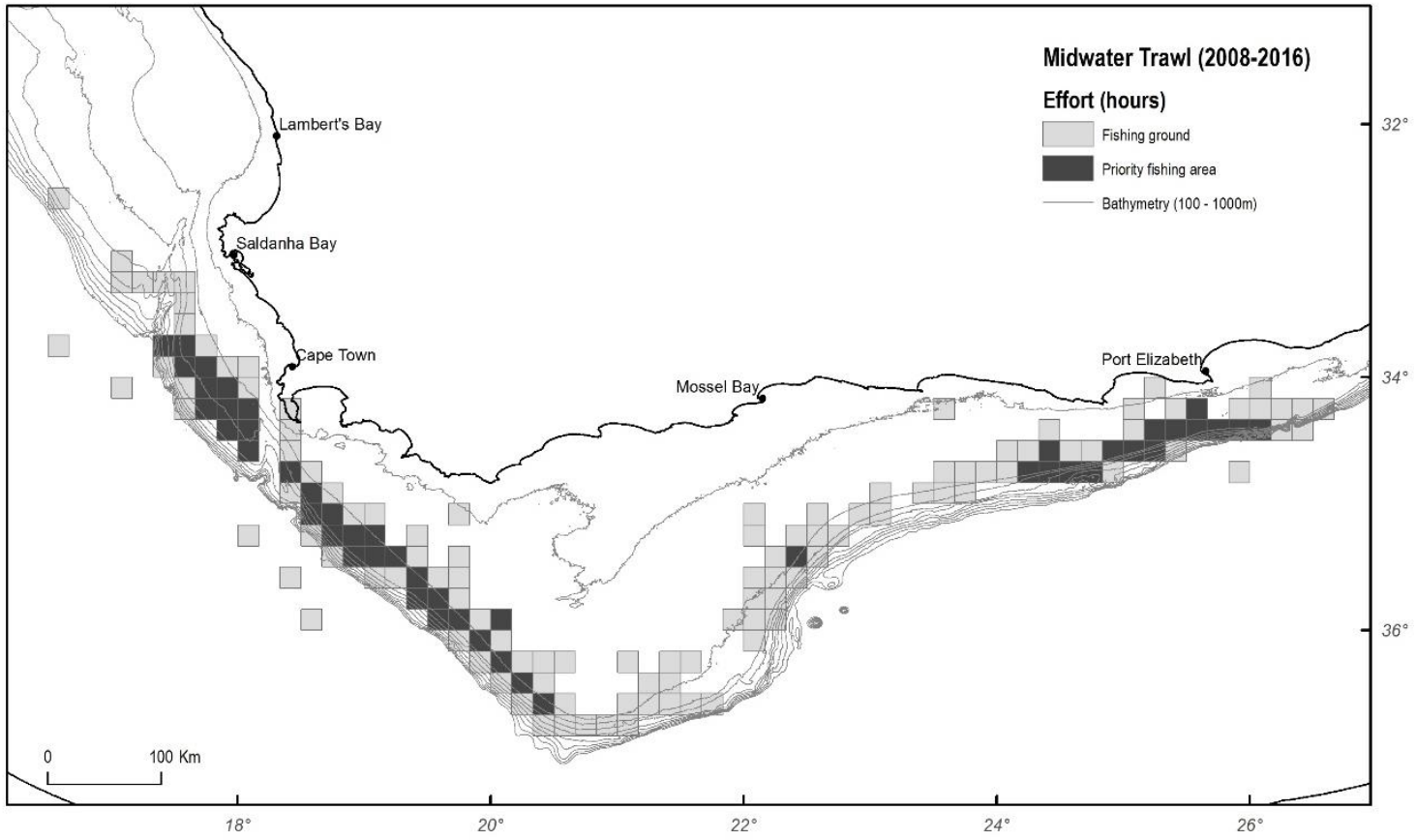

Figure 34: Spatial distribution of cumulative effort expended by the midwater trawl sector for the years 2008 to 2016 (DAFF). Priority fishing areas are those where the value of d1/d80 = 1 or higher (grid values of >110 hours of a maximum grid value of 955 hours). Grids with a value of d1/d80 < 0.05 were not shown (grid values of <6 hours).

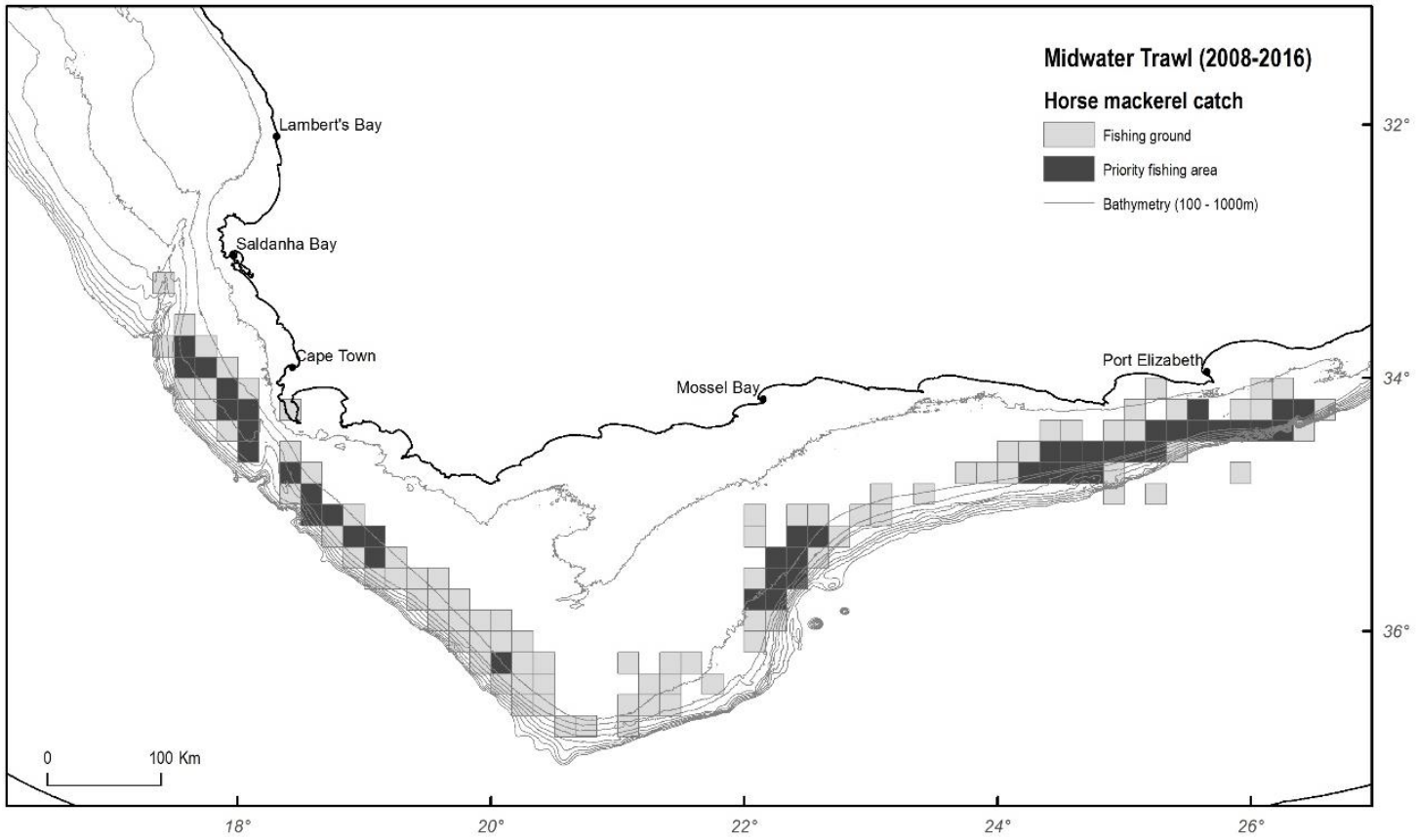

Figure 35: Spatial distribution of cumulative catch of horse mackerel landed by the midwater trawl sector for the years 2008 to 2016 (DAFF). Priority fishing areas are those where the value of d1/d80 = 1 or higher (grid values of >103 tons of a maximum grid value of 1665 tons). Grids with a value of d1/d80 < 0.05 were not shown (grid values of <50 tons).

South Coast Rock Lobster

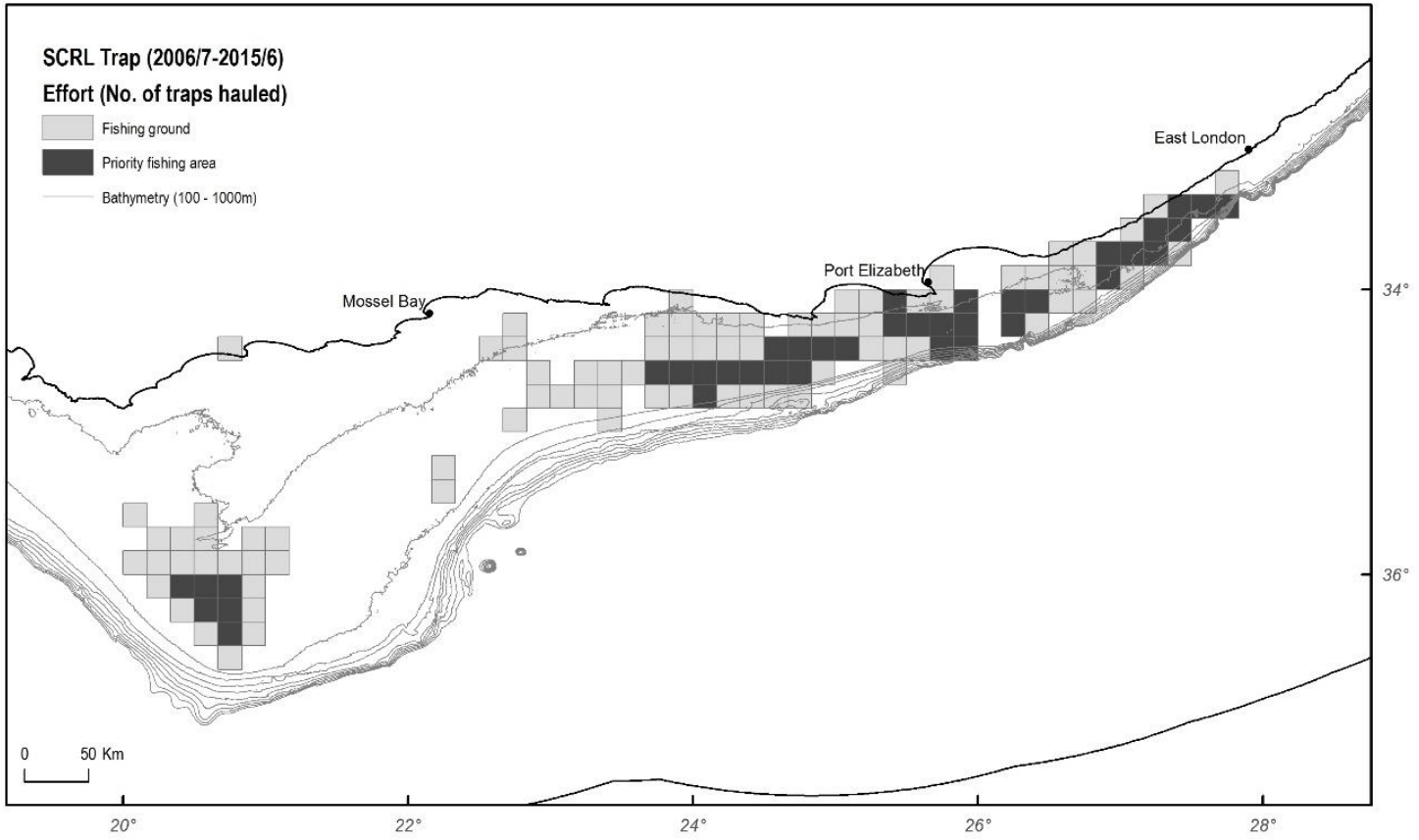

Figure 36: Spatial distribution of cumulative effort expended by the south coast rock lobster trap sector for the years 2006/7 to 2015/6 (DAFF). Priority fishing areas are those where the value of d1/d80 = 1 or higher (grid values of >17893 traps of a maximum grid value of 182442 hauled). Grids with a value of d1/d80 < 0.05 were not shown (grid values of <900 traps hauled).

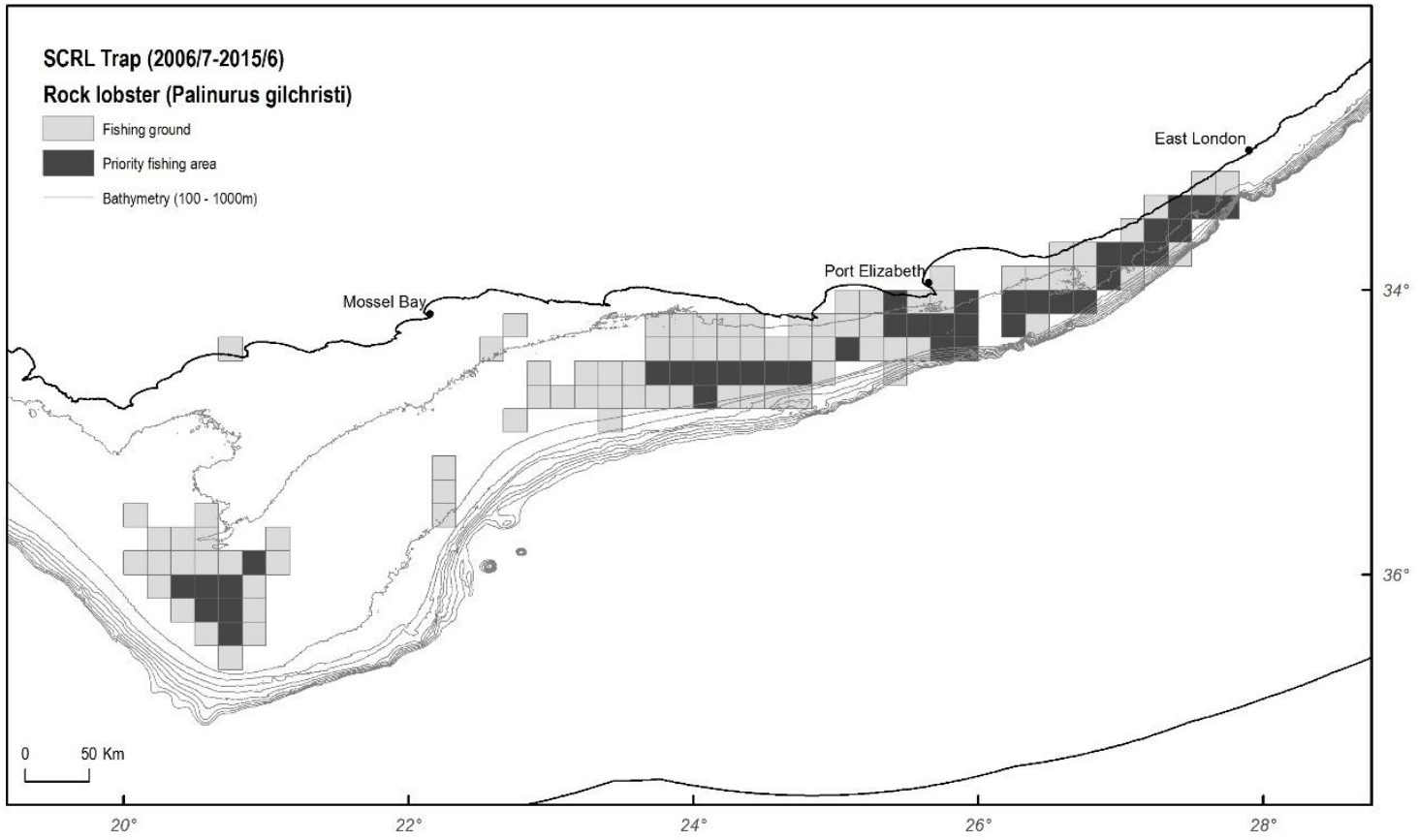

Figure 37: Spatial distribution of the cumulative catch of rock lobster (Palinurus gilchristi) recorded by the south coast rock lobster trap sector for the years 2006/7 to 2015/6 (DAFF). Priority fishing areas are those where the value of d1/d80 = 1 or higher (grid values of >2500 tons of a maximum grid value of 27095 tons tail weight). Grids with a value of d1/d80 < 0.05 were not shown (grid values of <120 tons).

Small Pelagic: Anchovy Target

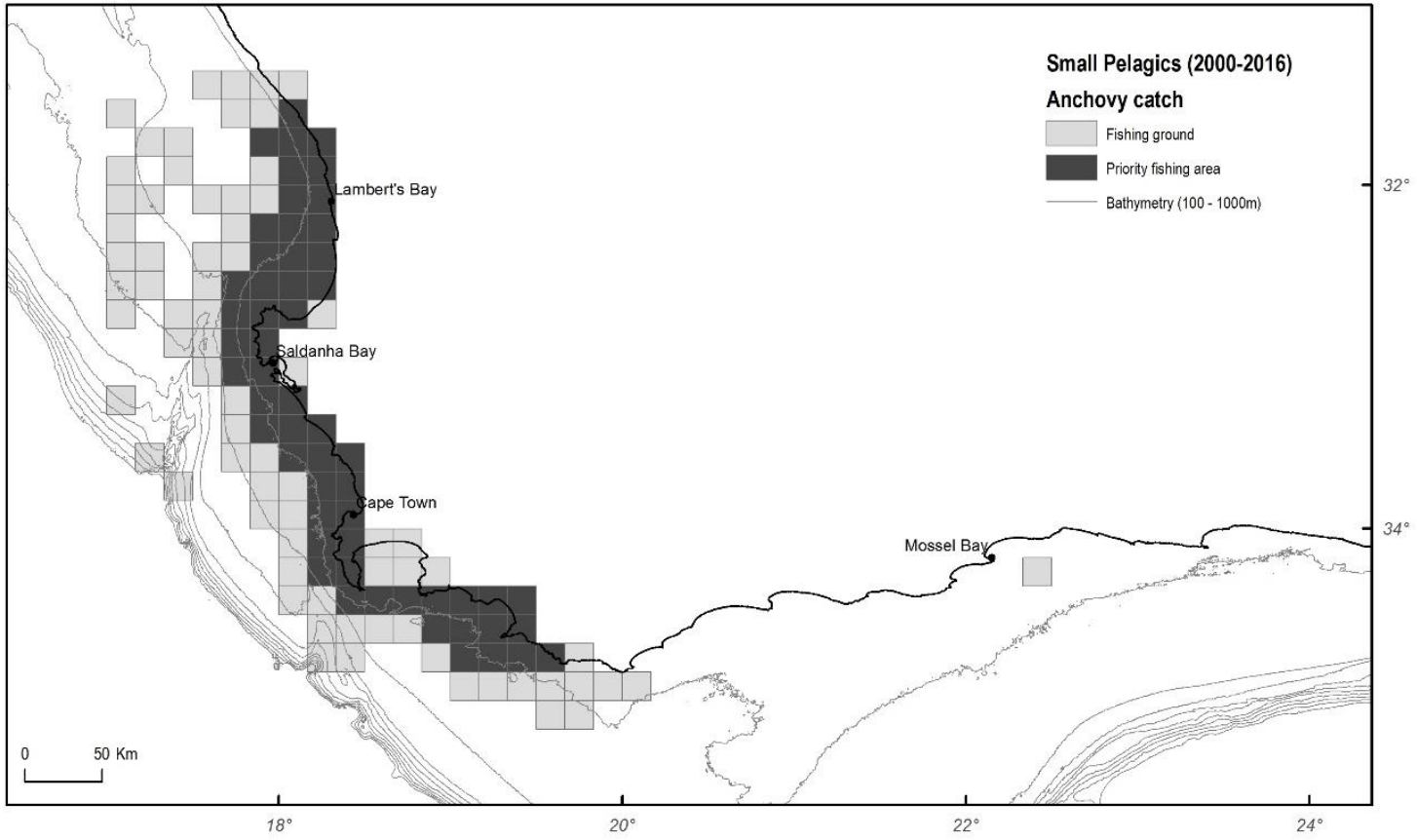

Figure 38: Spatial distribution of anchovy catch (Engraulis encrasicolus) landed by the purse-seine sector for the years 2000 to 2016 (DAFF). Priority fishing areas are those where the value of d1/d80 = 1 or higher (grid values of >270 tons of a maximum grid value of 31402 tons per year). Grids with a value of d1/d80 < 0.05 were not shown (grid values of <14 tons per year).

Small Pelagic: Sardine Target

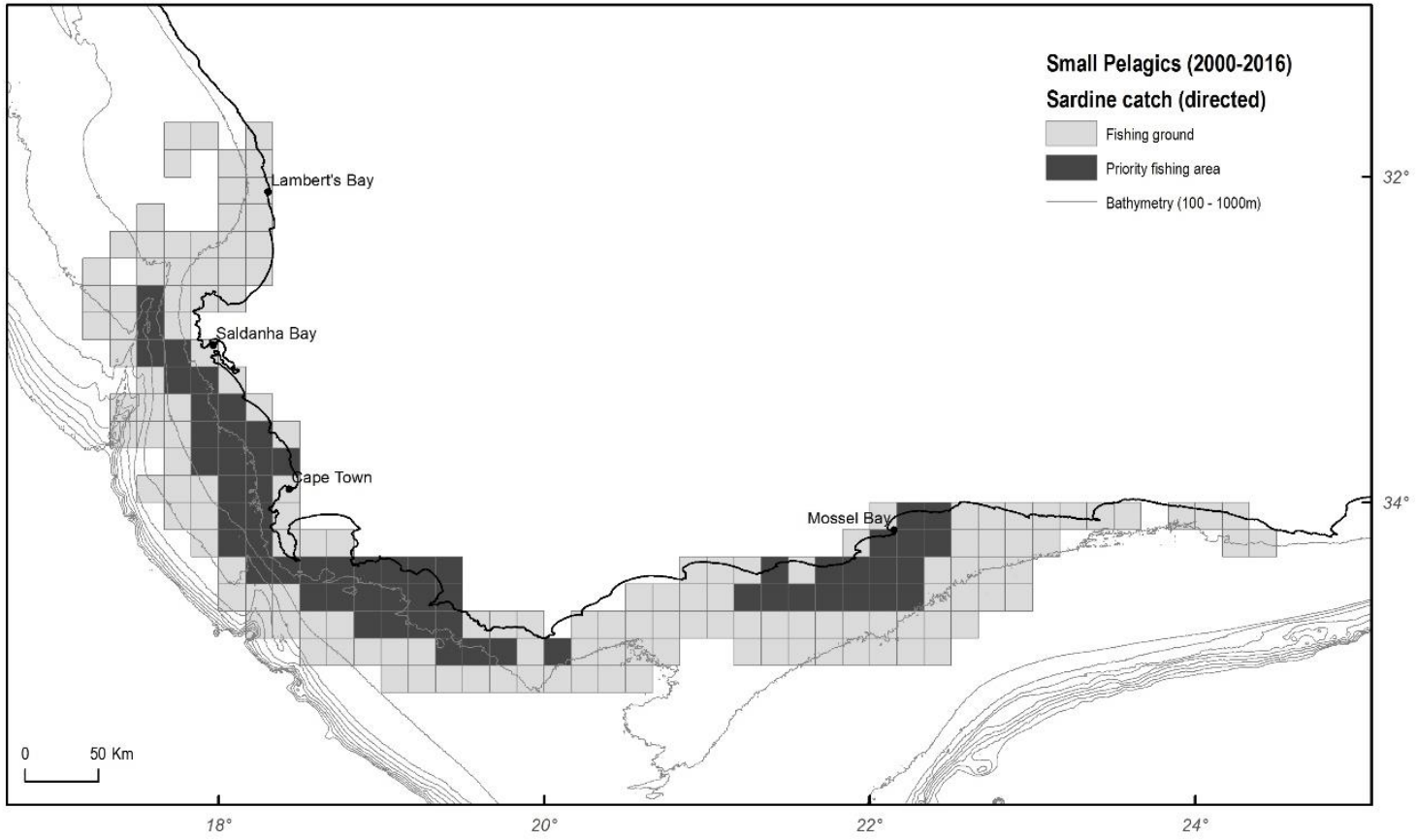

Figure 39: Spatial distribution of directed sardine catch (Sardinops sagax) landed by the purse-seine sector for the years 2000 to 2016 (DAFF). Priority fishing areas are those where the value of d1/d80 = 1 or higher (grid values of >490 tons of a maximum grid value of 19313 tons per year). Grids with a value of d1/d80 < 0.05 were not shown (grid values of <25 tons per year).

Squid Target

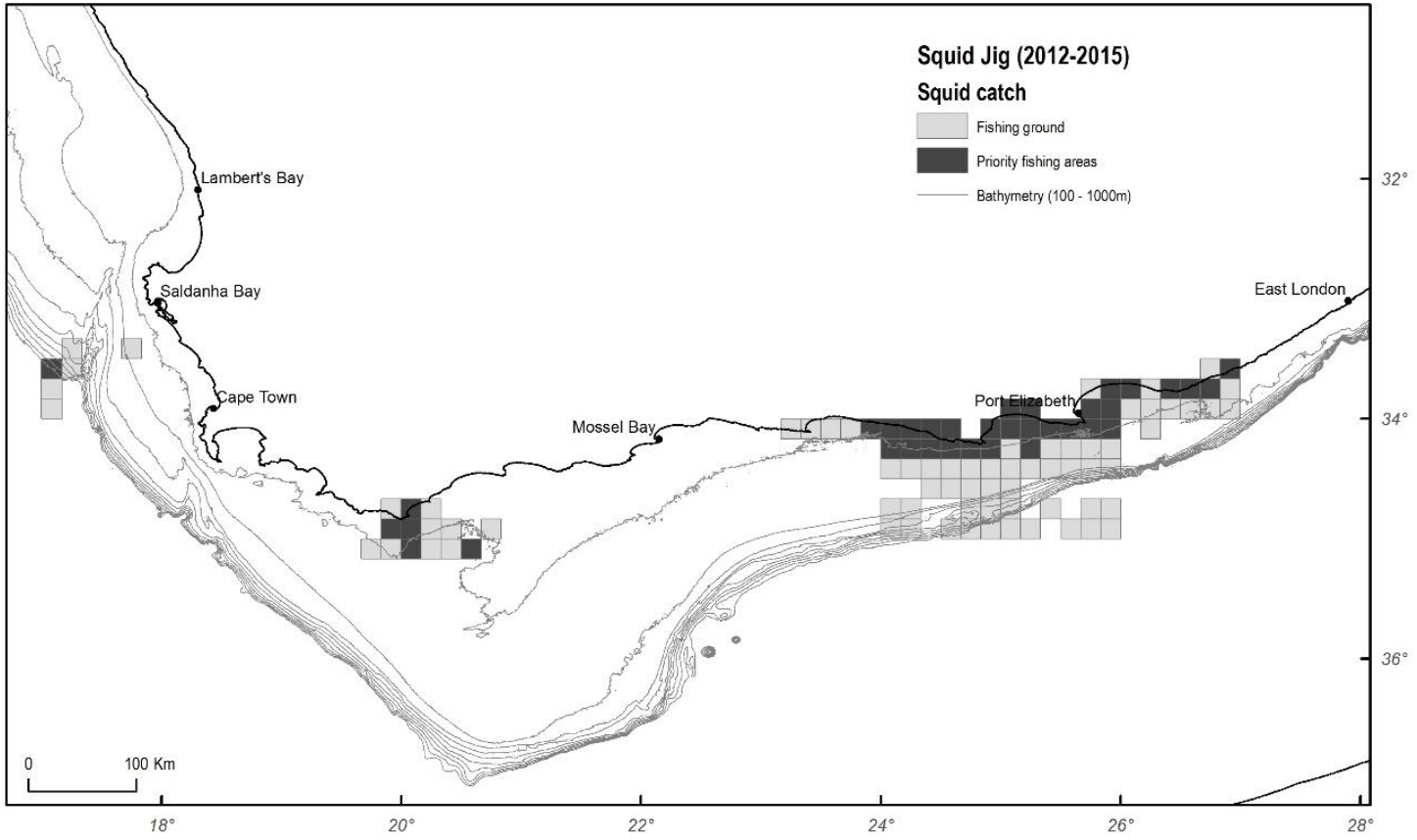

Figure 40: Spatial distribution of squid landed by the squid jig sector for the years 2012 to 2015 (DAFF). Priority fishing areas are those where the value of d1/d80 = 1 or higher (grid values of >46.7 tons (cumulative) of a maximum grid value of 2386.1 tons). Grids with a value of d1/d80 < 0.05 were not shown (grid values of <2.5 tons).

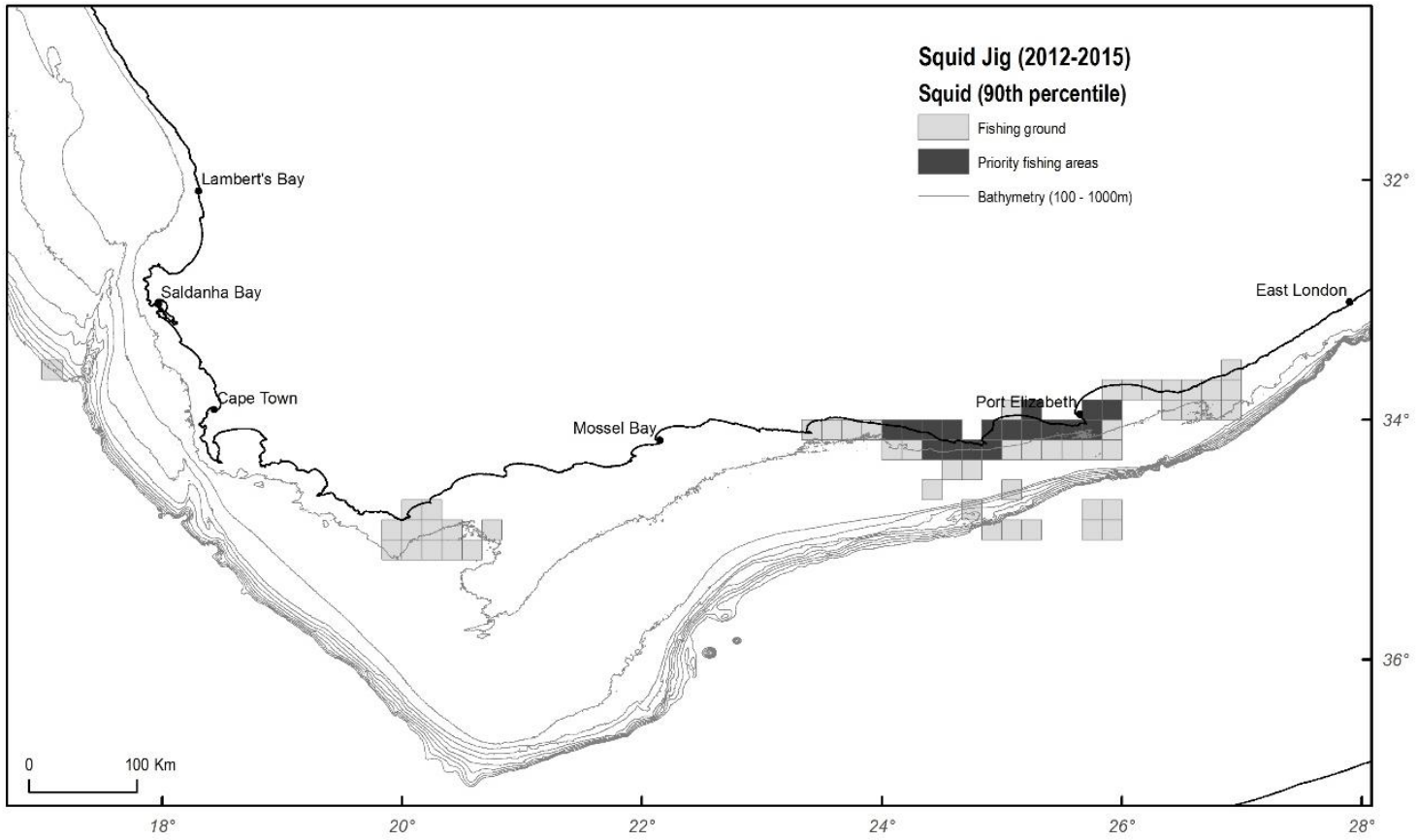

Figure 41: Spatial distribution of squid landed by the squid jig sector for the years 2012 to 2015 (DAFF). Priority fishing areas are those where the value of d1/d90 = 1 or higher (grid values of >219.5 tons (cumulative) of a maximum grid value of 2386.1 tons). Grids with a value of d1/d90 < 0.05 were not shown (grid values of <11 tons).

Appendix 2: Key Cross-cutting Species:

Hake (midwater)

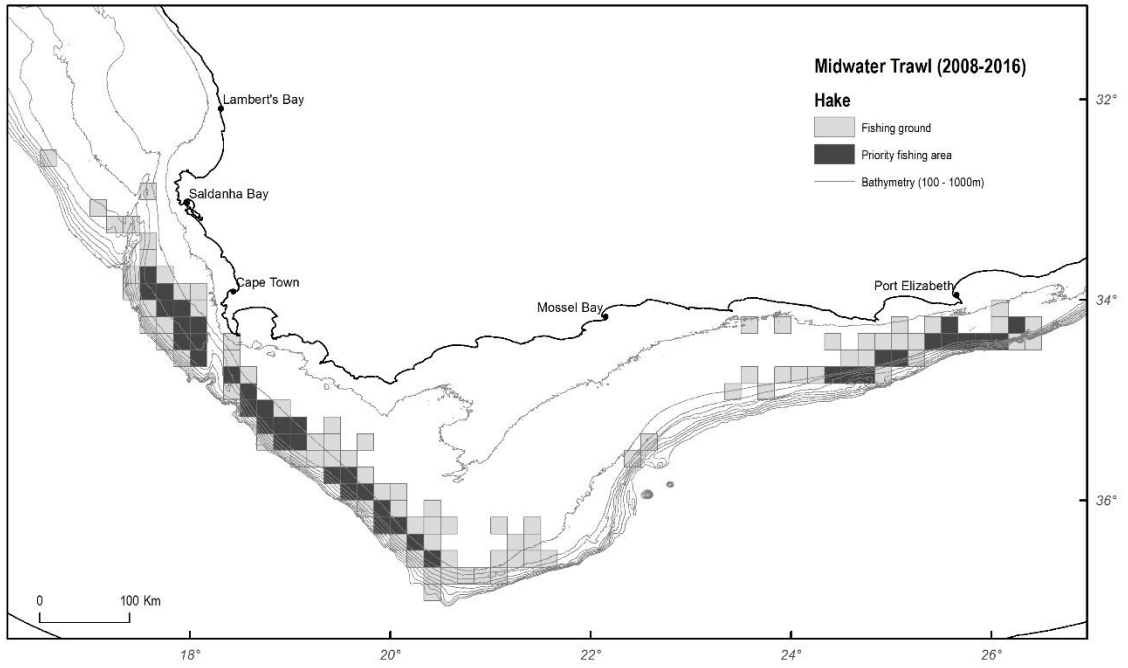

Figure 42: *Spatial distribution of cumulative catch of hake by the midwater trawl sector for the years 2008 to 2016 (DAFF). Priority fishing areas are those where the value of d1/d80 = 1 or higher (grid values of >104 tons of a maximum grid value of 830 tons). Grids with a value of d1/d80 < 0.05 were not shown (grid values of <5 tons).*

Kingklip (trawl & longline)

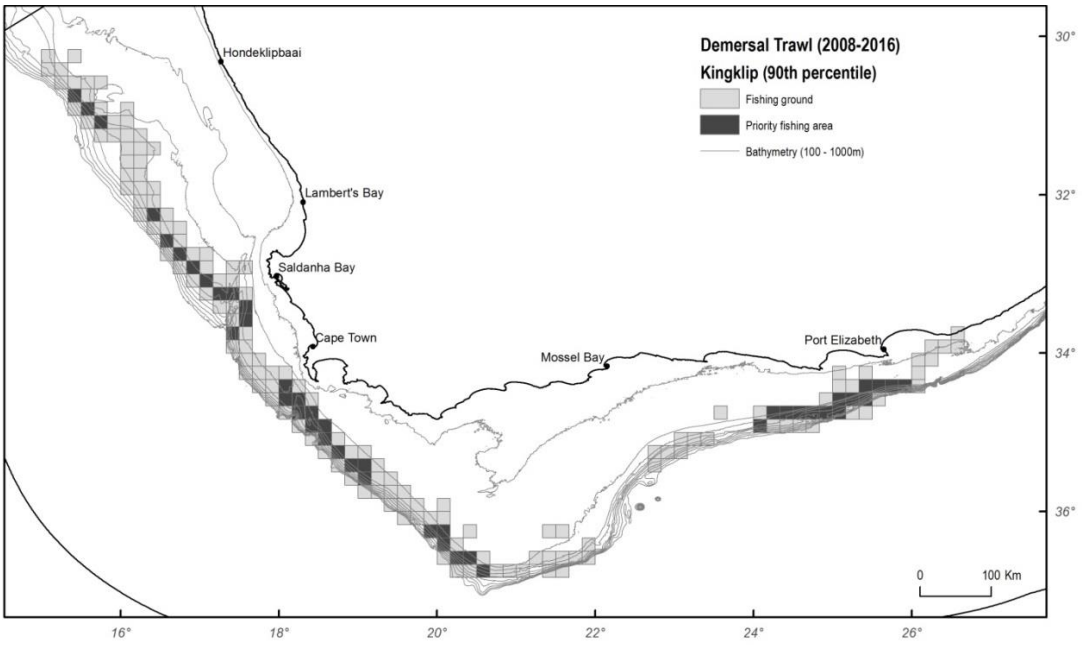

Figure 43: Spatial distribution of kingklip landed by the inshore and offshore demersal trawl sectors for the years 2008 to 2016 (DAFF). Priority fishing areas are those where the value of d1/d90 = 1 or higher (grid values of >145 tons (cumulative) of a maximum grid value of 1200 tons). Grids with a value of d1/d90 < 0.05 were not shown (grid values of <7.3 tons).

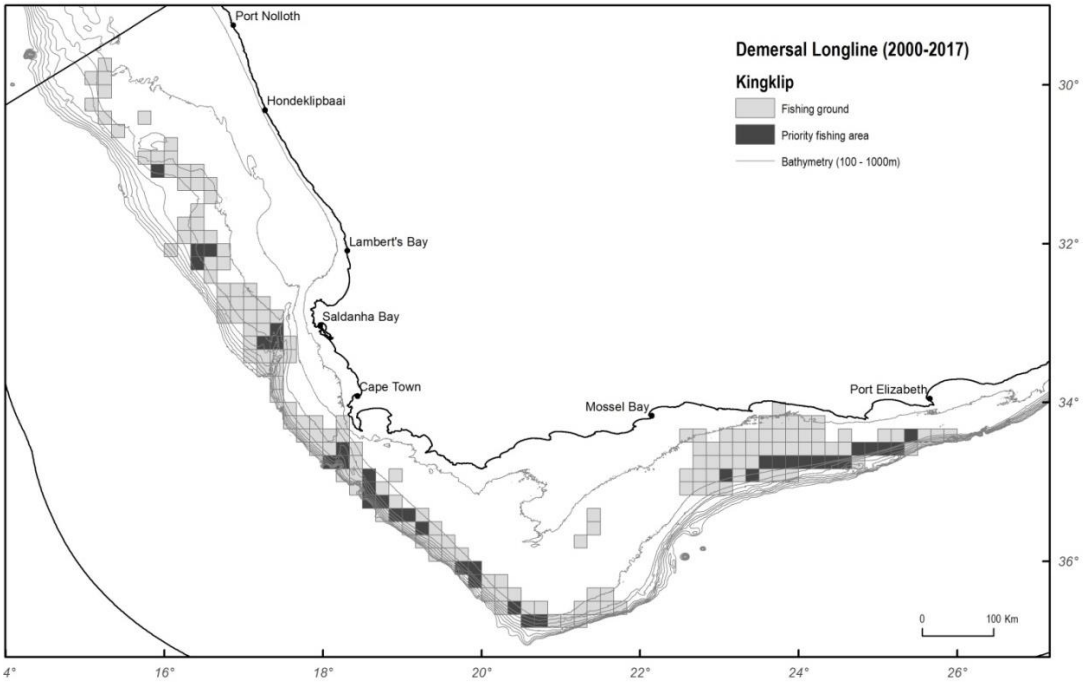

Figure 44: Spatial distribution of kingklip landed by the demersal longline sector for the years 2000 to 2017 (DAFF). Priority fishing areas are those where the value of d1/d90 = 1 or higher (grid values of >31 tons (cumulative) of a maximum grid value of 208 tons). Grids with a value of d1/d90 < 0.05 were not shown (grid values of <1.5 ton).

Redeye Pilchard (midwater and purse seine)

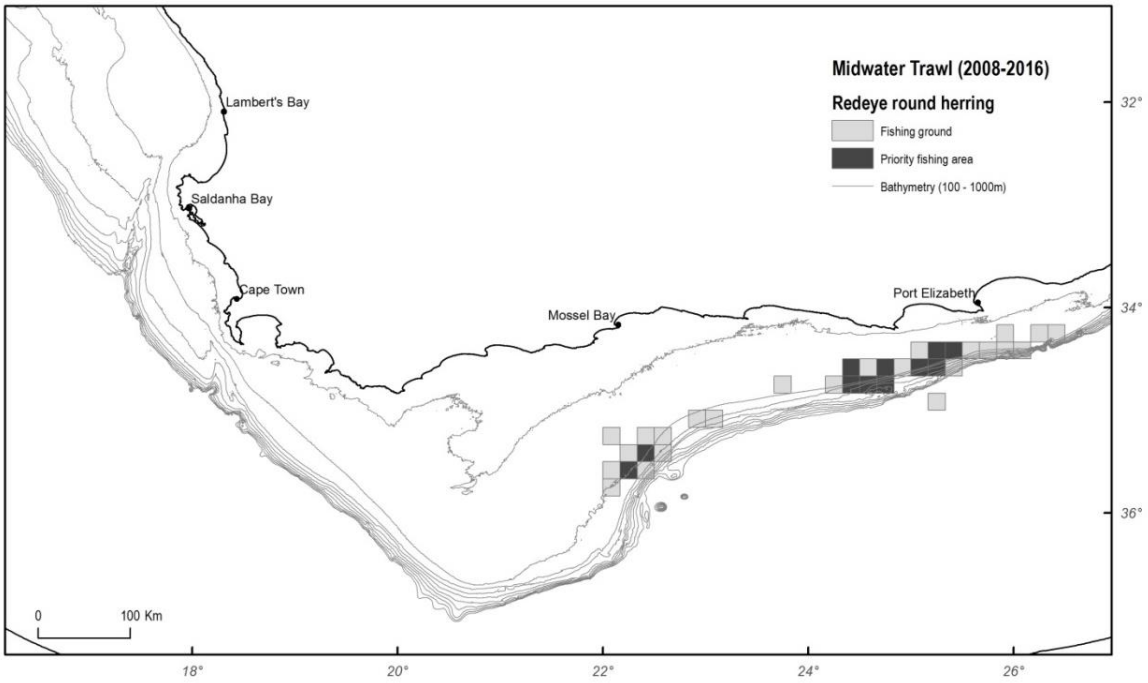

Figure 45: *Spatial distribution of cumulative catch of redeye round herring by the midwater trawl sector for the years 2008 to 2016 (DAFF). Priority fishing areas are those where the value of d1/d80 = 1 or higher (grid values of >49 tons of a maximum grid value of 116 tons). Grids with a value of d1/d80 < 0.05 were not shown (grid values of <2.5 tons).*

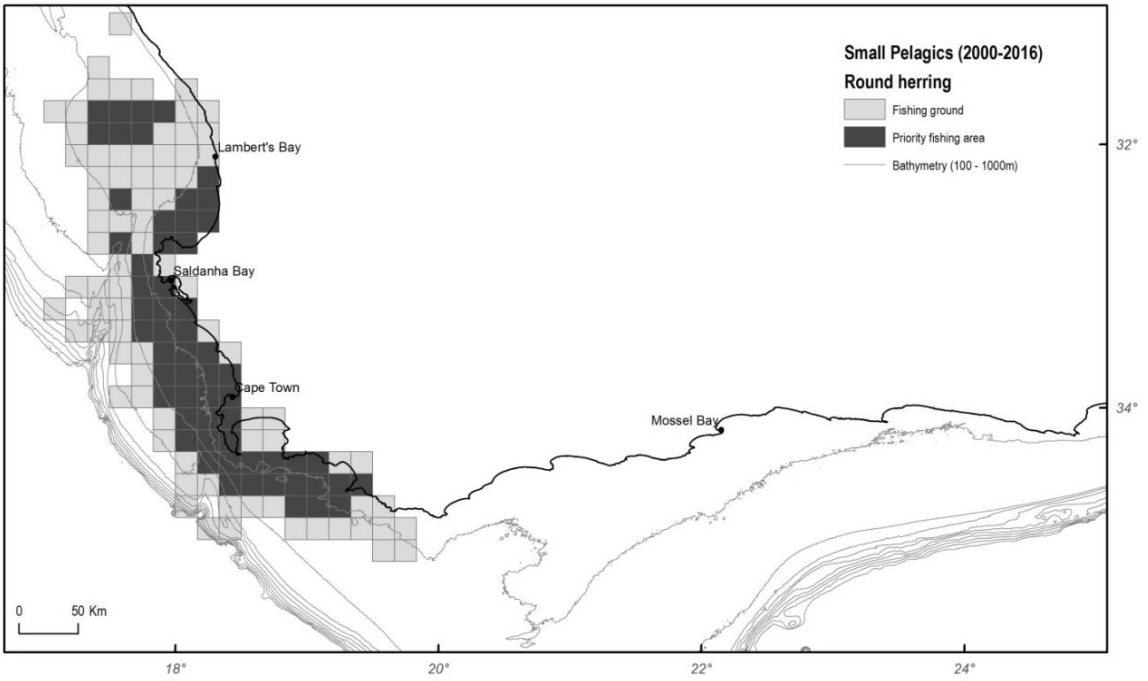

Figure 46: *Spatial distribution of red-eye round herring (Etrumeus whitheadii) landed by the purse-seine sector for the years 2000 to 2016 (DAFF). Priority fishing areas are those where the value of d1/d80 = 1 or higher (grid values of >157 tons of a maximum grid value of 3618 tons per year). Grids with a value of d1/d80 < 0.05 were not shown (grid values of <8 tons per year).*

Snoek (demersal trawl and midwater)

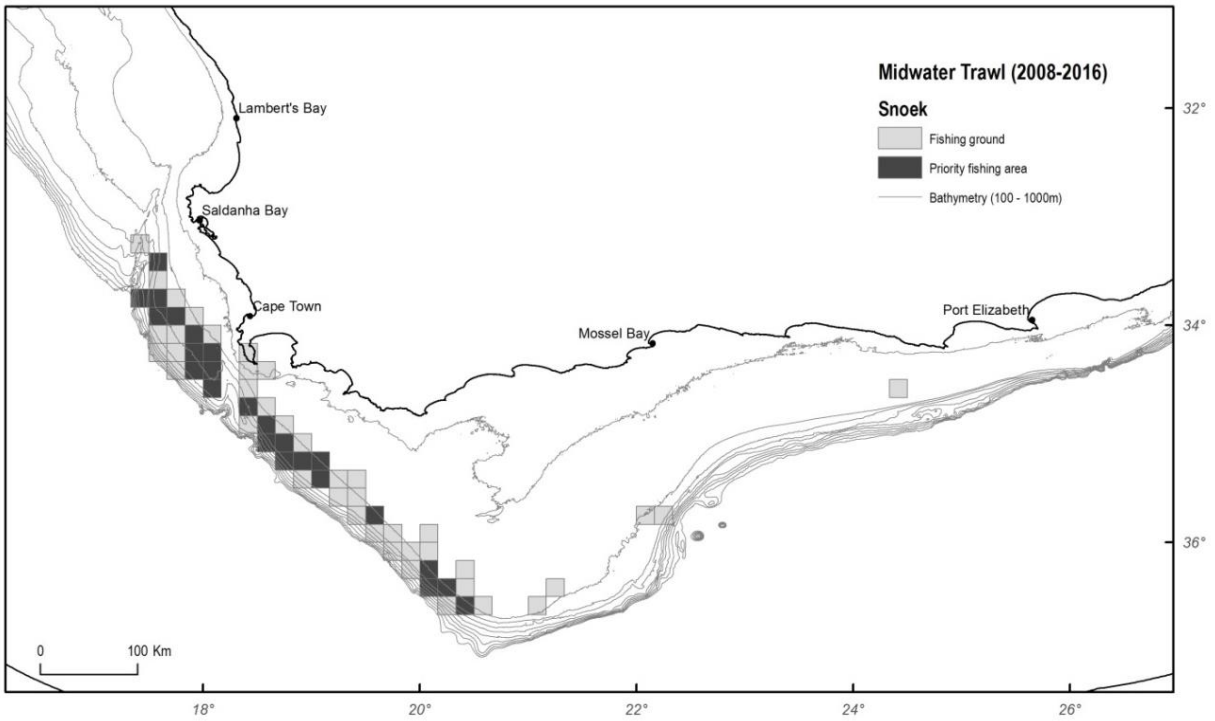

Figure 47: *Spatial distribution of cumulative catch of snoek by the midwater trawl sector for the years 2008 to 2016 (DAFF). Priority fishing areas are those where the value of d1/d80 = 1 or higher (grid values of >54 tons of a maximum grid value of 269 tons). Grids with a value of d1/d80 < 0.05 were not shown (grid values of <2.6 tons).*

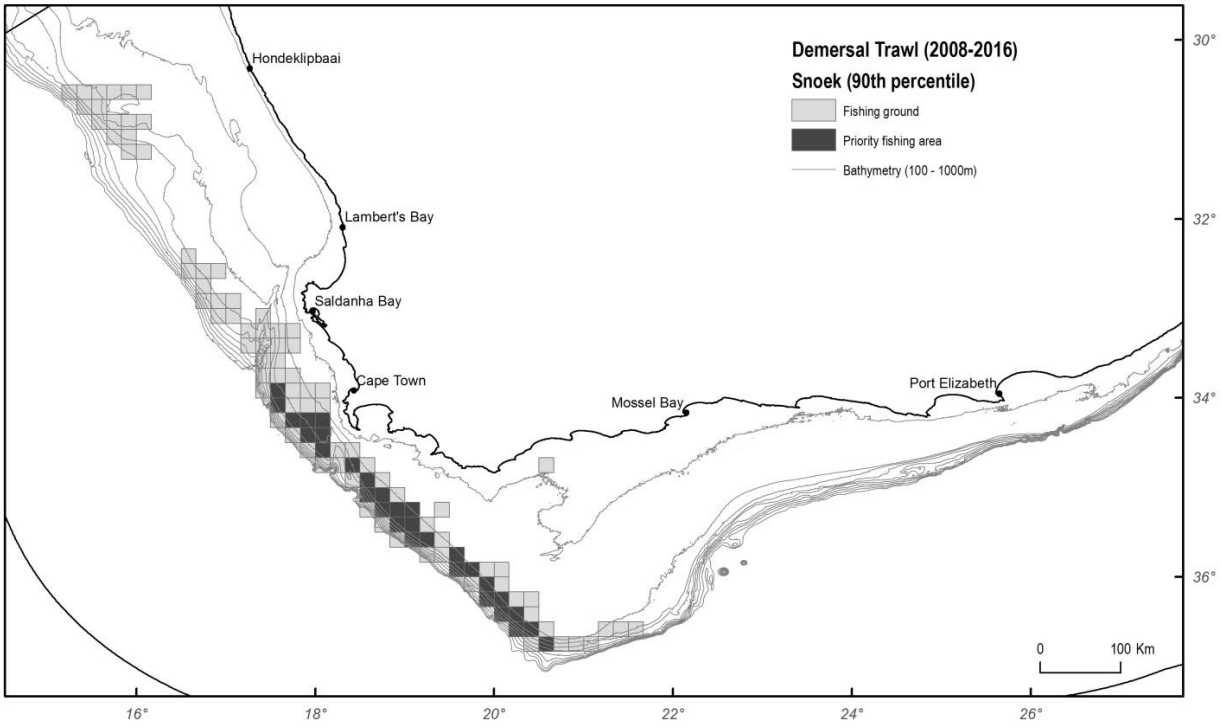

Figure 48: *Spatial distribution of snoek landed by the inshore and offshore demersal trawl sectors for the years 2008 to 2016 (DAFF). Priority fishing areas are those where the value of d1/d90 = 1 or higher (grid values of >223 tons (cumulative) of a maximum grid value of 1090 tons). Grids with a value of d1/d90 < 0.05 were not shown (grid values of <11 tons).*

Squid (demersal trawl & midwater)

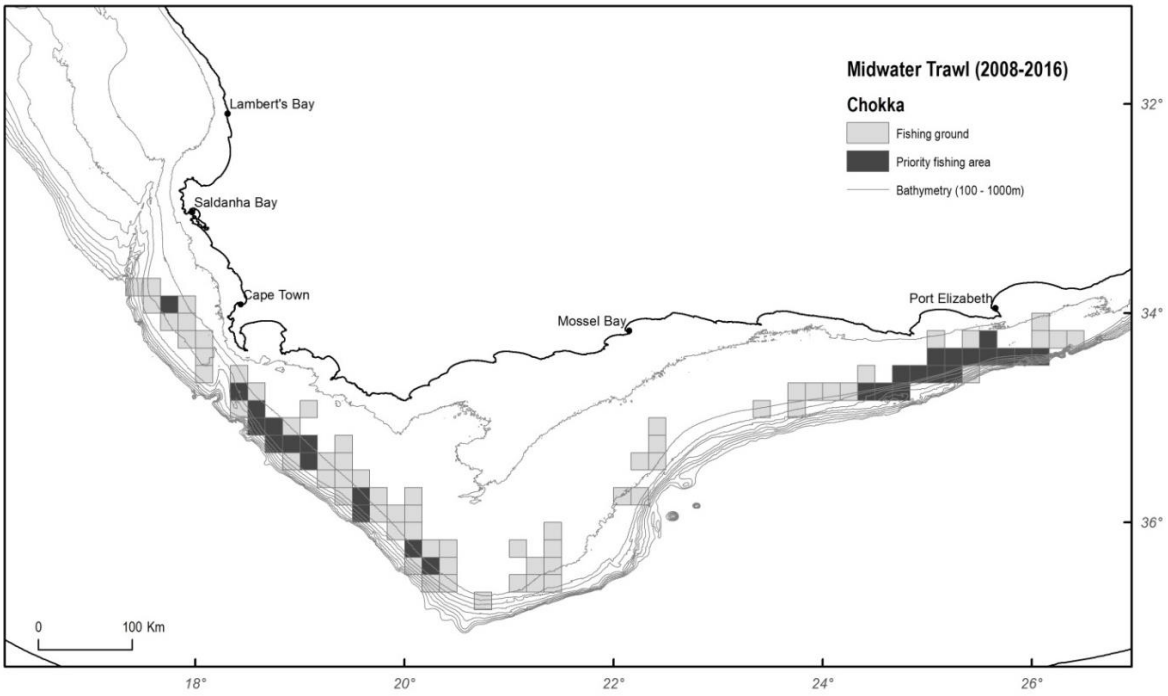

Figure 49: *Spatial distribution of cumulative catch of chokka squid (Loligo reynaudii) by the midwater trawl sector for the years 2008 to 2016 (DAFF). Priority fishing areas are those where the value of d1/d80 = 1 or higher (grid values of >6 tons of a maximum grid value of 378 tons). Grids with a value of d1/d80 < 0.05 were not shown (grid values of <300 kg).*

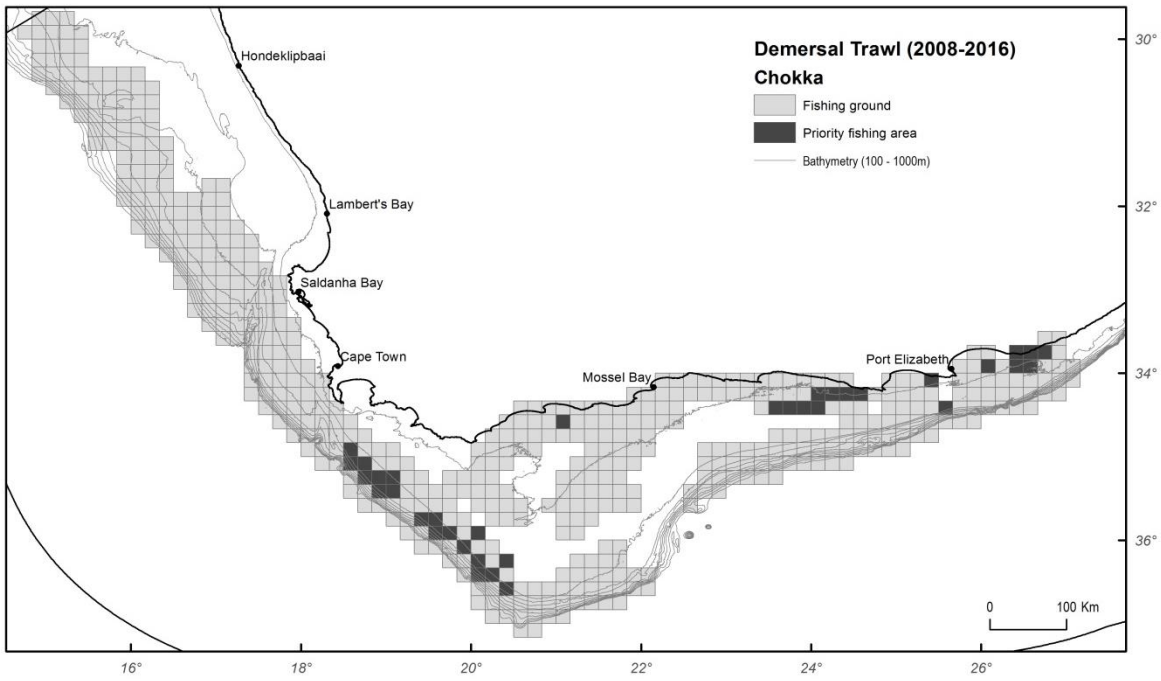

Figure 50: *Spatial distribution of cumulative catch of chokka squid (Loligo reynaudii) by the inshore and offshore demersal trawl sectors for the years 2008 to 2016 (DAFF). Priority fishing areas are those where the value of d1/d90 = 1 or higher (grid values of >21.8 tons (cumulative) of a maximum grid value of 116.7 tons). Grids with a value of d1/d90 < 0.05 were not shown (grid values of <1.1tons).*

Horse Mackerel (demersal trawl and small pelagic)

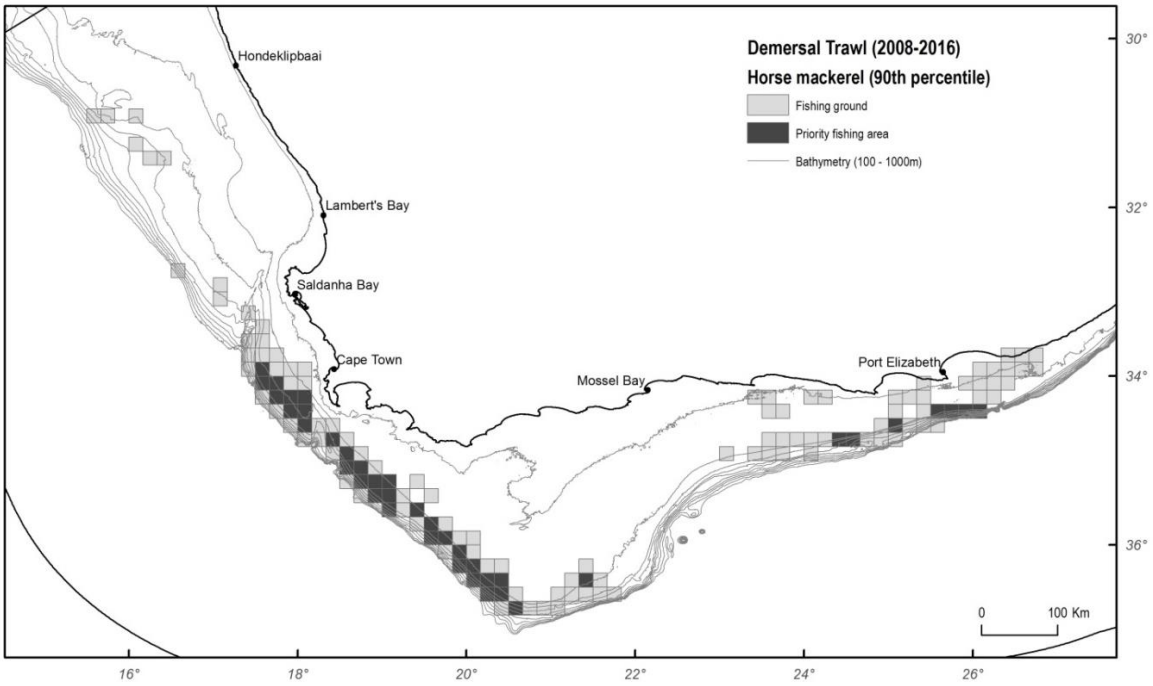

Figure 51: *Spatial distribution of cape horse mackerel (Trachurus capensis) landed by the inshore and offshore demersal trawl sectors for the years 2008 to 2016 (DAFF). Priority fishing areas are those where the value of d1/d90 = 1 or higher (grid values of >219 tons (cumulative) of a maximum grid value of 1027 tons). Grids with a value of d1/d90 < 0.05 were not shown (grid values of <11 tons).*

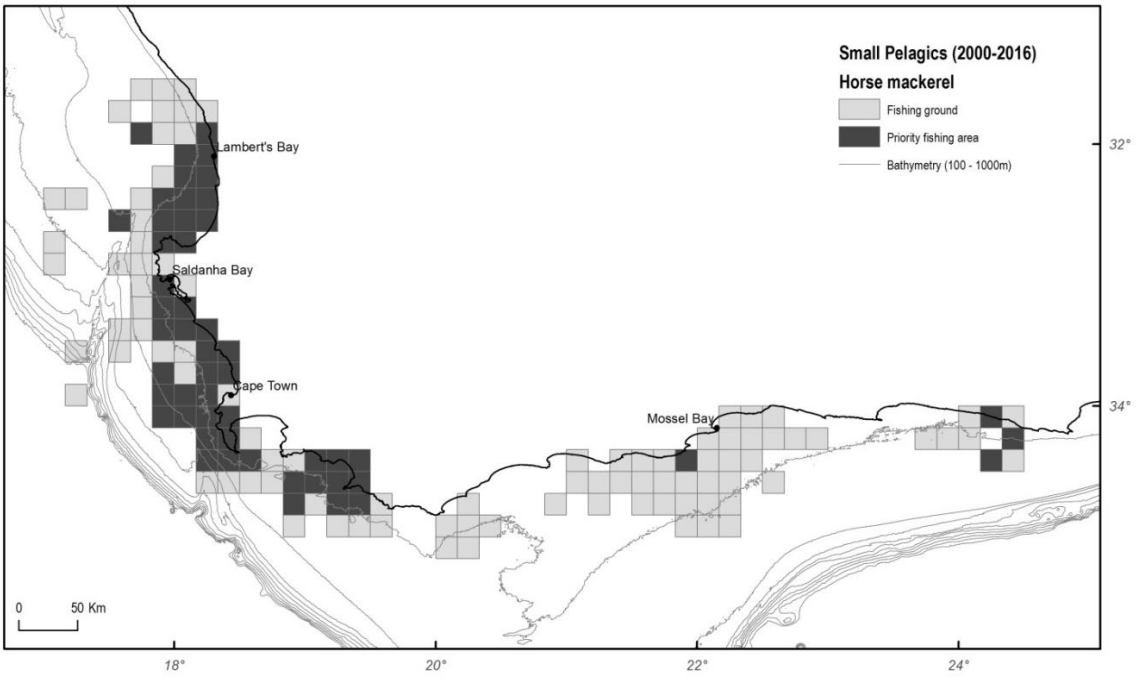

Figure 52: *Spatial distribution of juvenile cape horse mackerel (Trachurus capensis) landed by the purse-seine sector for the years 2000 to 2016 (DAFF). Priority fishing areas are those where the value of d1/d80 = 1 or higher (grid values of >7 tons of a maximum grid value of 573 tons per year). Grids with a value of d1/d80 < 0.05 were not shown (grid values of <300 kg per year).*

Sardine/pilchard (midwater trawl & small pelagic)

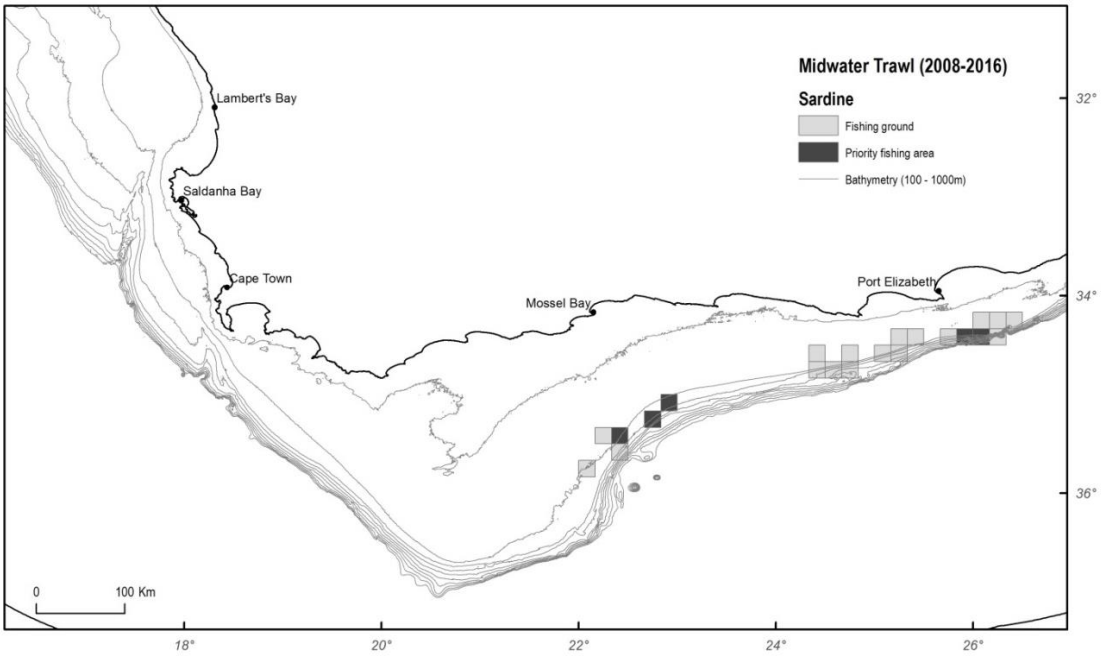

Figure 53: *Spatial distribution of cumulative catch of sardine (Sardinops sagax) by the midwater trawl sector for the years 2008 to 2016 (DAFF). Priority fishing areas are those where the value of d1/d80 = 1 or higher (grid values of >8 tons of a maximum grid value of 25 tons). Grids with a value of d1/d80 < 0.05 were not shown (grid values of <400 kg).*

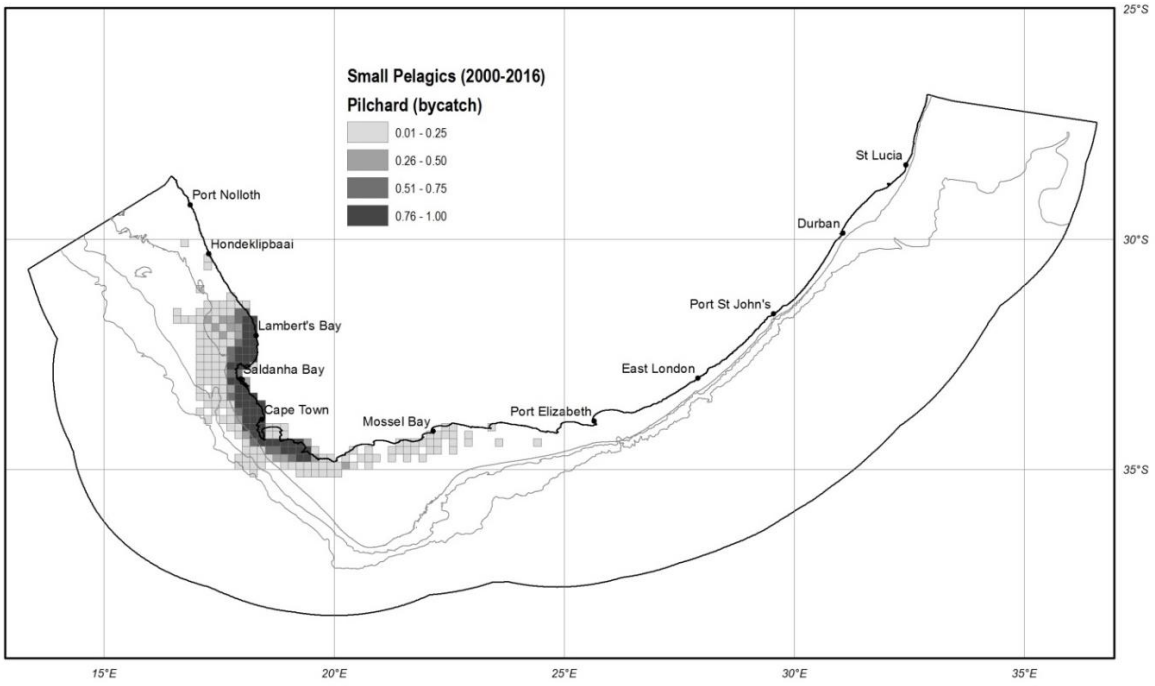

Figure 54: *Average annual catch (tons) of pilchard (Sardinops sagax) recorded as a bycatch by the purse-seine fleet for the years 2000 to 2016 (DAFF). Values were normalized to a 0-1 range using the formula d1/d80, where d1 is the raw data in a 10' grid and d80 is the 80th percentile of the values for that data set, with resultant values over 1 being assigned a 1 value. The 200 m, 500 m and 2000 m depth contours are shown.*

Appendix 3: Key Bycatch or Alternate Target Species

Albacore tuna (longfin) (pelagic longline)

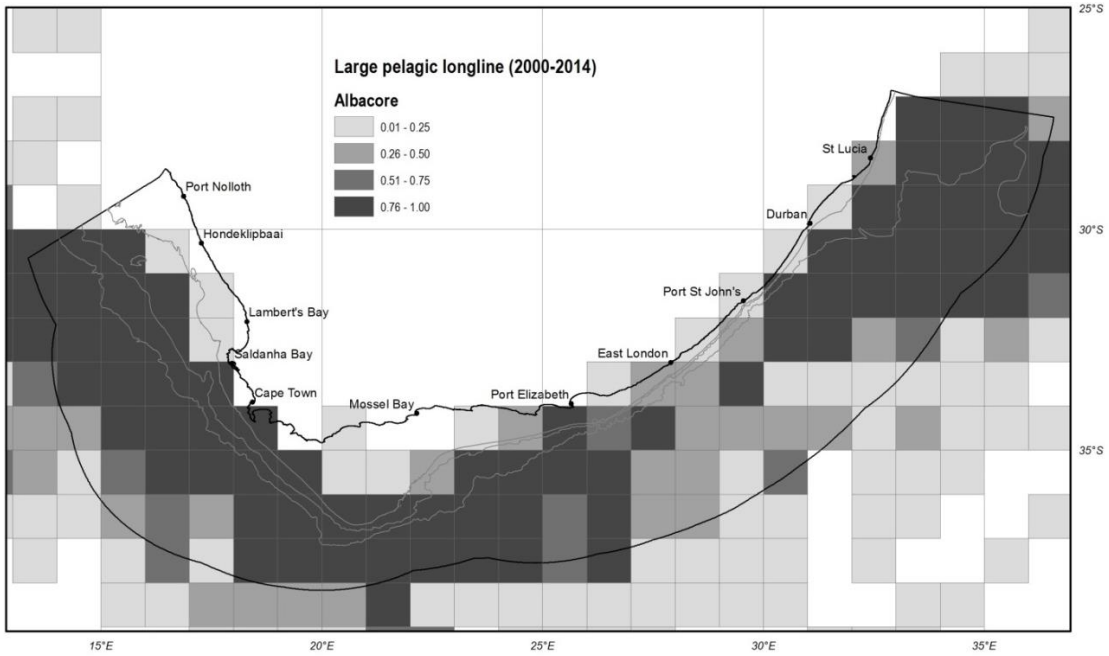

Figure 55: *Cumulative catch of albacore tuna (Thunnus alalunga) by the large pelagic longline sector for the years 2000 to 2014 (DAFF). Values were normalized to a 0-1 range using the formula d1/d80, where d1 is the raw data in a 60' grid and d80 is the 80th percentile of the values for that data set, with resultant values over 1 being assigned a 1 value. The 200 m, 500 m and 2000 m depth contours are shown.*

Yellowfin Tuna (pelagic longline)

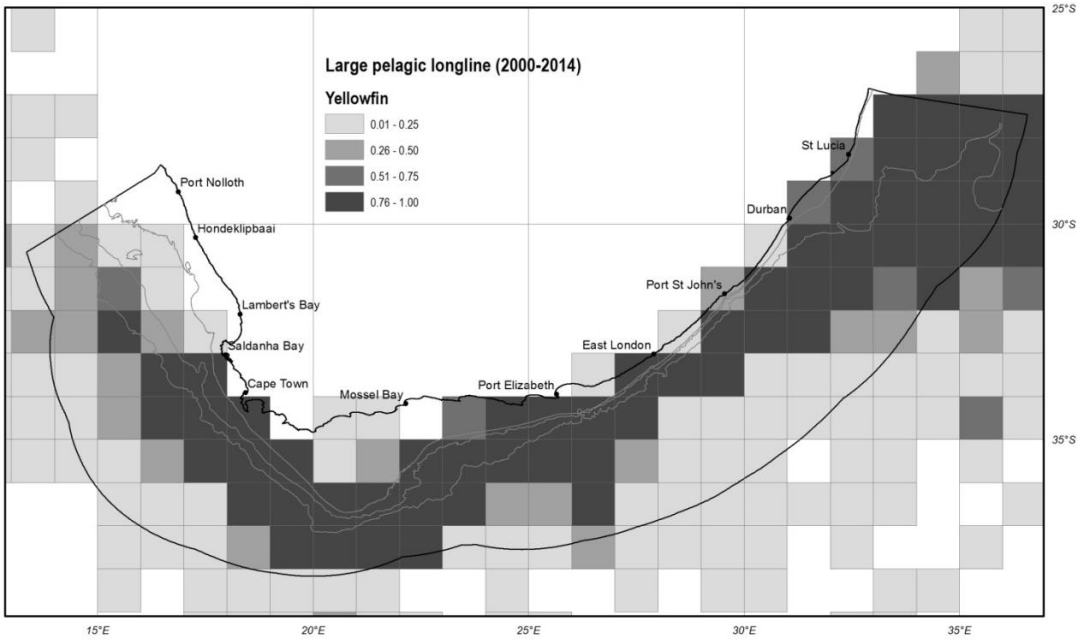

Figure 56: *Cumulative catch of yellowfin tuna (Thunnus albacares) by the large pelagic longline sector for the years 2000 to 2014 (DAFF). Values were normalized to a 0-1 range using the formula d1/d80, where d1 is the raw data in a 60' grid and d80 is the 80th percentile of the values for that data set, with resultant values over 1 being assigned a 1 value. The 200 m, 500 m and 2000 m depth contours are shown.*

Southern Bluefin Tuna (pelagic longline)

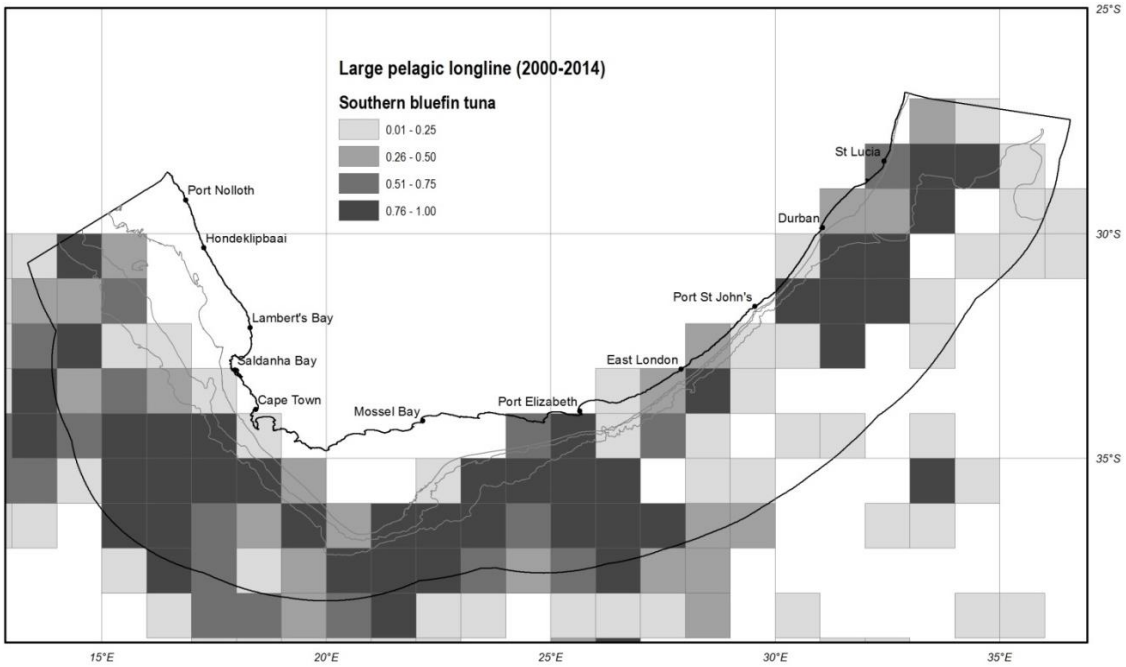

Figure 57: *Cumulative catch of southern Bluefin tuna (Thunnus maccoyii) by the large pelagic longline sector for the years 2000 to 2014 (DAFF). Values were normalized to a 0-1 range using the formula d1/d80, where d1 is the raw data in a 60' grid and d80 is the 80th percentile of the values for that data set, with resultant values over 1 being assigned a 1 value. The 200 m, 500 m and 2000 m depth contours are shown.*

Swordfish (pelagic longline)

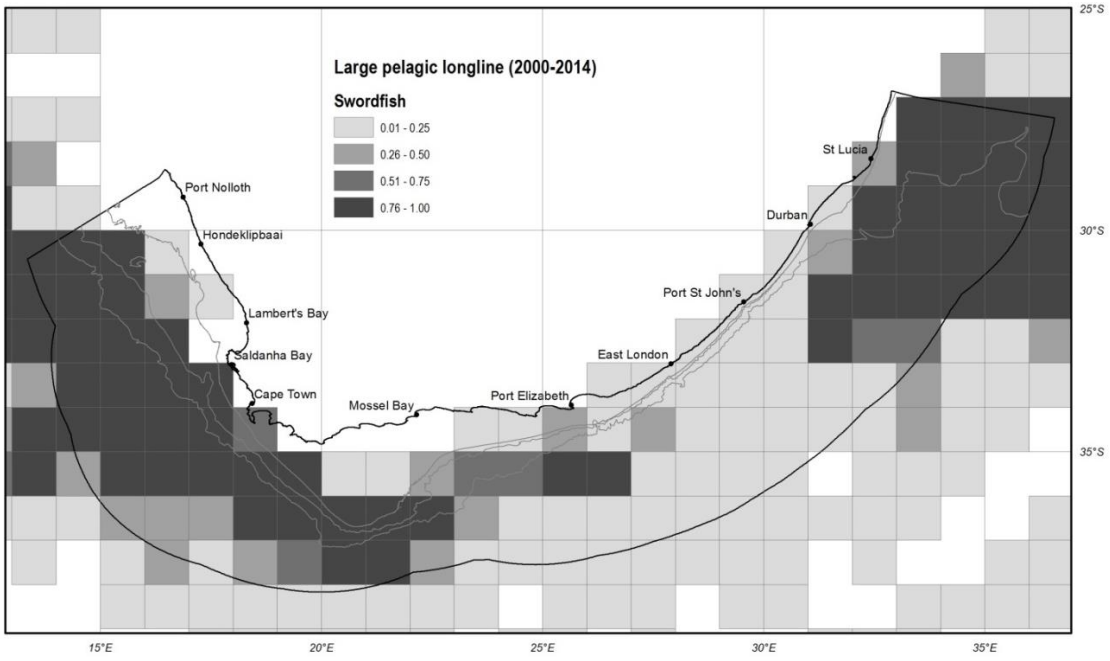

Figure 58: *Cumulative catch of swordfish (Xiphias gladius) by the large pelagic longline sector for the years 2000 to 2014 (DAFF). Values were normalized to a 0-1 range using the formula d1/d80, where d1 is the raw data in a 60' grid and d80 is the 80th percentile of the values for that data set, with resultant values over 1 being assigned a 1 value. The 200 m, 500 m and 2000 m depth contours are shown.*

Bigeye Tuna (pelagic longline)

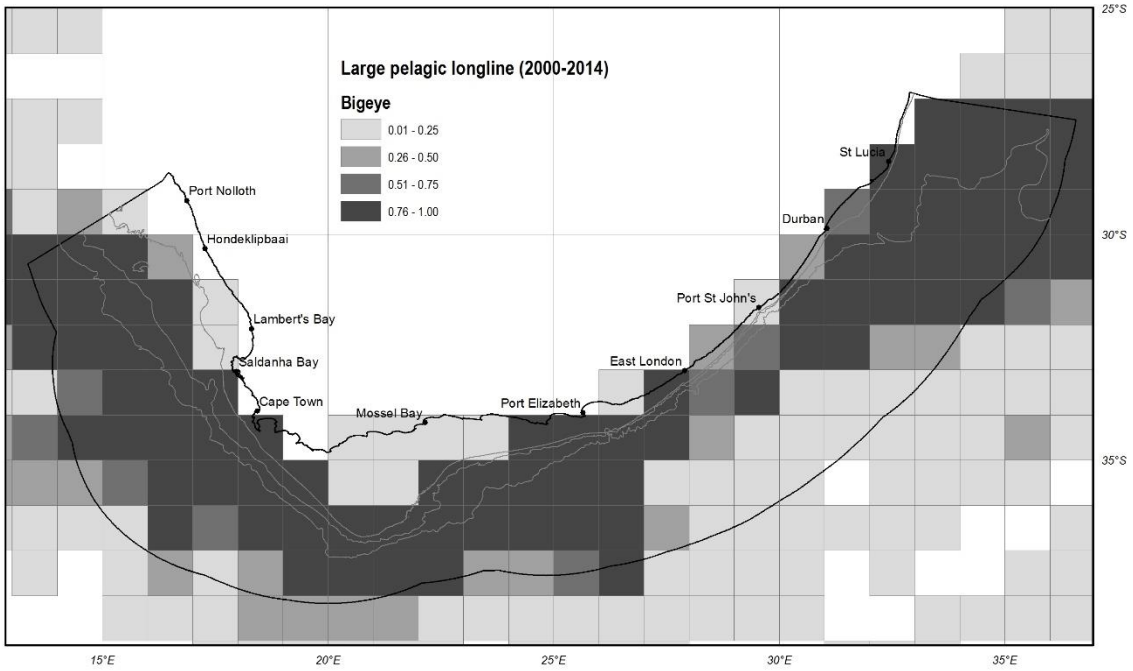

Figure 59: *Cumulative catch of bigeye tuna (Thunnus obesus) by the large pelagic longline sector for the years 2000 to 2014 (DAFF). Values were normalized to a 0-1 range using the formula d1/d80, where d1 is the raw data in a 60' grid and d80 is the 80th percentile of the values for that data set, with resultant values over 1 being assigned a 1 value. The 200 m, 500 m and 2000 m depth contours are shown.*

Mako Shark (pelagic longline)

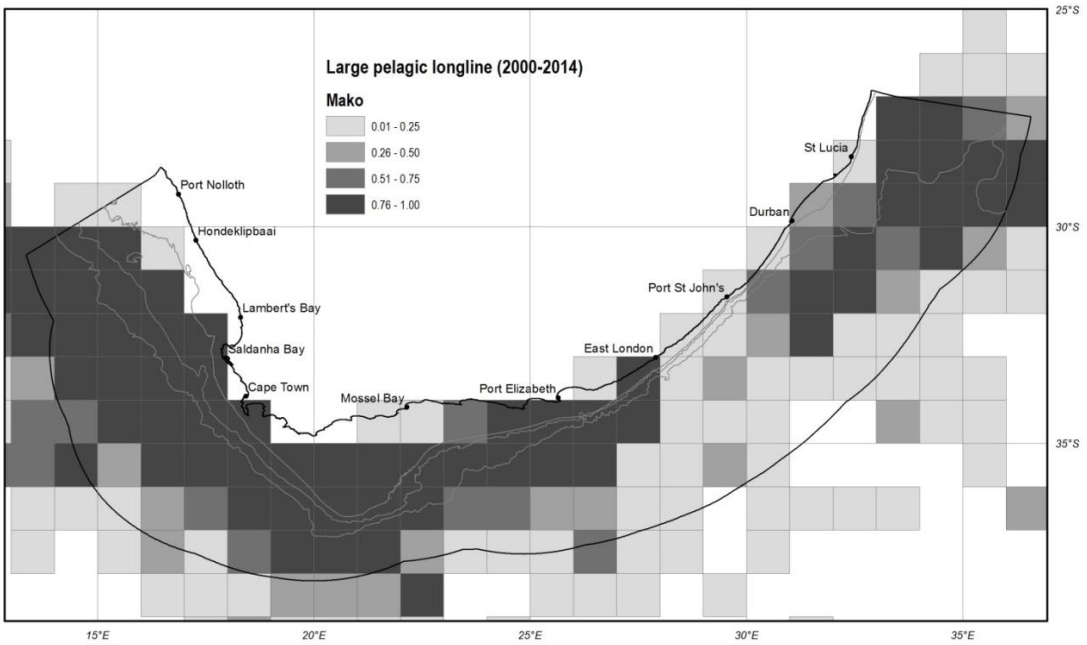

Figure 60: *Cumulative catch of mako shark (Isurus oxyrinchus) by the large pelagic longline sector for the years 2000 to 2014 (DAFF). Values were normalized to a 0-1 range using the formula d1/d80, where d1 is the raw data in a 60' grid and d80 is the 80th percentile of the values for that data set, with resultant values over 1 being assigned a 1 value. The 200 m, 500 m and 2000 m depth contours are shown.*

Blue Shark (pelagic longline)

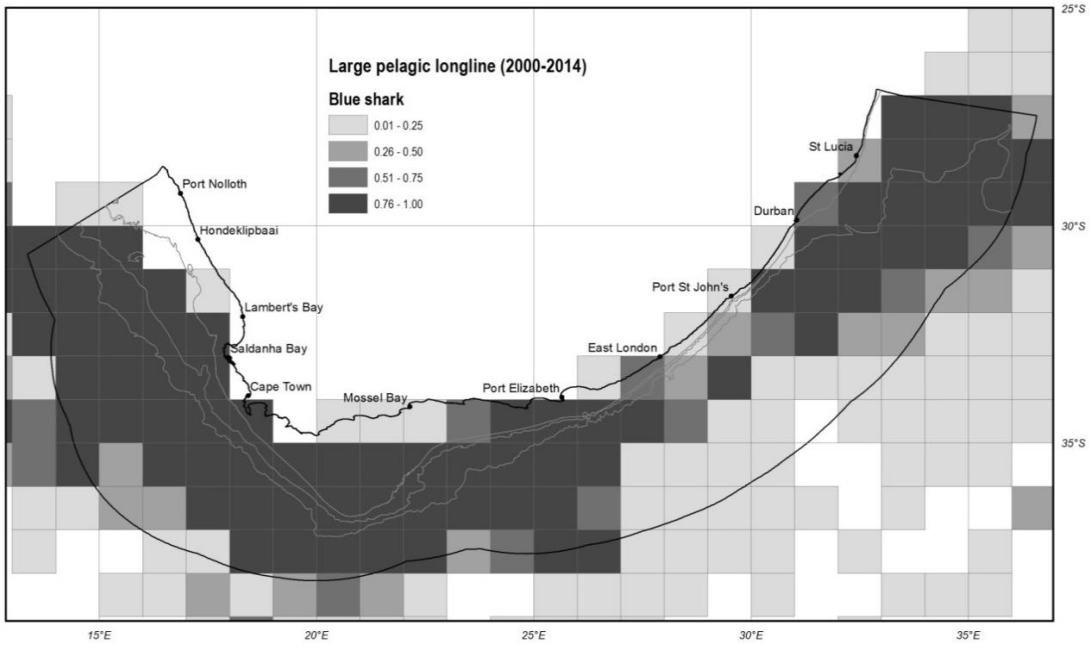

Figure 61: *Cumulative catch of blue shark (Prionace glauca) by the large pelagic longline sector for the years 2000 to 2014 (DAFF). Values were normalized to a 0-1 range using the formula d1/d80, where d1 is the raw data in a 60' grid and d80 is the 80th percentile of the values for that data set, with resultant values over 1 being assigned a 1 value. The 200 m, 500 m and 2000 m depth contours are shown.*

Monk (demersal trawl)

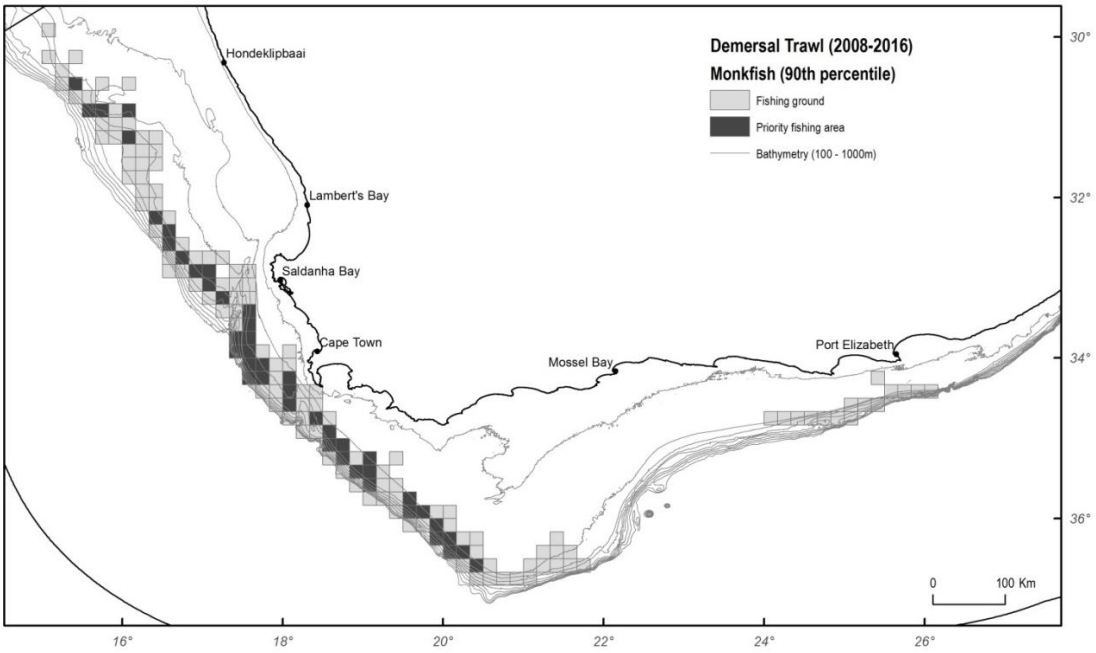

Figure 62: *Spatial distribution of monkfish landed by the inshore and offshore demersal trawl sectors for the years 2008 to 2016 (DAFF). Priority fishing areas are those where the value of d1/d90 = 1 or higher (grid values of >480 tons (cumulative) of a maximum grid value of 2219 tons). Grids with a value of d1/d90 < 0.05 were not shown (grid values of <24 tons).*

Mackerel (small pelagic and midwater trawl)

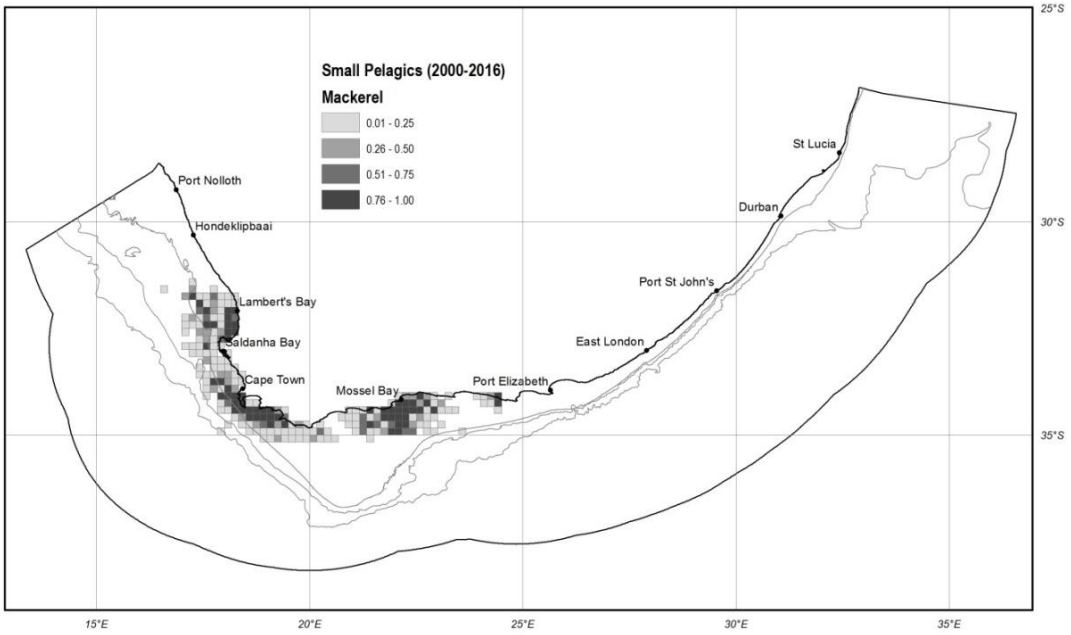

Figure 63: *Average annual catch (tons) of juvenile mackerel (Scomber japonicus) recorded by the purse-seine fleet for the years 2000 to 2016 (DAFF). Values were normalized to a 0-1 range using the formula d1/d80, where d1 is the raw data in a 10' grid and d80 is the 80th percentile of the values for that data set, with resultant values over 1 being assigned a 1 value. The 200 m, 500 m and 2000 m depth contours are shown.*

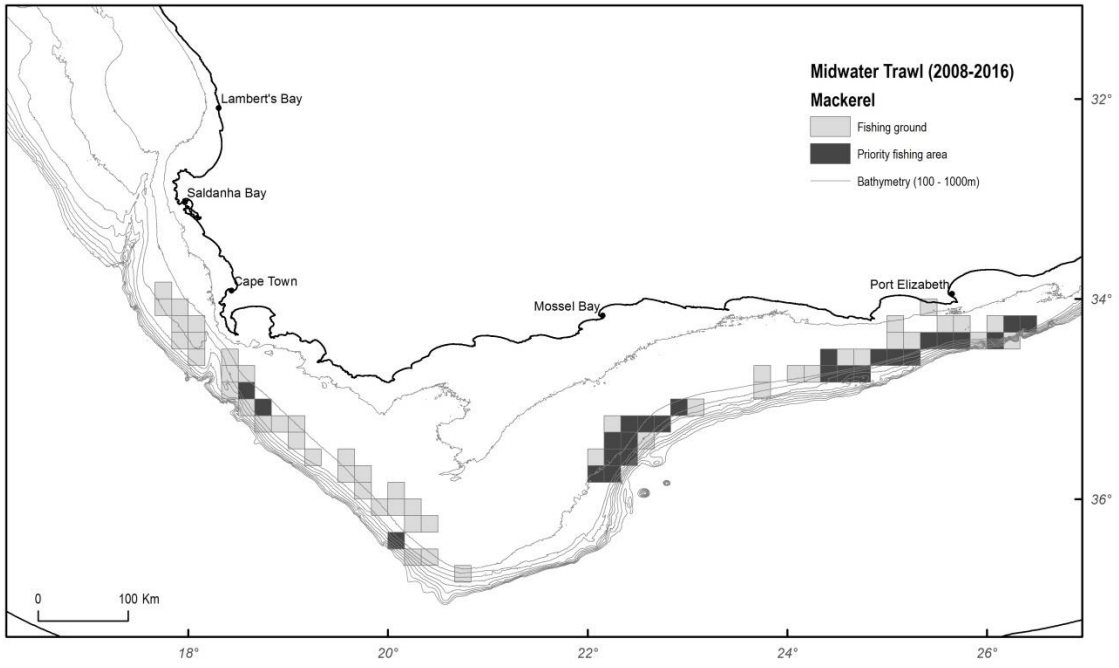

Figure 64: *Average annual catch (tons) of chub mackerel (Scomber japonicus) recorded by the midwater trawl fleet for the years 2000 to 2016 (DAFF). Priority fishing areas are those where the value of d1/d80 = 1 or higher (grid values of >31.2 tons of a maximum grid value of 390.6 tons). Grids with a value of d1/d80 < 0.05 were not shown (grid values of <1.6 tons).*

Kob (inshore trawl)

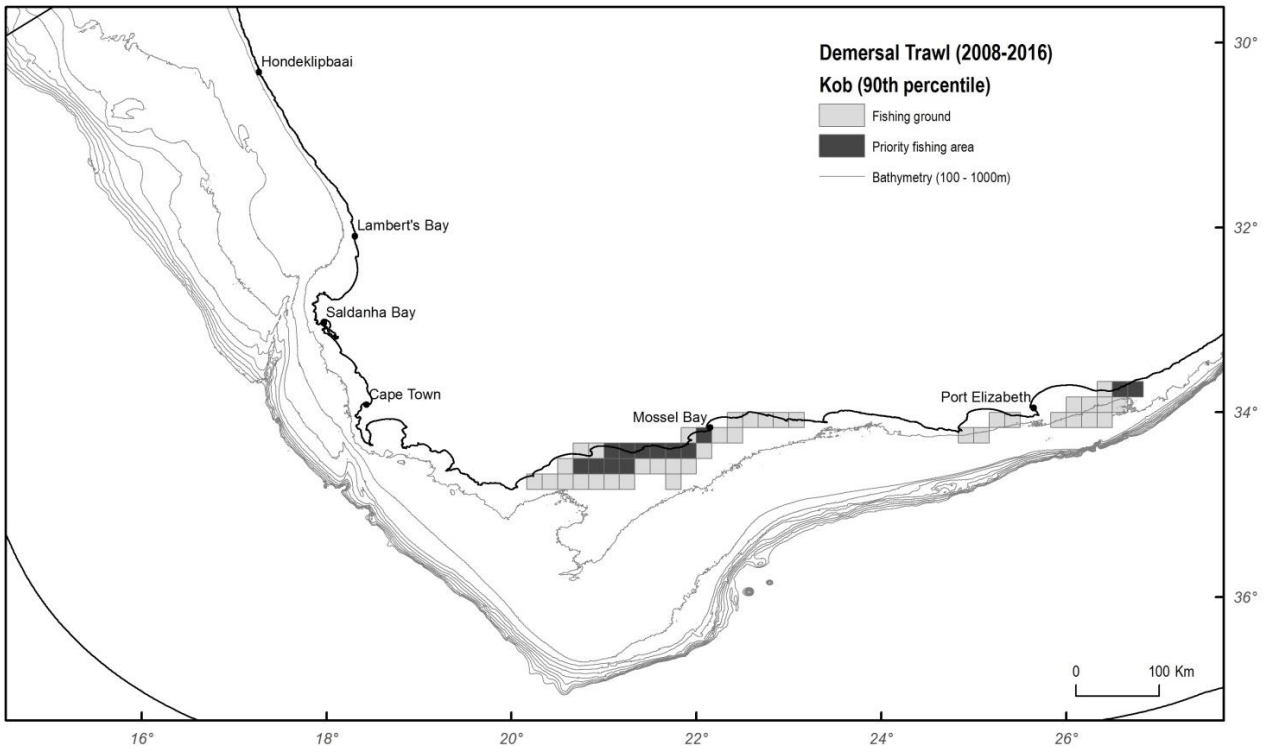

Figure 65: Spatial distribution of kob (Argyrosomus sp.) landed by the inshore and offshore demersal trawl sectors for the years 2008 to 2016 (DAFF). Priority fishing areas are those where the value of d1/d80 = 1 or higher (grid values of >7 tons (cumulative) of a maximum grid value of 46 tons). Grids with a value of d1/d80 < 0.05 were not shown (grid values of <350 kg).

Slipper Lobster (SCRL Trap)

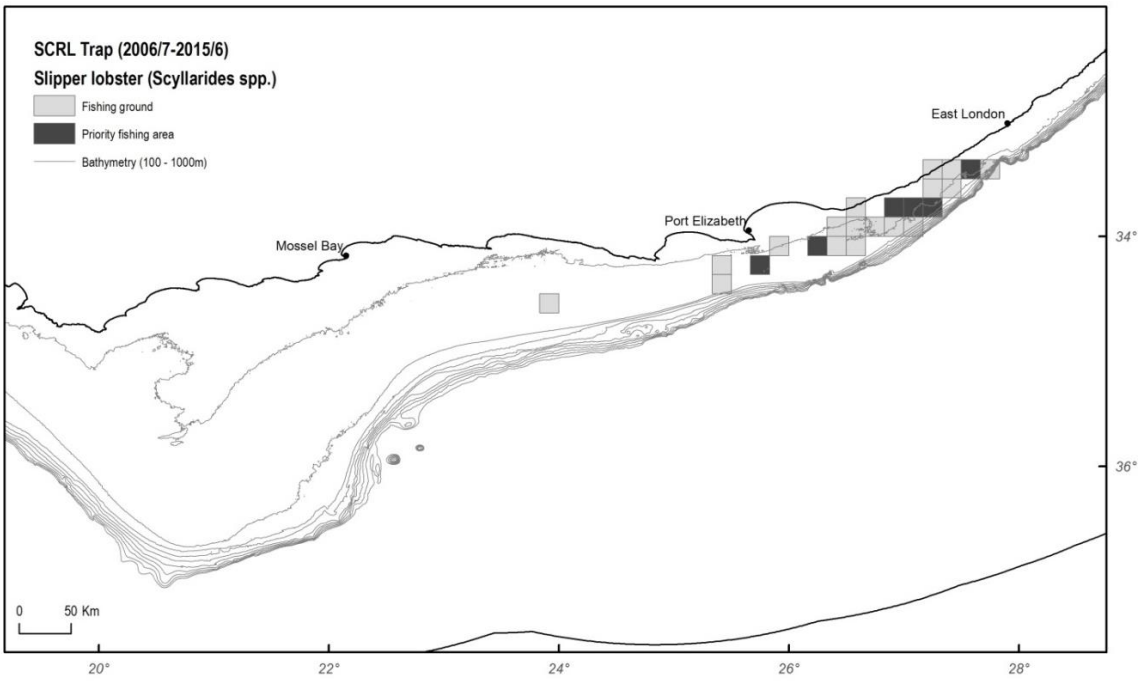

Figure 66: *Spatial distribution of the cumulative catch of slipper lobster (Scyllarides spp.) recorded by the south coast rock lobster trap sector for the years 2006/7 to 2015/6 (DAFF). Priority fishing areas are those where the value of d1/d80 = 1 or higher (grid values of >40 tons of a maximum grid value of 106 tons nominal weight). Grids with a value of d1/d80 < 0.05 were not shown (grid values of <2 tons).*

Octopus (SCRL trap)

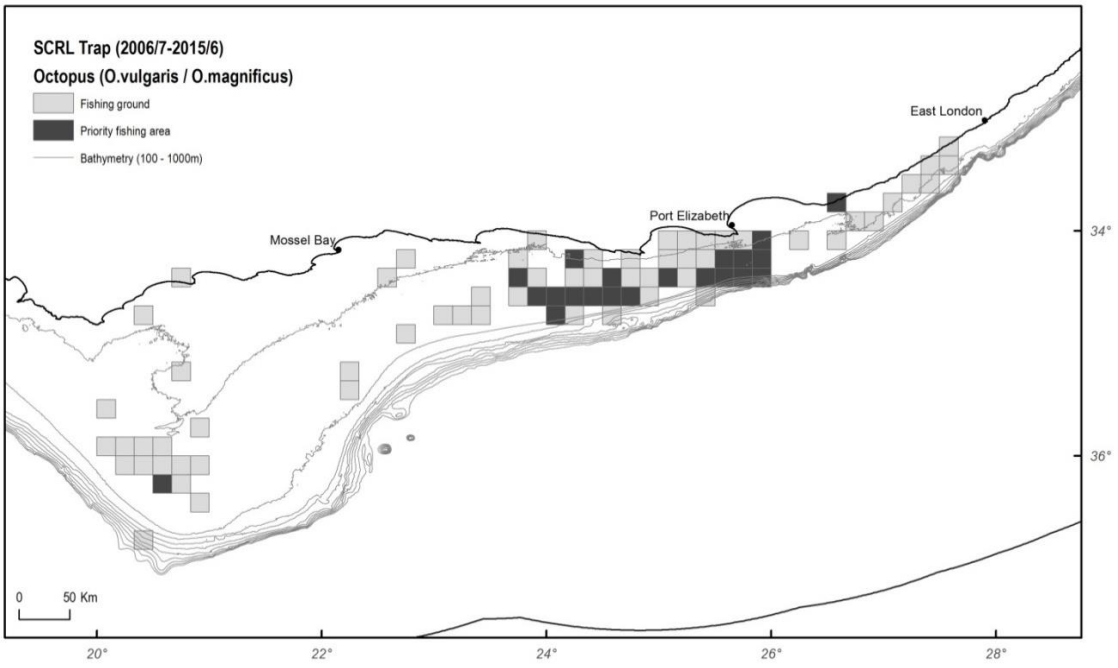

Figure 67: *Spatial distribution of the cumulative catch of octopus (Octopus vulgaris) recorded by the south coast rock lobster trap sector for the years 2006/7 to 2015/6 (DAFF). Priority fishing areas are those where the value of d1/d80 = 1 or higher (grid values of >600 tons of a maximum grid value of 7320 tons nominal weight). Grids with a value of d1/d80 < 0.05 were not shown (grid values of <30 tons).*

Appendix 4: Key Features of the proposed Phakisa MPA Network that contribute to the identification and support of Important Fisheries Areas and Protection of Nursery and Spawning Habitat

Table 11: **Proposed new MPAs, key objectives of relevance to fisheries, key stakeholders and potential impacts and benefits to fisheries sectors from implementation. In the key features column CR indicates Critically Endangered, En indicates Endangered and Vu indicates Vulnerable. EBSA refers to Ecologically and Biologically Significant Areas as identified by regional workshops (CBD 2013, 2014). An asterix after a habitat type indicates priority habitat types for management action in the demersal trawl fishery to support eco-certification conditions.**

Area	Key features and objectives for protection	Fisheries stakeholders	Potential benefits
1.Orange Shelf Edge	Benthic & Pelagic habitat representation Southern Benguela Sandy Shelf Edge (Vu)* Southern Benguela Hard Shelf Edge (CR)* South Atlantic Upper Bathyal Fisheries support – Hake Eco-certification support – demersal trawl Transboundary EBSA (vulnerability, naturalness, threatened habitat) Research (habitat impacts and recovery)	Demersal trawl Pelagic longlining	First protection to untrawled shelf edge, contribution to meeting benthic condition for MSC certification. Supports research on habitat impacts from demersal trawling. Contributes to bycatch management for both sectors.
2.Namaqua Fossil Forest	Benthic Unique feature of geological significance Cold water corals Namaqua Hard Inner Shelf Namaqua Sandy Inner Shelf EBSA (vulnerability, naturalness, threatened habitat)	No current fishing effort in this area Pelagic fishing accommodated.	Contribution to protection of nursery area for hake in area with seabed mining activities and interests. Protection of soft ground sponge habitat (*Suberites dandelini*) and therefore supports new MSC conditions to support identification and protection of Vulnerable Marine Ecosystems.
3.Namaqua Coast	Benthic & Pelagic Namaqua Sandy Inshore (CR) Namaqua Inshore Reef (CR) Namaqua Inshore Hard Grounds (CR) Namaqua Hard Inner Shelf Priority estuaries Hake nursery area	West coast rock lobster Small pelagics Recreational fishers (zoned so this sector accommodated in several zones)	Contribution to protection of nursery area for hake. Possible fisheries spillover benefits for west coast rock lobster. Ecotourism benefits may support alternative livelihoods for fishers.

Area	Key features and objectives for protection	Fisheries stakeholders	Potential benefits
	EBSA (threatened habitats, naturalness) Scenic Tourism		
4.Childs Bank	Benthic Cold water corals Southern Benguela Sandy Shelf Edge(Vu)* Southern Benguela Submarine Bank (probable carbonate mound) Southern Benguela Hard Outer Shelf (VU) Support for fisheries sustainability and bycatch management (demersal trawl and longline , Hake, monk, kingklip, jacopever) Eco-certification support – demersal trawl fishery EBSA (vulnerability, naturalness, threatened habitat) Research (habitat impacts and recovery)	DMR, PASA, DAFF Sungu Sungu, Anadarko / PetroSA Demersal trawl (0.27%) Demersal longline (<<1.95%) (Note - This area was recommended for implementation prior to the inception of the adjacent experimental closure to ensure that effort is not displaced onto this potential vulnerable marine ecosystem.)	Protection of cold water coral habitat and therefore supports new MSC conditions to support identification and protection of Vulnerable Marine Ecosystems. Contributes to bycatch management for hake fisheries. Small and large pelagic fishing and tuna pole fishing accommodated.
6.Benguela Muds	Benthic *Southern Benguela Muddy Shelf Edge (CR) Eco-certification support – demersal trawl EBSA (threatened habitats) Research (habitat impacts and recovery)	DMR, PASA, DAFF DMR, PASA Sungu Sungu Demersal longline fishery Demersal trawl Shark directed fishing Large pelagic	First protection to critically endangered mud habitat trawled over entire extent thereby contributing to fisheries habitat management and meeting of benthic condition for MSC certification for hake trawl.. Supports research on habitat impacts from demersal trawling. Contributes to bycatch management for demersal sectors.
7.Cape Canyon	Benthic & Pelagic Southern Benguela Canyon (CR)* Southern Benguela Hard Outer Shelf (VU) EBSA (life history importance for pelagic fish, foraging marine mammals, threatened seabirds, threatened habitats, vulnerability). Eco-certification support – demersal trawl Research (habitat impacts and recovery)	DMR, PASA, DAFF PetroSA/ Sasol Demersal longline fishery Small pelagic fishery Large pelagic fishery Demersal trawl fishery Recreational fishers	First protection to critically endangered canyon habitat, also noted to host Vulnerable Marine Ecosystems, thereby contributing to fisheries habitat management and meeting of existing and proposed new benthic condition for MSC certification for hake trawl. Supports research on habitat impacts from demersal trawling. Contributes to bycatch management for demersal sectors.
8.Robben Island	Benthic & Pelagic South-western Cape Island and associated habitat (EN);	Abalone fishery Shark directed fishing	Contributes to stock recovery of linefish and west coast rock lobster in an area with

Area	Key features and objectives for protection	Fisheries stakeholders	Potential benefits
	South-western Cape Hard Inner Shelf (EN) South-western Cape Hard Outer Shelf (VU) African penguin (EN), bank cormorant (EN) and other seabird species; Cultural heritage Scenic value and tourism Additional contribution to South African National Heritage site and UNESCO national heritage site	Small pelagic fishing Large pelagic Hake longline Tuna pole Squid Commercial linefish Recreational fishers Note this area is outside of west coast rock lobster grounds	increased enforcement activity.
9.Southeast Atlantic Seamount	Benthic & Pelagic Southeast Atlantic Seamount South Atlantic Lower Bathyal South Atlantic Lower Bathyal South Atlantic Abyss South Atlantic Abyss with hard substrate Research (habitat description, mapping)	Large pelagic longlining (Protea has higher large pelagic longline effort than Argentina, recommend zone for full protection of latter seamount)	Contribution to ecosystem and species management for large pelagic sector. Protection of threatened species such as turtles and seabirds in this area can be reported to ATC? Tuna?
10.Browns Bank Corals	Benthic Cold water corals Southern Benguela Hard Shelf Edge (CR)* Eco-certification of hake fishery EBSA (Vulnerability, life history, naturalness) Research (habitat impacts and recovery)	Demersal trawl Demersal longline fishery Shark directed fishing Large pelagics South coast rock lobster	Contribution to protection of spawning area for hake. Protection of cold water coral habitat and therefore supports new MSC conditions to support identification and protection of Vulnerable Marine Ecosystems.
12.Agulhas Bank Complex	Benthic & Pelagic (50%) Agulhas Gravel Outer Shelf (VU)* Agulhas Hard Inner Shelf (EN) Agulhas Hard Outer Shelf (VU) Agulhas Sandy Inner Shelf (VU) Southern Benguela Hard Outer Shelf (VU) Agulhas Gravel Inner Shelf Agulhas Sandy Outer Shelf Linefish recovery (red steenbras, red stumpnose) Linefish sustainability (carpenter, roman)	Inshore trawl Offshore trawl Hake longline Linefish Demersal shark South coast rock lobster Demersal longline fishery Large pelagics Sharks Squid	Important contribution to management of spawning aggregations of red steenbras. Contribution to lineish recovery. Zoned area accommodates trap and linefishing providing access to spillover.

Area	Key features and objectives for protection	Fisheries stakeholders	Potential benefits
	Aggregations and refuge of red steenbras (EN) Eco-certification support – demersal trawl EBSA (Life history, Vulnerability, Naturalness) Research (Habitat impacts and recovery)	Commercial linefish	
13.Agulhas Muds	Benthic Agulhas Muddy Inner Shelf (CR) Research (Habitat impacts and recovery)	DMR, PASA, DAFF Impact Africa / Exxonmobil Small pelagics South Coast Rock Lobster Shark directed fishing	First protection to critically endangered mud habitat trawled over almost entire extent thereby contributing to fisheries habitat management and meeting of benthic condition for MSC certification for hake trawl. Other fisheries sectors accommodated. Supports research on habitat impacts from demersal trawling. Contributes to bycatch management for inshore taw including silver kob (Lombard et al. 2010).
14.Southwest Indian Seamount	Benthic & Pelagic Agulhas Muddy Shelf Edge (Vu) Agulhas Hard Shelf Edge (Vu) Agulhas Sandy Shelf Edge (Vu), Southwest Indian Upper Bathyal Southwest Indian Lower Bathyal Southwest Indian Seamounts Research (habitat description, mapping)	Demersal trawl Midwater trawl Hake longline Large pelagic fishing Shark directed fishing	Tracking data suggests that this area will help protect turtles (Harris *et al.* 2017 and seabirds at risk from pelagic and demersal fisheries interactions
15.Agulhas Front	Benthic & Pelagic Southwest Indian Lower Bathyal Southwest Indian Lower Bathyal with hard grounds Southwest Indian Abyss Southwest Indian Abyss with hard substrate Research (habitat description, mapping)	Large pelagic fishery	Harris *et al.* 2017 published – role of proposed MPA in protecting key life history area for Critically Endangered leatherback turtles demonstrated
16. Port Elizabeth Corals	Benthic Cold water coral reefs Agulhas canyon (CR)* Southwest Indian Upper Bathyal	Midwater trawl (<0.5%) Demersal longline (<0.5%) Demersal trawl (0.04% of trawl effort)	Contribution to management of cold water corals, Vulnerable Marine Ecosystems, spawning area for kingklip, bycatch management for kingklip. Protection of critical

Area	Key features and objectives for protection	Fisheries stakeholders	Potential benefits
	Bycatch management support (kingklip) Kingklip aggregations and spawning Research (Habitat impacts and recovery, kingklip spawning requirements)	Large pelagic fishery (0.56%) Small pelagic (0.01%) South Coast Rock Lobster (<0.5%) Shark directed (0.96%)	habitat from seismic surveys.
17. Amathole Expansion	Benthic & Pelagic (50%) Agulhas canyon (good condition) (CR)* Agulhas Muddy Inner Shelf (good condition) (CR) Agulhas Gravel Inner Shelf, Agulhas Gravel Shelf edge, Southwest Indian Upper Bathyal, Southwest Indian Lower Bathyal Agulhas Sandy Inner Shelf (VU) Agulhas Sandy Outer Shelf Pelagic habitat types (3) Linefish recovery (seventy four, dageraad, red steenbras) Research (nursery function for linefish, linefish recovery, south coast rock lobster spillover potential and habitat recovery)	South coast rock lobster Linefish Squid	Protection of cold water coral habitat and therefore supports new MSC conditions to support identification and protection of Vulnerable Marine Ecosystems. Contributes to bycatch management for hake fisheries.
18.Protea Banks	Benthic & Pelagic Natal Inshore Reef (En) Natal Shelf Reef (Vu) Natal Canyon (Vu) Natal Sandy Shelf (Vu) Natal Boulder Shore (CR) Natal Delagoa Intermediate Sandy Coast (Vu) Reef building cold water corals (2 species) 2 pelagic habitats Frequent fronts Linefish recovery Spawning aggregations of black mussel cracker and red steenbras Shark aggregations (7 species) EBSA (habitat diversity, naturalness, life history)	Commercial linefishers (1.23%) Consumptive and non-consumptive charterboat industry Recreational fishers Large pelagic fishery (0.16%)	Linefish recovery and sustainability. Habitat protection for Natal canyon habitat. Protection of aggregation area for sharks including…..

Area	Key features and objectives for protection	Fisheries stakeholders	Potential benefits
19.Aliwal Shoal Expansion	Benthic & Pelagic Natal Inshore Reef (En) Natal Shelf Reef (Vu) Natal Sandy Inshore (Vu) Natal Sandy Shelf (Vu) Spawning area for seventy four (CR), red steenbras (EN), dusky kob and geelbek. Resource recovery (linefish) New research showing vulnerable marine ecosystems and distinct high profile deep reefs Good condition estuaries Good condition estuaries Presence of a semi-permanent cyclonic eddy south of Durban which increases the pelagic productivity of this region (enhanced survival of eggs and larvae) Linefish recovery Spawning aggregations of seventy four, dusky kob and geelbek. Research (biodiversity, linefish recovery)	Commercial linefishers Crustacean trawl Large Pelagic fishing Recreational fishers Consumptive and non-consumptive charter boat industry	Linefish recovery. Zoned areas accommodate fishing. Temporal protection for spawning aggregations of threatened and overexploited taxa for which spillover benefits have also been reported (Kerwath *et al.* 2013). This includes spawning habitat for critically endangered seventy four seabreams.
20. uThukela Banks	Benthic Natal Muddy Shelf (En) Natal Muddy Inshore (En) Natal Sandy Inshore (Vu) Natal Shelf Reef (En) Natal Canyon (Vu) Natal Sandy Shelf (Vu) Natal Gravel Shelf Southwest Indian Upper Bathyal St Lucia upwelling cell contributes to the unique environment and spawning and nursery conditions Spawning aggregations of square tail kob and slinger Linefish recovery (square tail kob) Support for bycatch management in crustacean trawl fishery	Crustacean trawl fishery Large pelagic fishery Linefish Consumptive and non-consumptive charter boat industry	Linefish recovery. Zoned areas accommodate small scale and commercial line fishing. The area will contribute to bycatch and habitat management for the crustacean trawl fishery

Area	Key features and objectives for protection	Fisheries stakeholders	Potential benefits
	Nursery area for kobs (square tail and snapper), scalloped hammerheads		
21. iSimangaliso Expansion	Benthic & Pelagic Leatherback turtle foraging area Delagoa Canyon Delagoa Shelf Edge Reef Southwest Indian Upper Bathyal Southwest Indian Lower Bathyal Coastal area) Cold water corals Entire canyon Natal Sandy Inshore (Vu) Natal Shelf reef (Vu) Natal-Delagoa Intermediate Sandy coast (Vu) Natal Shelf Edge Reef Natal Sandy Shelf Natal Sandy Shelf edge Linefish recovery Spawning aggregations of depleted linefish Support for bycatch management in the crustacean trawl fishery	Crustacean trawl fishery Linefishery Large pelagic fishery Recreational fishers	Contribution to VME management and protection of critically endangered turtles in their key life-history area. Support bycatch management for the large pelagic fishery
22. Addo Elephant National Park	Agulhas Island Agulhas Muddy Inner Shelf (CR) Agulhas Hard Inner Shelf (En) Agulhas Dissipative Intermediate Sandy Coast Agulhas Mixed Shore Agulhas Exposed Rocky Coast Agulhas Sandy Inner Shelf (Vu, poorly protected) Agulhas Sandy Inshore (Vu) Agulhas Mixed Sediment Inner Shelf Seabird foraging Linefish recovery	Squid Jig – controlled access areas Demersal trawl Linefish	Protection of key linefish and squid fishing grounds from increasingly industrialised port infrastructure The MPA helps provide forage fish for penguins which contributes to ecosystem-based management for this sector Recovery of overexploited kob species (silver kob and dusky kob) Contributes to bycatch management for the inshore trawl sector

Appendix 5: Key legislation for spatial management of the ocean in South Africa (as identified by Reed, 2018)

Act or Bill	Purpose of the Act/Bill	Objectives or Principles	Legislative tool relevant to spatial management
National Environmental Management Act, 1998 (No. 107 of 1998) as amended in 2013 (No. 30 of 2013).	To provide for co-operative, environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for coordinating environmental functions exercised by organs of state; and to provide for matters connected therewith.	*(1)* The principles set out in this section apply throughout the Republic to the actions of all organs of state that may significantly affect the environment and - *(a)* shall apply alongside all other appropriate and relevant considerations, including the State's responsibility to respect, protect, promote and fulfil the social and economic rights in Chapter 2 of the Constitution and in particular the basic needs of categories of persons disadvantaged by unfair discrimination; *(b)* serve as the general framework within which environmental management and implementation plans must be formulated: *(c)* serve as guidelines by reference to which any organ of state must exercise any function when taking any decision in terms of this Act or any statutory provision concerning the protection of the environment; *(d)* serve as principles by reference to which a conciliator appointed under this Act must make recommendations; and *(e)* guide the interpretation, administration and implementation of this Act, and any other law concerned with the protection or management of the environment. *(2)* Environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably. *(3)* Development must be socially, environmentally and economically sustainable. *(4)(a)* Sustainable development requires the consideration of all relevant factors including the following: *(i)* That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied; *(ii)* that pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied; *(iii)* that the disturbance of landscapes and sites that constitute the nation's cultural heritage is avoided, or where it cannot be altogether avoided, is minimised and remedied;	**24. Environmental authorisations** (2A) (a) In accordance with the risk averse and cautious approach contemplated in section 2(4)(a)(vii) and subject to paragraphs (e) and (f), the Minister may by notice in the Gazette prohibit or restrict the granting of an environmental authorisation by the competent authority for a listed or a specified activity in a specified geographical area for such period and on such terms and conditions as the Minister may determine, if it is necessary to ensure the protection of the environment, the conservation of resources or sustainable development. (b) Where the Minister has exercised his or her powers in terms of paragraph (a), the competent authority must— (i) not accept any further application for an environmental authorisation for the identified listed or specified activity in the identified geographical area until such time that the prohibition has been lifted; and (ii) deem all pending applications to have been withdrawn. (c) The exercise of the Minister's powers in terms of paragraph (a) does not affect the undertaking of activities authorised by means of an environmental authorisation prior to the prohibition or restriction becoming effective. (d) Where the prohibition or restriction affects the exercise of a power that an MEC has in terms of this Act, the prohibition or restriction contemplated in paragraph (a) may be published in the Gazette after consulting the MEC concerned. (e) The Minister may by notice in the Gazette— (i) lift a prohibition or restriction made in terms of paragraph (a) if the circumstances which caused the Minister exercise his or her powers in terms of paragraph (a) no longer exist; or (ii) amend any period, term or condition applicable to a prohibition or restriction if the circumstances which caused the Minister to exercise his or her powers in terms of paragraph (a) have changed. (f) Before the exercise of his or her powers in terms of paragraph (a), the Minister must—

		(iv) that waste is avoided. or where it cannot be altogether avoided, minimised and re-used or recycled where possible and otherwise disposed of in a responsible manner; *(v)* that the use and exploitation of non-renewable natural resources is responsible and equitable, and takes into account the consequences of the depletion of the resource; *(vi)* that the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised; *(vii)* that a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions; and *(viii)* that negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied. *(b)* Environmental management must be integrated, acknowledging that all elements of the environment are linked and interrelated, and it must take into account the effects of decisions on all aspects of the environment and all people in the environment by pursuing the selection of the best practicable environmental option. *(c)* Environmental justice must be pursued so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons. *(d)* Equitable access to environmental resources, benefits and services to meet basic human needs and ensure human well-being must be pursued and special measures may be taken to ensure access thereto by categories of persons disadvantaged by unfair discrimination. *(e)* Responsibility for the environmental health and safety consequences of a policy, programme, project, product. process. service or activity exists throughout its life cycle. *(f)* The participation of all interested and affected parties in environmental governance must be promoted, and all people must have the opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation, and participation by vulnerable and disadvantaged persons must be ensured. *(g)* Decisions must take into account the interest. needs and values of all interested and affected parties, and this includes recognizing all forms of knowledge, including traditional and ordinary knowledge.	(i) consult all Cabinet members whose areas of responsibility will be affected by the exercise of the power; (ii) in accordance with the principles of co-operative governance set out in Chapter 3 of the Constitution, consult an MEC who will be affected by the exercise of the power; and (iii) publish a notice in the Gazette inviting members of the public to submit to the Minister, within 30 days of publication of the notice in the Gazette, written representations on the proposed prohibition or restriction.

		(h) Community wellbeing and empowerment must be promoted through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means. *(i)* The social, economic and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in the light of such consideration and assessment. *j)* The right of workers to refuse work that is harmful to human health or the environment and to be informed of dangers must be respected and protected. *(k)* Decisions must be taken in an open and transparent manner, and access to information must be provided in accordance with the law. *(l)* There must be intergovernmental co-ordination and harmonisation of policies, legislation and actions relating to the environment. *(m)* Actual or potential conflicts of interest between organs of state should be resolved through conflict resolution procedures. *(n)* Global and international responsibilities relating to the environment must be discharged in the national interest. *(o)* The environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage. *(p)* The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimizing further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment. *(q)* The vital role of women and youth in environmental management and development must be recognized and their full participation therein must be promoted. *(r)* Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.	
National Environmental Management: Integrated Coastal	To establish a system of integrated coastal and estuarine management in the Republic,	The objects of this Act are— *(a)* to determine the coastal zone of the Republic: *(b)* to provide, within the framework of the National Environmental Management Act, for the co-ordinated and integrated management	***Coastal protection zone*** **Composition of coastal protection zone** **16.** (1) Subject to subsection (2). the coastal protection zone consists of—

Management Act, 2008 (No. 24 of 2008)	including norms, standards and policies, in order to promote the conservation of the coastal environment, and maintain the natural attributes of coastal landscapes and seascapes, and to ensure that development and the use of natural resources within the coastal zone is socially and economically justifiable and ecologically sustainable; to define rights and duties in relation to coastal areas; to determine the responsibilities of organs of state in relation to coastal areas; to prohibit incineration at sea; to control dumping at sea, pollution in the coastal zone, inappropriate development of the coastal environment and other adverse effects on the coastal environment; to give effect to South Africa's international obligations in relation to coastal matters; and to provide for matters connected therewith.	of the coastal zone by all spheres of government in accordance with the principles of co-operative governance; *(c)* to preserve, protect, extend and enhance the status of coastal public property as being held in trust by the State on behalf of all South Africans, including future generations; *(d)* to secure equitable access to the opportunities and benefits of coastal public properly: and *(e)* to give effect to the Republic's obligations in terms of international law regarding coastal management and the marine environment.	*(a)* land falling within an area declared in terms of the Environment Conservation Act, 1989 (Act No. 73 of 1989), as a sensitive coastal area within which activities identified in terms of section 21(1) of that Act may not be undertaken without an authorisation; *(b)* any part of the littoral active zone that is not coastal public property; *(c)* any coastal protection area, or part of such area, which is not coastal public property; *(d)* any land unit situated wholly or partially within one kilometre of the high-water mark which, when this Act came into force— (i) was zoned for agricultural or undetermined use; or (ii) was not zoned and was not part of a lawfully established township, urban area or other human settlement; *(e)* any land unit not referred to in paragraph *(d)* that is situated wholly or partially within 100 metres of the high-water mark; *(f)* any coastal wetland, lake, lagoon or dam which is situated wholly or partially within a land unit referred to in paragraph *(d)(i)* or *(e):* *(g)* any part of the seashore which is not coastal public property, including all privately owned land below the high-water mark; *(h)* any admiralty reserve which is not coastal public property: or *(i)* any land that would be inundated by a 1:50 year flood or storm event. (2) An area forming part of the coastal protection zone, except an area referred to in subsection (1)*(g)* or *(h)* may be excised from the coastal protection zone in terms of section 26. **Purpose of coastal protection zone** **17.** The coastal protection zone is established for enabling the use of land that is adjacent to coastal public property or that plays a significant role in a coastal ecosystem to be managed, regulated or restricted in order to— *(a)* protect the ecological integrity, natural character and the economic, social and aesthetic value of coastal public property; *(b)* avoid increasing the effect or severity of natural hazards in the coastal zone; *(c)* protect people, property and economic activities from risks arising from dynamic coastal processes, including the risk of sea-level rise;

			(d) maintain the natural functioning of the littoral active zone; *(e)* maintain the productive capacity of the coastal zone by protecting the ecological integrity of the coastal environment; and (f) make land near the seashore available to organs of state and other authorised persons for— (i) performing rescue operations; or (ii) temporarily depositing objects and materials washed up by the sea or tidal waters. ***Coastal protected areas*** **Excision of protected areas from coastal protection zone** **22.** (1) Subject to section 87, the MEC may by notice in the *Gazette* declare that with effect from a specified date the whole or any part of a protected area that is not coastal public property, will not form part of the coastal protection zone. (2) The MEC may only publish a notice referred to in subsection (1) after consultation with the management authority of the protected area, if he or she on reasonable grounds believes that doing so will not prejudice the effective management of the coastal zone. ***Special management areas*** **Declaration of special management areas** **23.** (1) The Minister may. after consultation with the MEC, by notice in the *Gazette*— *(a)* declare an area that is wholly or partially within the coastal zone to be a special management area; or *(b)* withdraw or amend any declaration made in terms of paragraph *(a).* (2) Before declaring an area to be a special management area, the Minister must give interested and affected parties an opportunity to make representations in accordance with Part 5 of Chapter 6. (3) An area may be declared as a special management area only if environmental, cultural or socio-economic conditions in that area require the introduction of measures which are necessary in order to more effectively— *(a)* attain the objectives of any coastal management programme in the area; *(b)* facilitate the management of coastal resources by a local community;

			(c) promote sustainable livelihoods for a local community; or *(d)* conserve, protect or enhance coastal ecosystems and biodiversity in the area. (4) The Minister may prescribe specified activities which are prohibited in special management areas taking into account the purpose for which the special management area was declared. **Management of special management areas** **24.** (1) The Minister may, by notice in the *Gazette,* appoint a manager for each special management area. (2) The manager must have sufficient expertise and capacity to manage the special management area in a manner that will achieve the objectives for which it was established and may be— *(a)* a juristic person constituted for that purpose; *(b)* an organ of state; *(c)* a traditional council; or *(d)* any other person with appropriate expertise and capacity. (3) Before authorising the manager to begin managing the special management area, the Minister must make regulations that— *(a)* define the duties and powers of the manager; and *(b)* prescribe rules to facilitate the achievement of the objectives for which the special management area was declared.
National Environmental Management: Protected Areas Act, 2003 (No. 5 of 2003) as amended in 2014 (No. 21 of 2014)	To provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national register of all national, provincial and local protected areas; for the management of those areas in accordance with national norms and standards; for intergovernmental co-	The objectives of this Act are – *(a)* to provide, within the framework of national legislation, including the National Environmental Management Act, for the declaration and management of protected areas; *(b)* to provide for co-operative governance in the declaration and management of protected areas; *(c)* to effect a national system of protected areas in South Africa as part of a strategy to manage and conserve its biodiversity; *(d)* to provide for a diverse and representative network of protected areas on state land, private land, communal land and marine waters; *(e)* to promote sustainable utilisation of protected areas for the benefit of people, in a manner that would preserve the ecological character of such areas; *(f)* to promote participation of local communities in the management of protected areas, where appropriate; and *(g)* to provide for the continued existence of South African National Parks.	***Marine protected areas*** **Declaration of marine protected areas** **22A.** (1) The Minister may, by notice in the *Gazette*— *(a)* declare an area specified in the notice— (i) as a marine protected area; or (ii) as part of an existing marine protected area; and *(b)* assign a name to the marine protected area. (2) A declaration under subsection (1)*(a)* may only be issued— *(a)* to conserve and protect marine and coastal ecosystems; *(b)* to conserve and protect marine and coastal biodiversity; *(c)* to conserve and protect a particular marine or coastal species, or specific population and its habitat; *(d)* if the area contains scenic areas or to protect cultural heritage; *(e)* to facilitate marine and coastal species management by protecting migratory routes and breeding, nursery or feeding areas, thus allowing species recovery and to enhance species abundance in adjacent areas; *(f)* to protect and provide an appropriate environment for

	operation and public consultation in matters concerning protected areas; for the continued existence, governance and functions of South African National Parks; and for matters in connection therewith.		research and monitoring in order to achieve the objectives of this Act; or *(g)* to restrict or prohibit activities which is likely to have an adverse effect on the environment. (3) A notice under subsection (1)*(a)* may only be issued after consultation with the Cabinet member responsible for fisheries. **Withdrawal of declaration of, addition to, or exclusion from, marine protected areas** **22B.** The Minister may, by notice in the *Gazette*— *(a)* withdraw a declaration made under section 22A (1); *(b)* add to or exclude any area from a marine protected area; and *(c)* assign a different name to a marine protected area.
Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002) as amended in 2008 (No. 49 of 2008)	To make provision for equitable access to and sustainable development of the nation's mineral and petroleum resources; and to provide for matters connected therewith.	The objects of this Act are to- (a) recognise the internationally accepted right of the State to exercise sovereignty over all the mineral and petroleum resources within the Republic; (b) give effect to the principle of the State's custodianship of the nation's mineral and petroleum resources; (c) promote equitable access to the nation's mineral and petroleum resources to all the people of South Africa; (d) substantially and meaningfully expand opportunities for historically disadvantaged persons, including women and communities, to enter into and actively participate in the mineral and petroleum industries and to benefit from the exploitation of the nation's mineral and petroleum resources; (e) promote economic growth and mineral and petroleum resources development in the Republic, particularly development of downstream industries through provision of feedstock, and development of mining and petroleum inputs industries; (f) promote employment and advance the social and economic welfare of all South Africans; (g) provide for security of tenure in respect of prospecting, exploration, mining and production operations; (h) give effect to section 24 of the Constitution by ensuring that the nation's mineral and petroleum resources are developed in an orderly and ecologically sustainable manner while promoting justifiable social and economic development; and (i) ensure that holders of mining and production rights contribute towards the socio-economic development of the areas in which they are operating.	**Minister's power to prohibit or restrict prospecting or mining** **49.** (1) Subject to subsection (2), the Minister may after inviting representations from relevant stakeholders, from time to time by notice in the *Gazette*, having regard to the national interest, the strategic nature of the mineral in question and the need to promote the sustainable development of the nation's mineral resources— *(a)* prohibit or restrict the granting of any reconnaissance permission, prospecting right, mining right or mining permit in respect of land identified by the Minister for such period and on such terms and conditions as the Minister may determine; or *(b)* restrict the granting of any reconnaissance permission, reconnaissance permit, prospecting right, mining right or mining permit in respect of a specific mineral or mining permit in respect of a specific mineral or minerals or class of minerals identified by the Minister for such period and on such terms and conditions as the Minister may determine. (2) A notice contemplated in subsection (1) does not affect prospecting or mining in, on or under land which, on the date of the notice is the subject of a reconnaissance permission, prospecting right, a mining right, a retention permit or a mining permit. (3) The Minister may from time to time by notice in the *Gazette*— *(a)* lift a prohibition or restriction made in terms of subsection (1) if the circumstances which caused the Minister so to prohibit or restrict no longer exist; or *(b)* amend the period, term or condition applicable to any prohibition or restriction made in terms of subsection (1) if the

			circumstances which caused the Minister so to prohibit or restrict have changed. (4) Subject to subsection (2) (b), the Minister may by notice in the *Gazette* invite applications for a prospecting right, mining right or mining permit in respect of any mineral or land, and may specify in such notice the period within which any application may be lodged and the terms and conditions subject to which such right or permit may be granted.
Marine Living Resources Act, 1998 (No. 18 of 1998) as amended in 2014 (No. 5 of 2014) and by Regulations Relating to Small-Scale Fishing in terms of section 19 of the MLRA, 1998 (published 08 March 2016)	To provide for the conservation of the marine ecosystem, the long-term sustainable utilisation of marine living resources and the orderly access to exploitation, utilisation and protection of certain marine living resources; and for these purposes to provide for the exercise of control over marine living resources in a fair and equitable manner to the benefit of all the citizens of South Africa; and to provide for matters connected therewith.	The Minister and any organ of state shall in exercising any power under this Act, have regard to the following objectives and principles: *(a)* The need to achieve optimum utilisation and ecologically sustainable development of marine living resources; *(b)* the need to conserve marine living resources for both present and future generations; *(c)* the need to apply precautionary approaches in respect of the management and development of marine living resources; *(d)* the need to utilise marine living resources to achieve economic growth, human resource development, capacity building within fisheries and mariculture branches, employment creation and a sound ecological balance consistent with the development objectives of the national government; *(e)* the need to protect the ecosystem as a whole, including species which are not targeted for exploitation; *(f)* the need to preserve marine biodiversity; *(g)* the need to minimise marine pollution; *(h)* the need to achieve to the extent practicable a broad and accountable participation in the decision-making processes provided for in this Act; *(i)* any relevant obligation of the national government or the Republic in terms of any international agreement or applicable rule of international law; and *(j)* the need to restructure the fishing industry to address historical imbalances and to achieve equity within all branches of the fishing industry.	**Fisheries management areas** **15.** (1) The Minister may by notice in the *Gazette* declare any area of the South African waters to be a fisheries management area for the management of the species described in the notice. (2) The Minister may in respect of each fisheries management area approve a plan for the conservation, management and development of the fisheries. (3) The Minister shall, during the preparation of any plan contemplated in subsection (2), consult with the Forum and other organs of state affected by the plan. **Priority fishing areas** **17.** If the Minister is of the opinion that special measures are necessary to ensure that authorised fishing within any area of the South African waters is not impeded or otherwise interfered with, he or she may, after consultation with the affected parties, by notice in the *Gazette*— *(a)* declare such an area to be a priority fishing area for the purposes stated in the notice; and *(b)* prohibit any activity determined in the notice. **Small-scale fishing areas and zones** 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. (2) For the purposes of sub-regulation (1), the demarcation must – (a) be done in a manner that reduces conflict between small-scale fishing communities; and (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 are (3) if there are other activities that have a proven severe impact on the fishing activities of a small-scale fishers the Department shall by means of *Gazette* establish exclusive zones which can either regulate or prohibit these activities from operating in that area.
Draft Aquaculture Bill, 2016	To promote the development of an equitable, diverse, viable and competitive aquaculture sector; to create a harmonised enabling regulatory environment within a framework of sustainable development; to improve coordination in the regulation of the aquaculture sector; to promote the participation of historically disadvantaged individuals in the aquaculture sector; to establish an aquaculture development fund; and to provide for related matters.	The objects of this Act are to— (a) promote responsible aquaculture development; (b) promote the development and management of an aquaculture sector that: (i) is diverse; (ii) enhances food security in the Republic; (iii) contributes to the production of aquaculture products that are safe for human consumption; (iv) contributes to the management and control of aquatic diseases; (v) contributes to income generation and sustainable livelihoods; (vi) is domestically and internationally competitive; and (vii) is ecologically, socially and economically sustainable; (c) promote coordination of aquaculture research and development activities; (d) enable the aquaculture sector to be regulated more effectively; and (e) promote transformation of the aquaculture sector.	**Aquaculture development zones** **19.** (1) The Minister may, by notice in the *Gazette*— (a) declare any area on land and within the waters of the Republic of South Africa as an aquaculture development zone if the Minister is satisfied that the: (i) area is particularly suitable for aquaculture of a specific type or types; (ii) declaration is consistent with responsible aquaculture development; and (iii) declaration is consistent with any applicable national policies and law. (b) determine the location and define the physical boundaries of an aquaculture development zone; (c) determine the physical boundaries of a buffer zone for the aquaculture development zone; (d) determine measures for the management of land, water and other resources for aquaculture in the aquaculture development zone; (e) determine and implement support measures, including incentive schemes in collaboration with the Ministers responsible for industry development and finance, the provisions of essential services for aquaculture activities within an aquaculture development zone; and (f) in order to protect aquaculture activities undertaken in an aquaculture development zone, specify restrictions and conditions on the conduct of activities and uses in— (i) the aquaculture development zone; (ii) the waters draining into an aquaculture development zone; and (iii) any buffer zone for an aquaculture development zone. (2) Before declaring an area as an aquaculture development zone or determining a buffer zone, the Minister must— (a) consult with relevant national government department(s) having jurisdiction in the proposed aquaculture development zone;

			(b) in consultation with the national Minister responsible for the environment, consider whether the area may— (i) also be declared as a special management area in terms of section 23 of the Integrated Coastal Management Act; or (ii) be delisted in terms of section 24B of the National Environmental Management Act; and (c) in consultation with the national Minister responsible for industry development, consider whether the area may also be designated a special economic zone in terms of sections 23 or 24 of the Special Economic Zones Act, 2014 (Act No. 16 of 2014). (3) The Minister must, for the purposes of identifying aquaculture development zones and buffer zones— (a) develop criteria and a methodology for determining whether an area is suitable for aquaculture of specific type or types; and (b) conduct environmental assessments, in consultation with the Minister responsible for environment, to identify suitable areas. **Aquaculture Disease Zones** **20**. The Minister may declare a specific geographic area or areas as aquaculture disease zones for the purpose of prescribing measures for the prevention, management and control of diseases affecting aquaculture in the Republic.
Marine Spatial Planning Bill, 2017 [B 9B-2017]	To provide a framework for marine spatial planning in South Africa; to provide for the development of marine spatial plans; to provide for institutional arrangements for the implementation of marine spatial plans and governance of the use of the ocean by multiple sectors; and to provide for matters connected therewith.	The objects of the Act are to— *(a)* develop and implement a shared marine spatial planning system to manage a changing environment that can be accessed by all sectors and users of the ocean; *(b)* promote sustainable economic opportunities which contribute to the development of the South African ocean economy through coordinated and integrated planning; *(c)* conserve the ocean for present and future generations; *(d)* facilitate responsible use of the ocean; *(e)* provide for the documentation, mapping and understanding of the physical, chemical and biological ocean processes and opportunities in, and threats to, the ocean; and *(f)* give effect to South Africa's international obligations in South African waters.	

Appendix 6: Recommendation for further research

Further research that can be harmonised with the body of work presented in this report and related to the identification and mapping of Strategic Commercial Fisheries Resources Areas to Support Marine Spatial Planning in South Africa, as has been proposed by Tsamelo Malebu (NMU).

Aims

The overall aim of the research is to build on the maps of fisheries priority areas and develop additional metrics that would support the identification of Strategic Commercial Fisheries Resource Areas (SCFRAs). Strategic resource areas (as opposed to priority fishing areas) take into account the socio-economic attributes of fishing grounds above and beyond the service of food provisioning and also take into consideration ecological support areas critical to these fisheries (i.e. areas required to fulfil the life cycle of targeted resources such as spawning grounds, nursery areas, migration routes, etc.). Those supporting metrics will provide increasingly important motivation while developing guidelines for the spatial management of these fisheries, taking into account competing ocean uses and developing industries. The outputs aim to support the delivery of sustainable long-term fisheries benefits in the form of food provision, and job and economic security, to South Africa.

Objectives

1. Select the commercial fisheries for the study, based on the Department of Agriculture, Forestry and Fisheries (DAFF) Status of the South African Marine Fisheries Resources report (2014).

2. Map the spatial patterns of social and economic value to identify important (core) areas for each of these metrics for the selected fisheries that will support the mapping of priority fishing areas based on commercial catch and effort.

3. Explore the use of these metrics to communicate the location of "Strategic Commercial Fisheries Resource Areas" (SCFRAs) to policy. Develop new metrics to communicate more nuanced information, for example, numbers of jobs and actual Rand value of the SCFRAs.

4. Examine spatio-temporal shifts in SCFRAs over the last three decades.

5. Identify and delineate ecological support areas for important commercial species. Ecological support areas are defined as those areas that are critical to the life cycle of the target species. Ecological support areas will be considered as part of the SCFRAs for the relevant fisheries.

6. Identify compatible and incompatible activities in SCFRAs and contribute to the development of guidelines for the spatial management of these fisheries.