7. DESCRIPTION OF THE AFFECTED ENVIRONMENT

This chapter provides a description of the Southeast Coast region and the physical, biological and socio-economic environment likely to be affected by the proposed exploration activities.

7.1 INTRODUCTION

The Reconnaissance Permit application area/survey area of interest is situated in the Algoa/Outeniqua Basins off the Southeast Coast, roughly between Plettenberg Bay and Gqeberha. The proposed survey area of interest ranges between 45 and 120 km from the coast at its closest points and in water depths between 200 m to beyond 4 000 m (see Figure 1-1).

An understanding of the environmental and social context and sensitivity within which the proposed project activities would be located is important to understanding the potential impacts.

7.2 AREAS OF INFLUENCE

The Area of Influence of the project is defined as a basis for defining the boundaries for baseline data gathering by taking into consideration the spatial extent of potential direct and indirect impacts of the project. In terms of International Finance Corporation (IFC) Performance Standard (PS) 1, a "*Project's Area of Influence encompasses, as appropriate:*

- *The area likely to be affected by:*
  - *the project and the client's activities and facilities that are directly owned, operated or managed (including by contractors) and that are a component of the project;*
  - *impacts from unplanned but predictable developments caused by the project that may occur later or at a different location; or*
  - *indirect project impacts on biodiversity or on ecosystem services upon which affected communities' livelihoods are dependent.*
- *Associated facilities, which are facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable.*
- *Cumulative impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted*".

For seismic operations, the direct areas of influence during normal operations are set out below:

- The proposed survey operational area (including turning circles). This includes all seismic data acquisition and maintenance of an operational safety zone around the survey vessel and gear;
- Port of Gqeberha for provision of supplies, waste management services, refuelling and crew changes; and
- Marine traffic route between Gqeberha and the proposed survey area of interest.

Based on the above area of influence, Sections 7.3, 7.4 and 7.5 detail the physical and biological marine environment (including protected and other sensitive areas) off the Southeast Coast of South Africa. Section 7.6 describes the regional and local social and human context; Section 7.7 details the marine-based fisheries; Section 7.8 provides a brief overview of other marine infrastructure and users, and Section 7.9 briefly covers marine archaeology.

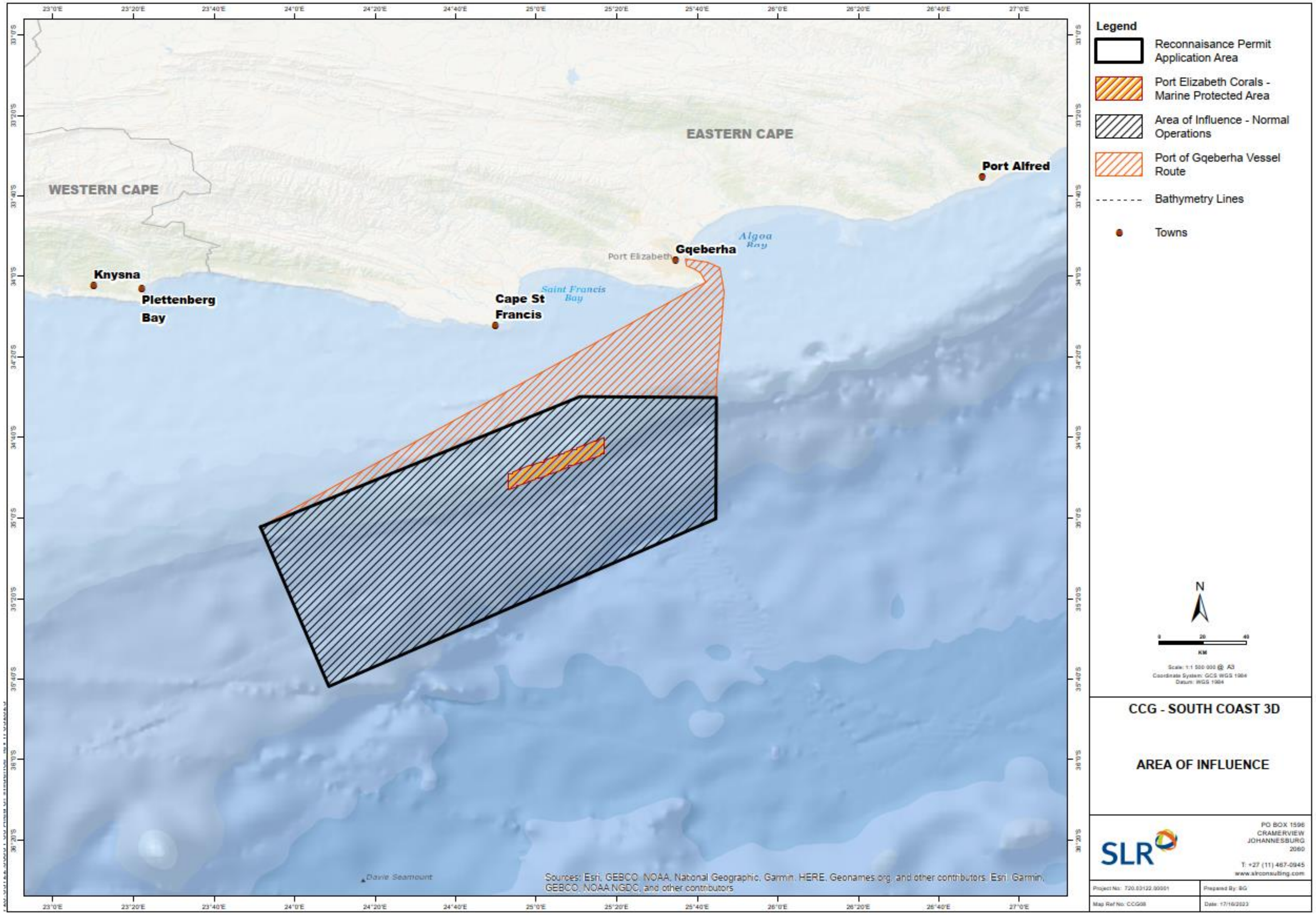


Figure 7-1: Area of Influence during seismic operations

7.3 PHYSICAL ENVIRONMENT

This section describes the climate, bathymetry and seafloor sediment; ocean currents and thermal structure; winds and swells, turbidity and sedimentary phosphates.

7.3.1 Climate

The climate along the south and east coast of South Africa transitions from the Mediterranean winter (May to August) rainfall climate in the Western Cape which occurs between Cape Town and Agulhas to the subtropical summer (November to February) rainfall climate of Kwazulu-Natal in the east of the country. The South Coast falls between the two extremes and transitions from winter rainfall in the west (April-October) to an all-year rainfall pattern in the east, with a peak in spring (refer to Figure 7-2:). Rainfall in the region is driven by seasonal movement of the subtropical high-pressure belt northwards in winter and southwards in summer by approximately six degrees of latitude. This allows mid-latitude systems to extend their reach northwards during winter and tropical-temperate systems to extend southwards during summer, both extending into the Southern Cape (van Zyl 2003).

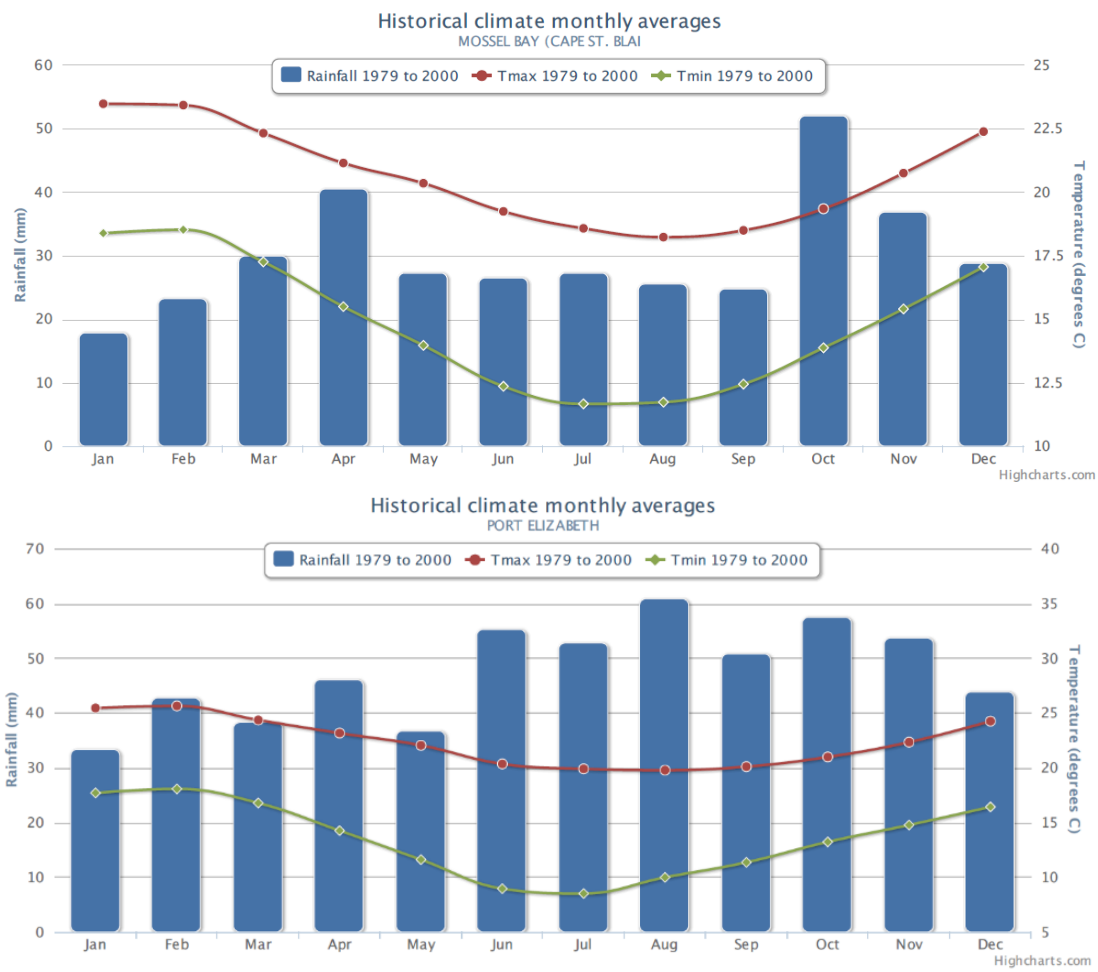


Figure 7-2: Historic rainfall and temperature monthly averages for Cape St Francis (top) and Gqeberha (Port Elizabeth) (bottom)

Source: CSAG 2020

The primary contributors of different systems to rainfall in the area are ridging high pressure systems (46%), tropical temperate troughs (28%) and cut-off lows (16%) (Engelbrecht and Landman 2016). Cut off lows do, however, contribute 29% of all extreme rain events which typically occur in the winter rainfall period (between May and September). Orographic rain is also a significant factor along this coastline due to the presence of mountain chains near the coast in many places, and this likely contributes to the remaining 10% of rainfall (van Zyl 2003).

At Gqeberha, average minimum temperatures range between approximately 16°C in summer and approximately 8°C in winter. Maximum temperatures vary between 20 and 25.5°C for winter and summer. Climate change predictions along the southern coastline indicated a general reduction in precipitation, with a possible shift towards increased summer and autumn rainfall in the eastern parts (CSAG 2020). Wind in this region is predominantly parallel to the coast with westerlies dominating the winter months and both easterlies and westerlies present during summer (Lutjeharms *et al*. 2000 and Goschen *et al*. 2015). Wind is discussed in relation to currents in Section 7.3.5.

7.3.2 Bathymetry and Sediments

Along the Southeast Coast, the bathymetry is characterised by a very narrow shelf, with a steep continental slope. The bathymetry drops steeply at the coast to approximately 50 m. In the region of Algoa Bay, the shelf begins to widen, with depth increasing gradually to the shelf break at a depth of 140 m off Gqeberha, 130 m off Cape St Francis, and 300 m south of Cape Agulhas (Birch & Rogers 1973) (see Figure 7-3). Between 22° and 23°E, the shelf break indents towards the coast forming the Agulhas 'bight' (Schumann 1998).

Major bathymetric features on the Agulhas Bank include various banks (Alphard, 6-Mile, 12-Mile, 45-Mile and 72-Mile Banks, and the "Blues" and "Browns" Banks), situated south of Cape Infanta and off Cape Agulhas, the Agulhas Arch and Alphard Rise (Birch & Rogers 1973; CCA & CSIR 1998). Dalgleish Bank and Grue Bank lie due south of Knysna. Grue Bank extends eastwards as a deep reef complex referred to as Kingklip Koppies and the Agulhas- and Kingklip Ridges. The Kingklip Ridge (situated on the slope between Gqeberha and Cape St. Francis) is a unique 40 km long, 500 m wide feature that rises from a depth of more than 700 m to as shallow as 350 m with very strong currents on the outer ridge (Sink *et al.* 2019). Outside the shelf break, depth increases rapidly to more than 1 000 m (Hutchings 1994) descending into the Transkei Basin. Three submarine canyons are known off Algoa Bay with the Sundays and Addo Canyons breaching the shelf and spanning a depth range of approximately -150 m to -2 000 m. The deeper Cannon Rocks Canyon, off the Boesmans Estuary east of Port Elizabeth, is confined to the slope (Sink *et al.* 2012, 2019). The Southwest Indian Seamounts are situated to the east of the Agulhas Bank beyond 3 000 m depth (Sink *et al.* 2012) (see Figure 7-3).

Off Gqeberha, the seafloor is predominantly rocky, seaward of the inner shelf sediment-wedge (Birch & Rogers 1973; Schumann 1998). Although mud patches occur inshore east of Cape Infanta, the majority of unconsolidated sediment is sand to muddy sand (Birch & Rogers 1973). The inshore portions of the Reconnaissance Permit Area comprise Agulhas Sandy Shelves, Agulhas Mosaic Shelves, Agulhas Rocky Shelves (minor overlap) and Southwest Indian Slopes Ridges (minor overlap). Offshore of the shelf break, benthic habitats are dominated by Southwest Indian Unclassified Slope unconsolidated sediments, with the deeper portions of the project area comprising sediments of the Southwest Indian Unclassified Abyss (Lombard *et al.* 2004; Sink *et al.* 2019) (see Figure 7-4).

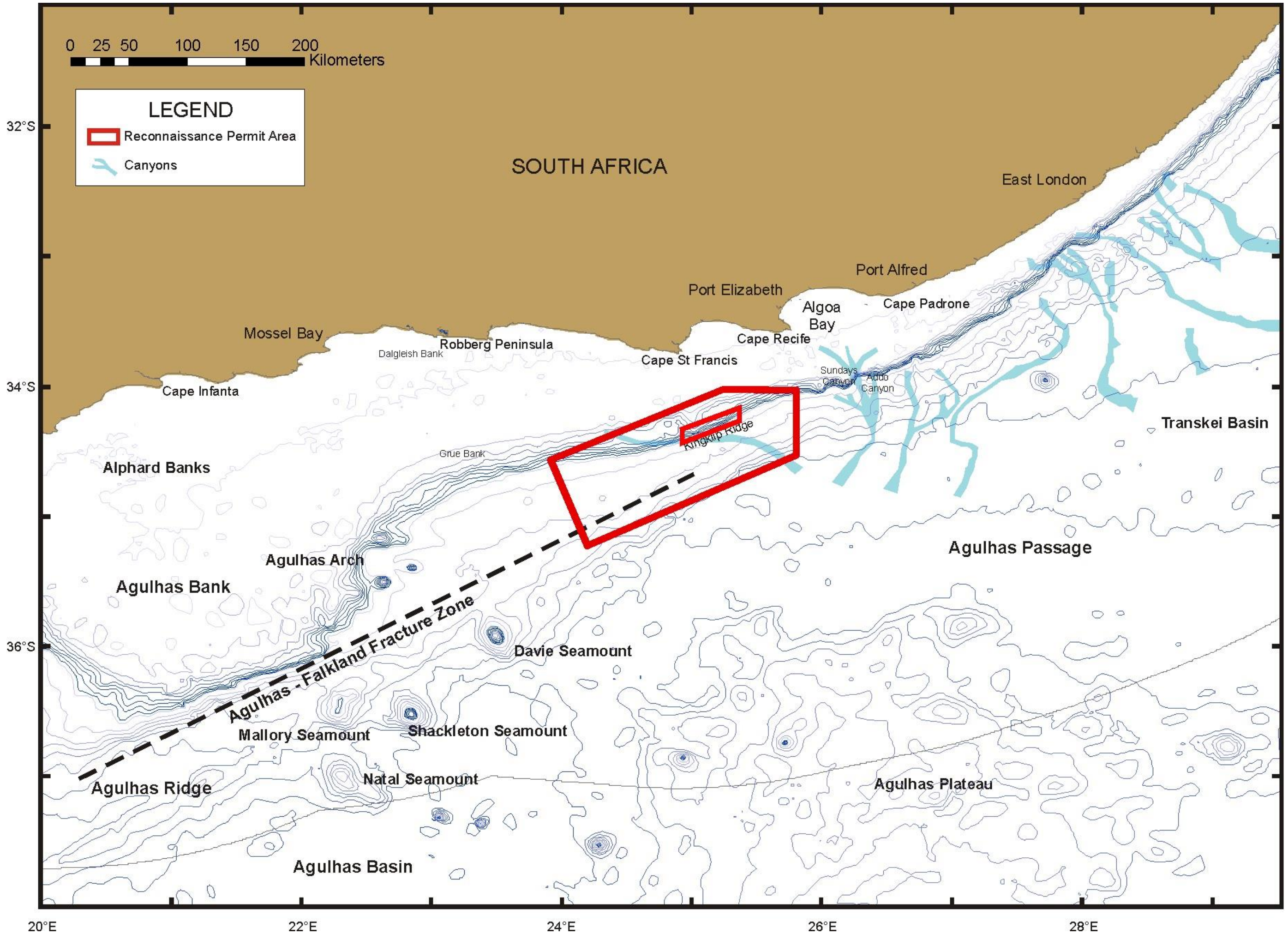


Figure 7-3: Location, bathymetry and seabed features off the Southeast Coast in relation to the Reconnaissance Permit Area

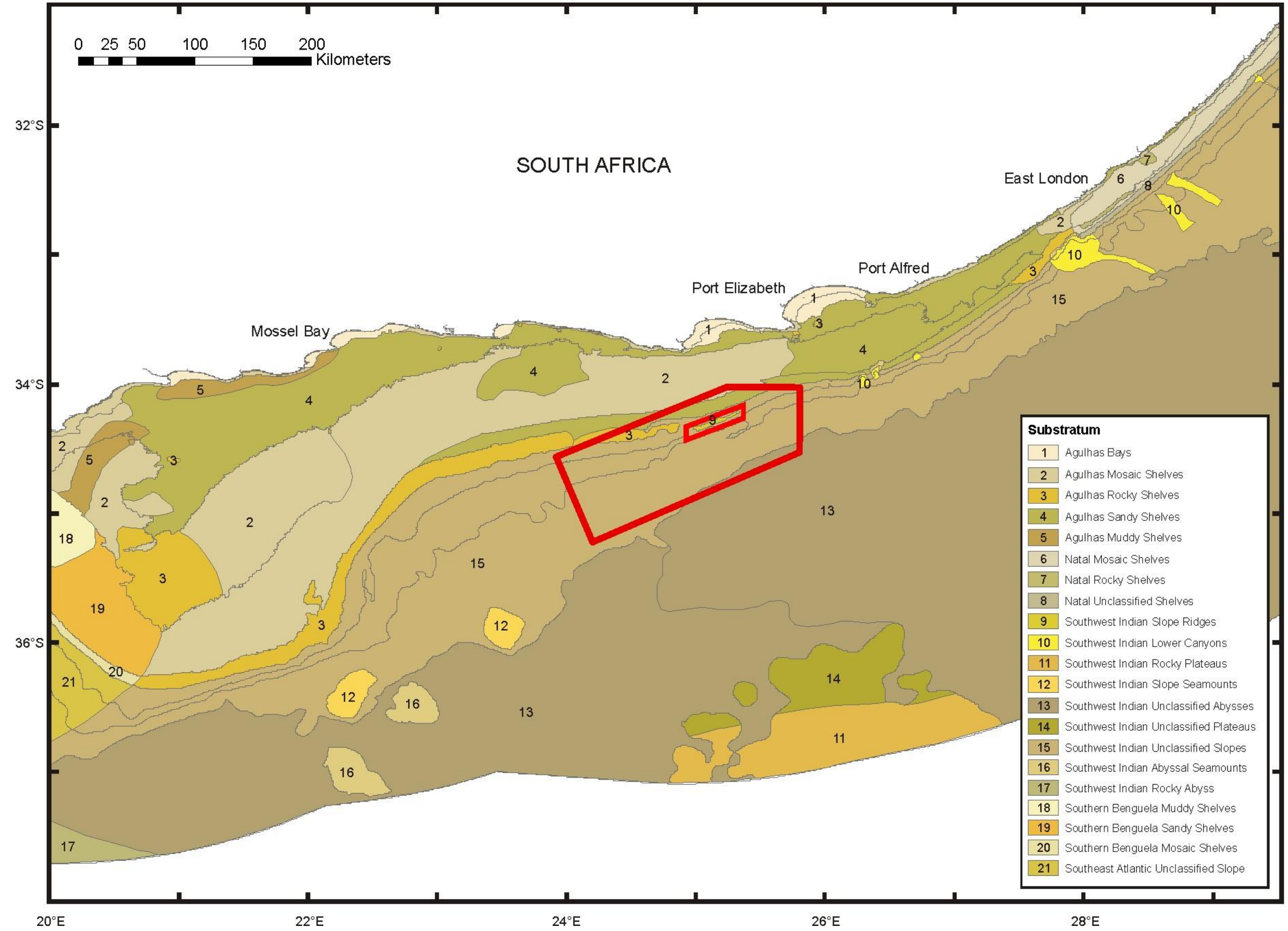


Figure 7-4: The Reconnaissance Permit Area (red) in relation to coastal and offshore benthic habitat types of the Southeast coast (adapted from Sink *et al.* 2019)

7.3.3 Water Masses and Circulation

The oceanography of the South Coast is almost totally dominated by the warm Agulhas Current (see Figure 7-5). The current forms between 25° and 30° S, flowing southwards along the shelf edge of the southern African East Coast (Schumann 1998) as part of the anticyclonic Indian Ocean gyre. It is a well-defined and intense jet some 100 km wide and 1 000 m deep (Schumann 1998), flowing in a south-west direction at a rapid rate, with current speeds of 2.5 m/s or more, and water transport rates of over 60 × 10^6 m^3/s have being recorded (Pearce *et al.* 1978; Gründlingh 1980). Following its divergence into deep water off the Tugela Bank, the Agulhas Current re-attaches itself to the coast south of Durban, where the continental shelf again narrows, until off Port Edward where it is so close inshore that the inshore edge (signified by a temperature front) is rarely discernible (Pearce 1977a, 1977b). On the eastern half of the South Coast, the Agulhas Current flows along the shelf break at speeds of up to 3 m/sec, diverging inshore of the shelf break south of Still Bay (34° 28'S, 21° 26'E) before realigning to the shelf break off Cape Agulhas (Heydorn & Tinley 1980). The Agulhas Current may produce large meanders with cross shelf dimensions of approximately 130 km, which move downstream at approximately 20 km per day (Lutjeharms 2006). It may also shed eddies, which travel at around 0.20 m/s and advect onto the Agulhas Bank (Swart & Largier 1987; Penven *et al.* 2001) (see Figure 7-6).

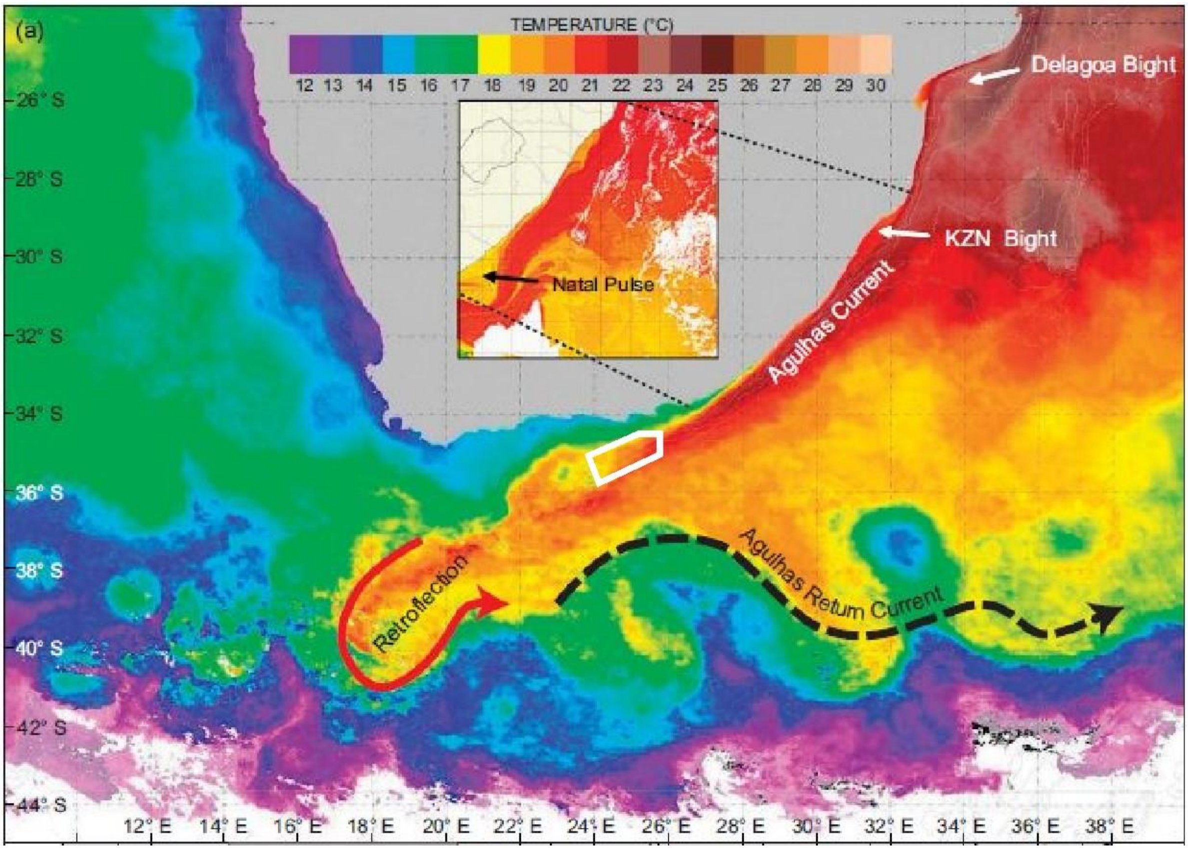


Figure 7-5: The predominance of the Agulhas current in the oceanography of the Reconnaissance Permit Area (adapted from Roberts et al. 2010)

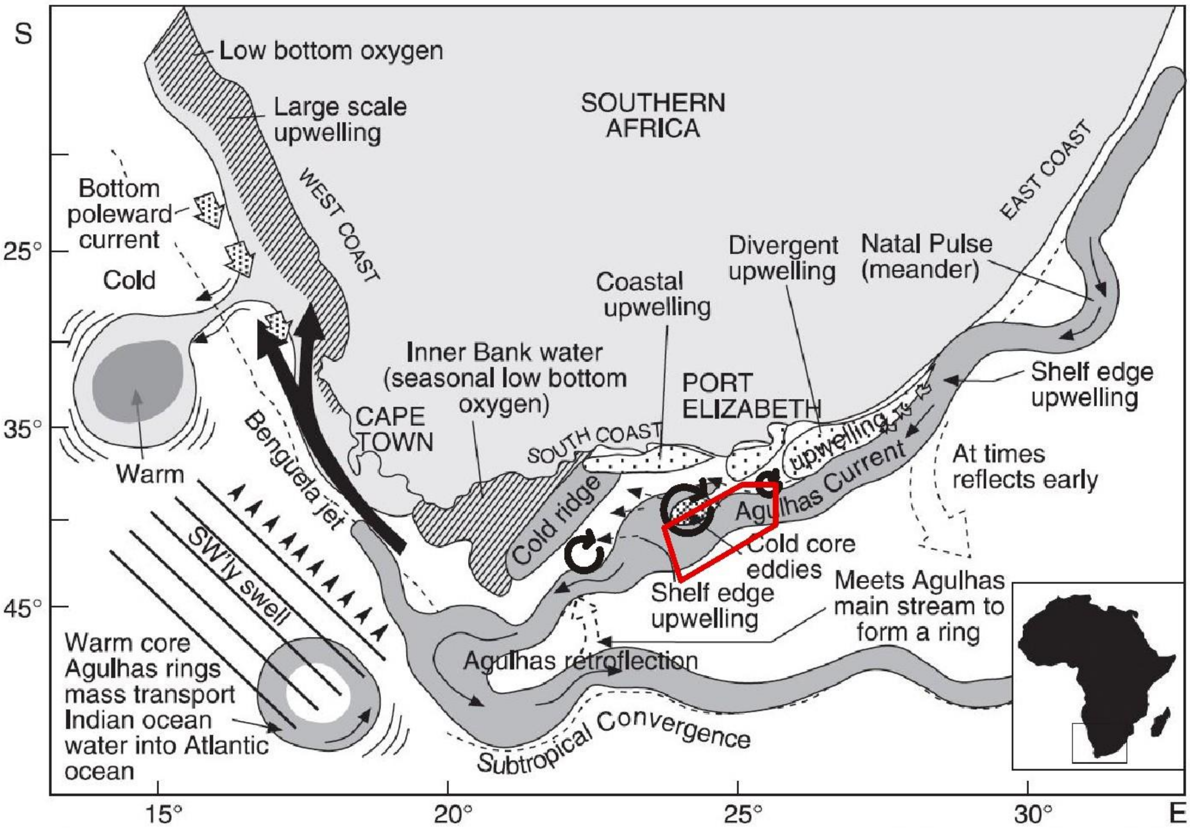


Figure 7-6: The Reconnaissance Permit Area (red) in relation to important physical processes and features associated with the Southeast coast (adapted from Roberts 2005)

Occasionally huge warm-water rings break off from the main current and slowly spin off into the South Atlantic, carrying heat, salt and some pelagic plants and animals characteristic of the Agulhas Current far into the South Atlantic Ocean (Gründlingh 1988; Luschi *et al.* 2003b; Lutjeharms 2006). This movement of surface waters from the Indian Ocean to the Atlantic is an important component of the global circulation of water, maintaining the input of heat and salt into the Atlantic Ocean. Long-term variations in this input have been linked to global changes in glacial and inter-glacial periods (Peeters *et al.* 2004; Beal *et al.* 2011).

After detaching from the shelf edge at 15° E, the Agulhas Current retroflects and flows eastwards as the Agulhas Return Current (Schumann 1998). The Return Current navigates through shallower features such as the Agulhas Plateau, which result in wide meanders along the eastern edge of the Agulhas Bank in the direction of the equator. These grow downstream and have attendant cyclonic eddies and warm water plumes (Lutjeharms 2006) (see Figure 7-6). These warm water plumes may extend over large parts of the Agulhas Bank and are thought to influence the waters and the biota in bays on the coastline (Goschen & Schumann 1988, 1994).

Currents over the inner and mid-shelf (to depths of 160 m) are weak and variable, with velocities along the eastern half of the South Coast ranging from 25 - 75 cm/sec mid-shelf and 10 - 40 cm/sec nearshore. In common with other western boundary currents, a northward (equator-ward) undercurrent — termed the Agulhas Undercurrent — is found on the continental slope of the East Coast at depths of between 800 m and 3,000 m (Beal & Bryden 1997). Eastward flow may occur close inshore (Boyd *et al.* 1992; Boyd & Shillington 1994), being particularly strong off Gqeberha (Port Elizabeth). Bottom water shows a persistent westward movement, although short-term current reversals may occur (Swart & Largier 1987; Boyd & Shillington 1994; CCA & CSIR 1998). The currents along the Southeast coast are important for the spawning of many pelagic fish species, as eggs and larvae are swept westwards around Cape Agulhas and then northwards up the West Coast to productive nursery areas, returning southwards again as adults to spawn on the Agulhas Bank (Hutchings *et al.* 2002).

The surface waters over most of the project area are a mix of Tropical Surface Water (originating in the South Equatorial Current) and Subtropical Surface Water (originating from the mid-latitude Indian Ocean). The surface waters of the Agulhas Current may be over 25°C in summer and 21°C in winter and have lower salinities than the Equatorial Indian Ocean, South Indian Ocean Central water masses found below. Surface water characteristics, however, vary due to insolation and mixing (Schumann 1998). South Indian Ocean Central Water of 14°C and a salinity of 35.3 ppt occurs below the surface water layers at between 150 - 800 m depth. The deeper waters comprise, from shallowest to deepest, Antarctic Intermediate Water, North Indian Deep Water, North Atlantic Deep Water and Antarctic Bottom Water. Sub-tropical Surface Water of between 15 and 20°C often intrudes into the Agulhas Current at depths of 150 - 200 m from the east (Schumann 1998).

Seasonal variation in temperatures is limited to the upper 50 m of the water column (Gründlingh 1987), increasing offshore towards the core waters of the Agulhas Current. Inshore, waters are warmest during autumn, with warm water tongues found off Cape Recife (near Gqeberha) from January to March, and Knysna from October to January and during August. Warm water also tends to bulge towards Knysna between April and July and during September (Christensen 1980).

7.3.4 Thermal Structure and Variability

The thermal structure of Agulhas Bank waters is mediated by the intrusions of Agulhas Current water at surface and subsurface depths, upwelling and surface heating by insolation. At the inner boundary of the Agulhas current, cold bottom water is advected onto the Agulhas Bank *via* shelf-edge upwelling (Schumann 1998). This process is primarily due to frictional interactions between the Agulhas Current and bottom topography (Hutchings 1994), and is most intense at the eastern boundary of the South Coast, where the cold bottom layer breaks the surface (see Figure 7-7). The core of the upwelling lies at Port Alfred but can extend from the eastern edge of Algoa Bay to Mbashe on the Transkei Coast (Lutjeharms *et al.* 2000b). This upwelling has been associated with large meanders in the Agulhas Current (Jackson *et al.* 2012; Goshen *et al.* 2015; Malan *et al.* 2018). Such shelf-edge upwelling largely defines the strong thermocline and halocline topography that typically develops between the cold bottom water and the sun warmed surface layer during spring (September to November), summer (December to February) and autumn (March to May).

On the central Agulhas Bank, a prominent feature of the midshelf is the ridge of cool water that extends in a north-east (NE) – south-west (SW) direction between the shelf-edge upwelling and inshore waters close to the coast (Swart & Largier 1987; Boyd & Shillington 1994; Schumann 1998; Krug *et al.* 2014). A cool ridge of upwelled water extends in a north-east (NE) – south-west (SW) direction over the mid-shelf regions between the shelf-edge upwelling and inshore waters close to the coast (Swart & Largier 1987; Boyd & Shillington 1994; Schumann 1998). The ridge has its 'base' at the coast between the Robberg Peninsula and Cape St Francis and appears to be most prominent under south-east wind conditions, which cause coastal upwelling in the Knysna region (Walker 1986; Boyd & Shillington 1994; Jury 1994). As easterly winds dominate in the spring-autumn period the cool water ridge is a semi-permanent feature during much of the year. Inshore of the cool water ridge, the thermoclines may be disrupted by coastal upwelling on the lee side of capes under easterly wind conditions (Schumann *et al.* 1982; Walker 1986; Schumann 1998). Such upwelling usually begins at the prominent capes and progresses westwards (Schumann *et al.* 1982;

Schumann *et al.* 1988), and can result in temperature changes of up to 8° C within a few hours (Hutchings 1994). However, northeastward moving upwelling along the coast east of Port Elizabeth has also been reported (Goshen *et al.* 2012).

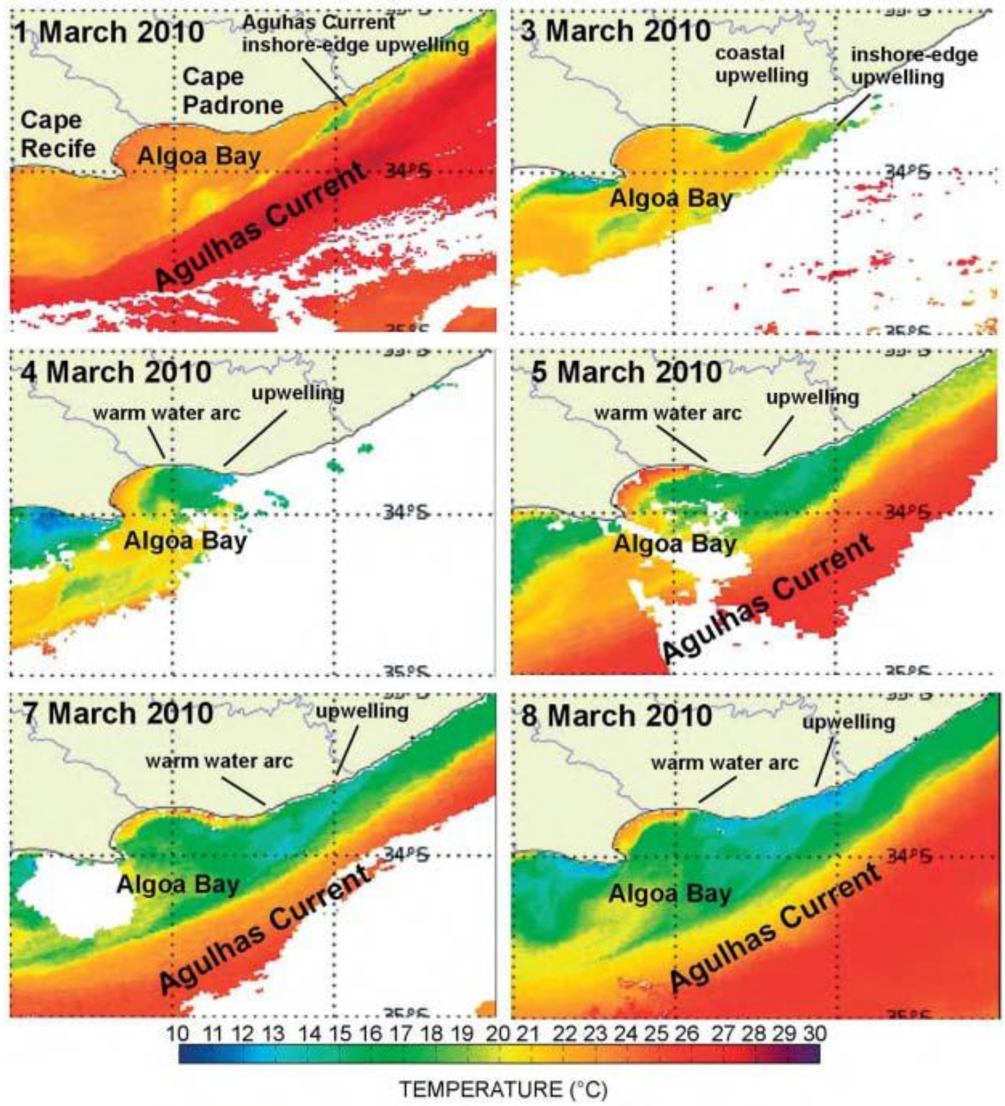


Figure 7-7: Satellite imagery of sea surface temperature between 1 and 8 March 2010, showing an upwelling event. Cool water first emerges at Woody Cape / Cape Padrone and expands into Algo Bay (Source: Hutchings *et al.* 2013)

The thermoclines on the central and eastern Agulhas Bank are resistant to breakdown under strong wind conditions due to their strong gradients and the fact that they are maintained by advection. Temperature gradients are usually around 5-6 °C/10 m close inshore east of Cape Agulhas but reaching extremes of 10°C/10 m around the Alphard Banks and eastwards inshore towards Cape St. Francis. The thermoclines at the eastern edge of the South Coast are located at 20-40 m depth (Largier & Swart 1987). During strong winds, the isothermal upper mixed layer erodes down into the top of the thermocline, thereby increasing the temperature gradient and thus thermocline stability (Carter *et al.* 1987). In contrast, on the outer Bank, offshore of the cold water ridge, thermocline development is weak. In winter (June – August), when westerly winds dominate, the cold bottom water recedes to the shelf break and the nearer shore water column tends to become isothermal (Schumann & Beekman 1984; Boyd & Shillington 1994).

7.3.5 Tides, Wind and Swells

In common with the rest of the southern African coast, tides are semi-diurnal, with a total range of some 1.5 m at spring tide, but only 0.6 m during neap tide periods. Tidal influence in the offshore regions of the Reconnaissance Permit Area will be minimal.

Along the Eastern Cape, westerly winds predominate in winter, frequently reaching gale force strengths. During summer, easterly wind directions increase markedly resulting in roughly similar strength/frequency of east and west winds during that season (Jury 1994) (Figure 7-8). The strongest winds are observed at capes, including Infanta, Robberg and Cape Recife (Jury & Diab 1989). Calm periods are most common in autumn (CCA & CSIR 1998). At Cape Recife, the winds have a variable west south-westerly component, with the highest frequency of south westerly wind speeds greater than 10.5 m/sec occurring during September and October (Cliff 2013).

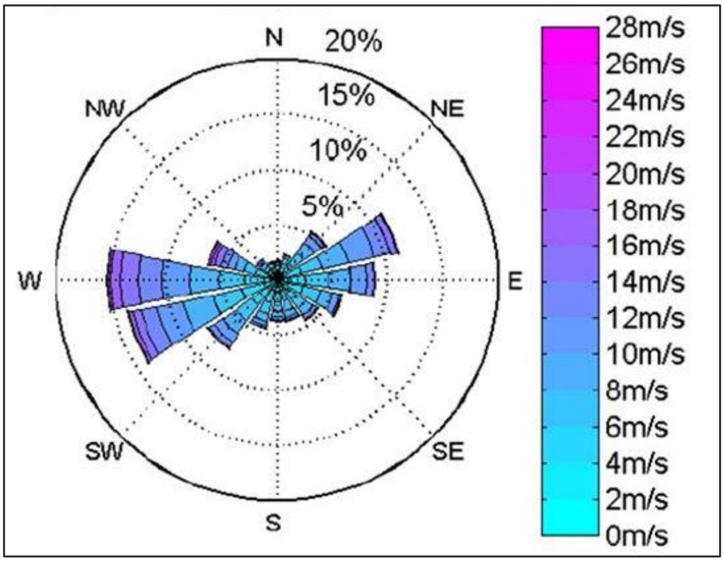


Figure 7-8: Wind rose for a location at approximately 35°40’S, 23°20’E for the period 1950 – 2019 (ACTIMAR).

On the Southeast coast, the majority of waves arrive from the south-west quadrant (Whitefield *et al.* 1983), dominating wave patterns during winter (June – August) and spring (September – November) (Carter & Brownlie 1990). Waves from this direction frequently exceed 6 m (Swart & Serdyn 1981, 1982) and can reach up to 10 m (Heydorn 1989) (Figure 7-9). During summer, easterly wind-generated ‘seas’ occur (Heydorn & Tinley 1980; Heydorn 1989; Carter & Brownlie 1990).

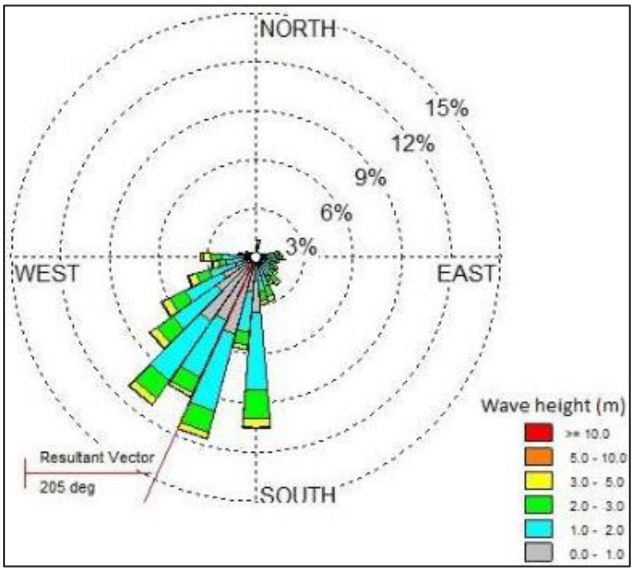


Figure 7-9: Wave rose showing the direction, proportion and magnitude of waves experienced offshore of the St. Francis- Algoa Bay region (Source: SADCO Voluntary Observing Ships for a 30-year period).

7.3.6 Nutrient Distributions

As the Agulhas Current originates in the equatorial region of the western Indian Ocean its waters are typically blue and clear, with low nutrient levels. In coastal waters, freshwater seepage from dune aquifers on the south coast constitutes an important source of nitrogen for surf-zone phytoplankton (particularly accumulation-forming diatoms) (Campbell & Bate 1991a).

The distribution of nutrients over the Agulhas Bank demonstrates the existence of three distinct nutrient provinces (Lutjeharms *et al.* 1996). The western Agulhas Bank is associated with higher nutrient values driven by coastal upwelling, whereas the shelf edge of the eastern Agulhas Bank is characterised by nutrient-poor surface waters and nutrient-rich bottom water, while the major part of the eastern Agulhas Bank is under the influence of the far-eastern Agulhas Bank upwelling cell, which provides nutrient rich bottom water. Seasonal changes in the nutrient distribution over the whole Agulhas Bank is driven by strong vertical stratification in the austral summer, and vertical mixing of the water column in winter. Nutrient concentrations in surface waters during summer are characteristic of Subtropical Surface Water while those in bottom waters are derived from South Indian and South Atlantic Central Water (Lutjeharms *et al.* 1996).

Nitrate-nitrogen concentrations in Agulhas Current source water range from 7-10 µM/ℓ, while those of sub-thermocline water may be up to 20 µM/ℓ (Carter *et al.* 1987). During winter, when the water column is well mixed, bottom nutrients mix upwards and nutrient concentrations in the surface waters are higher than in summer (CCA & CSIR 1998). On the eastern Agulhas Bank, the shear-edge eddies (cold-core eddies in Figure 8) that result in the shelf-edge upwelling are are responsible for enrichment in productivity (Koné *et al.* 2005), whereas further to the west a regenerative regime dominates (Lebourges-Dhaussy *et al.* 2009).

Primary production is nitrogen-limited in the upper layers of the euphotic zone (to ~30 m depth), but light-limited in the sub-surface chlorophyll maximum layer at depths of between -20 m to -30 m (Probyn & Lucas 1987). It is unlikely that phosphorous would ever become limiting, except perhaps at the primary production maximum. Much of the ammonia and phosphorous needed for phytoplankton growth in the surface layers is supplied by heterotrophic microflagellates (1 - 5 µm) and nanoplankton (1 - 15 µm). However, size-related differences in the relative importance of the microplanktonic groups to the immobilization and recycling of different nutrients occur (Probyn & Lucas 1987). On the Agulhas Bank, the 1 – 5 µm size class were found to be a proportionally greater sink for phosphorous than for ammonium, immobilising on average 36% of the total phosphorous assimilated (Probyn & Lucas 1987). However, microplankton uptake and regeneration of both ammonium and phosphorus were approximately in balance, indicating that variations in assimilation ratios were the result of heterotrophic excretory activity. Here, picoplankton in the 15 – 200 µm size range were more important in the regeneration of phosphorous than of ammonium, the latter primarily being regenerated by the nanoplankton (1 – 15 µm).

In summary, nutrient concentrations in the surface waters of the Reconnaissance Permit Area are typically low, with primary production being nitrogen-limited. The strong vertical stratification that develops during summer, breaks down during winter when shelf-edge upwelling results in the mixing of the water column bringing the nutrient rich bottom waters to the surface.

7.3.7 Turbidity

Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particulate matter. Total Suspended Particulate Matter (TSPM) can be divided into Particulate Organic Matter (POM) and Particulate Inorganic Matter (PIM), the ratios between them varying considerably. The POM usually consists of detritus, bacteria, phytoplankton and zooplankton, and serves as a source of food for filter-feeders. On the Agulhas Bank, seasonal microphyte production associated with upwelling events, both inshore and along the shelf edge, will play an important role in determining the concentrations of POM. PIM, on the other hand, is primarily of geological origin consisting of fine sands, silts and clays. The PIM loading in nearshore waters is strongly related to natural riverine inputs and resuspension and bedload transport of seabed sediments. As there are no major rivers entering the Southeast coast, PIM loading in the offshore regions of the Reconnaissance Permit Area would be negligible. Offshore of the continental shelf, and within the Reconnaissance Permit Area, the oceanic surface waters are clear and background concentrations are typically <1 mg/ℓ (Emery *et al.* 1973).

A feature of continental shelf waters off the Southeast coast is the benthic nepheloid layer (Zoutendyk & Duvenage 1989; Dorfler 2002). This layer can be up to 10 m thick and may have TSPM values of up to 38 mg/ℓ. It is usually located below the thermocline at a depth of between 20 m and 30 m (Zoutendyk & Duvenage 1989). Initially thought to be associated with the mud belts on the inner Agulhas Bank near Mossel Bay, the nepheloid layer has recently been found associated with the Cape St Francis and Cape Infanta areas (Dorfler 2002) (see Figure 7-10), as well as at about 150 m depth on the continental slope between Knysna and Cape St Francis (Jackson *et al.* 2012). Although thought to originate from detrital fallout from surface waters, Zoutendyk & Duvenage (1989) reported that POM contributed <10% of the TSPM in the turbid layer. The dynamics of the nepheloid layer are complex, and appear to be driven by a combination of wind, waves and currents. Turbidity events, however, not only occur during upwelling but also in isothermal conditions, with down-welling and turbidity being correlated in deeper waters (Dorfler 2002). The benthic nepheloid layer plays a significant role in the benthic community structure of nearshore reefs (Zoutendyk & Duvenage 1989) and is thought to influence the spawning success of squid in Eastern Cape inshore waters (Dorfler 2002). The benthic nepheloid layer is primarily located inshore of the Reconnaissance Permit Area.

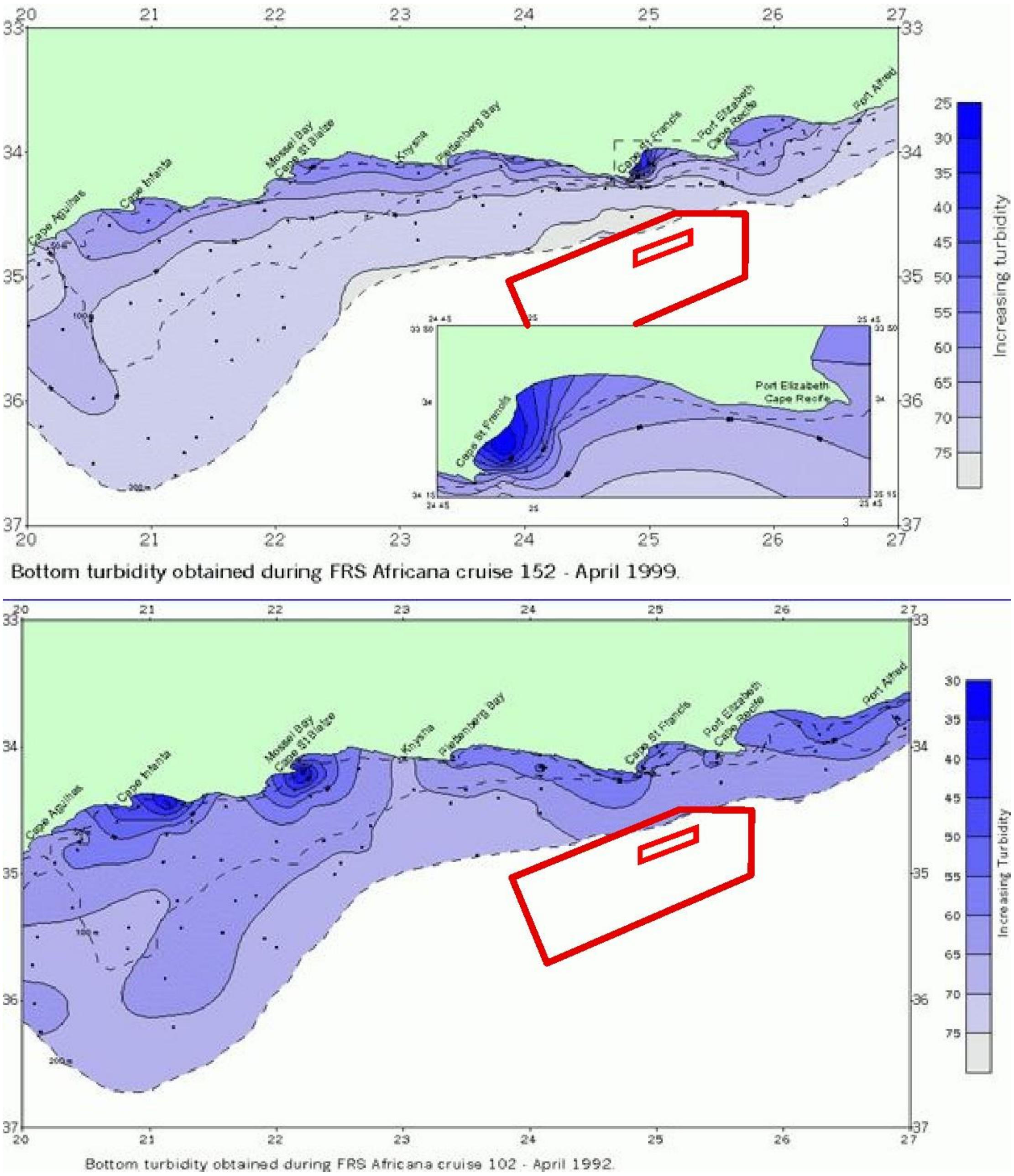


Figure 7-10: The Reconnaissance Permit Area (red polygon) in relation to benthic turbidity events on the Eastern Agulhas Bank in April 1992 (bottom) and April 1999 (top) (adapted from Dorfler 2002). The turbidity scales are in Nephelometric Turbidity Units (NTU).

7.3.8 Sedimentary Phosphates

Phosphorite, or phosphate-rich rock is defined as sedimentary rock typically containing between 5%-20% phosphate. In the marine environment, it occurs either as a nodular hard ground capping of a few metres thick (see Figure 7-11, left) or as series of unconsolidated sediments (Morant 2013). Several types of sedimentary phosphates occur offshore and onshore in South Africa, the largest of which is the diagenetic replacement resource on the Agulhas Bank. These replacement phosphate resources occur as near-continuous ‘pavements’ or cappings of limestones at depths between 200 m and 500 m on the continental shelf between Cape Agulhas and Cape Recife, covering an approximate area of 21 500 km^2. Further sporadic phosphate mantles over the continental shelf are known to occur from Lamberts Bay, north to the mouth of the Orange River (see Figure 7-11, right).

The "open shelf" phosphorite deposits, were formed during several episodes over the last 1.7 – 65 million years. They originated from the precipitation of phosphate in the form of calcium phosphate in an environment of intense upwelling and high biological activity along the continental margin of South Africa. The upwelling resulted in a change in temperature and pressure of the phosphate-laden oceanic waters, thus lowering the solubility of the phosphate salts they contained, and consequently precipitating the phosphates (in the form of apatite) over the continental shelf to form phosphatic packstones and colitic pellets at the sediment-water interface. The precipitation is facilitated by the decay of siliceous phytoplankton. The precipitated phosphates subsequently combined with calcium, derived from the disaggregation of calcareous foraminiferal and coccolithophorid debris on the outer continental shelf, to form phosphatised lime-rich muds. These muds subsequently lithified or consolidated through their replacement by secondary calcium phosphate (francolite), to form a near continuous hard capping of phosphate rock over the seafloor sediments (Birch 1990; Morant 2013).

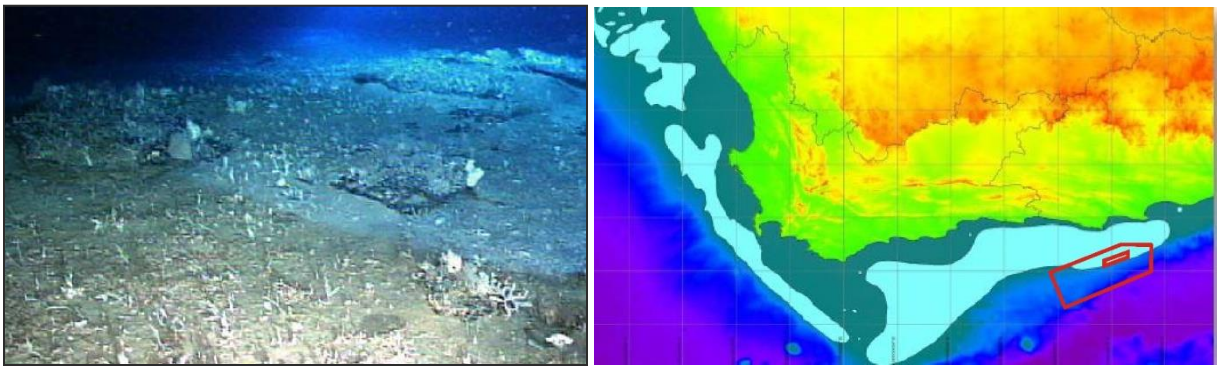


Figure 7-11: Phosphorite hard ground (left) and its distribution (cyan) on the South African continental shelf (right) in relation to the Reconnaissance Permit Area (red polygon) (adapted from Morant 2013).

During repeated sea level changes, the phosphate-rich rocks were extensively re-worked, eroding the hard capping pavements thereby liberating the heavy phosphate-bearing minerals (mainly glauconite and apatite) and concentrating them in the overlying unconsolidated sediments. Migrating zones of deposition and erosion occurred during repeated transgressive/regressive cycles.

Renewed carbonate deposition and a further period of phosphatization occurred when the deposition zones migrated back across the shelf in response to a rising sea level, thereby incorporating boulders and cobbles of phosphatized limestone and glauconite left behind after the previous regressive cycle into the second-generation phosphatic deposits, forming conglomeratic rock types. Two main periods of phosphatization have been identified, namely the Middle Miocene (ca 15 Ma), and possibly the Upper Eocene (ca 37 Ma) (Birch 1990; Morant 2013).

The ore bearing lithologies comprise three non-conglomeratic and two conglomeratic rock types. The non-conglomeratic types are phosphatized foraminiferal lime packstones (a type of limestone), which are either poor in glauconite and quartz, rich in goethite, or highly glauconitic. The first conglomeratic type is also rich in glauconite, but contains pebble inclusions of phosphatized foraminiferal limestone. The second conglomeratic type is distinguished by its low glauconite content and high macrofossil and goethite abundance. The depth of mineralization within the conglomeratic ores is typically restricted to the upper few metres of sediment. The phosphate-rich rocks on the Agulhas Bank are estimated to have an average

P_2O_5 content of 16.2%. With an area of 35 000 million m^2, an average thickness of 0.5 m, the Agulhas Bank offshore phosphate deposits are estimated to contain in the order of 5 000 million tons of P_2O_5 (Birch 1990).

Although not mined at present, an application to prospect for marine phosphate in the Outeniqua West Licence Area, Offshore Mossel Bay, was submitted to the Department of Mineral Resources by Diamond Fields International Ltd in June 2013 (Morant 2013). However, following the moratorium on marine phosphate mining in Namibia and the conclusion that marine mining of phosphate resources in South Africa was unwarranted (Vidima & von Blottnitz 2016; see also Biccard *et al.* 2018), there has been no further development in this regard.

7.4 BIOLOGICAL OCEANOGRAPHY

7.4.1 Introduction

Biogeographically the majority of the study area falls into the Southwest Indian Deep Ocean ecoregion, with only the inshore portions of the Reconnaissance Permit application area falling into the Agulhas ecoregion (Figure 7-12) (Sink *et al.* 2019). The Area of Interest is located beyond the 200 m depth contour and therefore comprises primarily deepwater benthic habitats and the water body. The ecosystem threat status of the benthic habitat types and the offshore pelagic habitat types along most of the Southeast coast, and within most of the Reconnaissance Permit Area have been rated as 'Least Threatened' reflecting the great extent of these habitats within the South African Exclusive Economic Zone (EEZ) (Sink *et al.* 2012) (see Figure 7-13). However, the Agulhas Coarse Sediment Shelf Edge, Agulhas Sandy Outer Shelf, Agulhas Upper Canyon and Kingklip Koppies ecosystem types are considered 'Vulnerable' and the Kingklip Ridge ecosystem type is considered 'Endangered' (see Figure 7-13 and Figure 7-14).

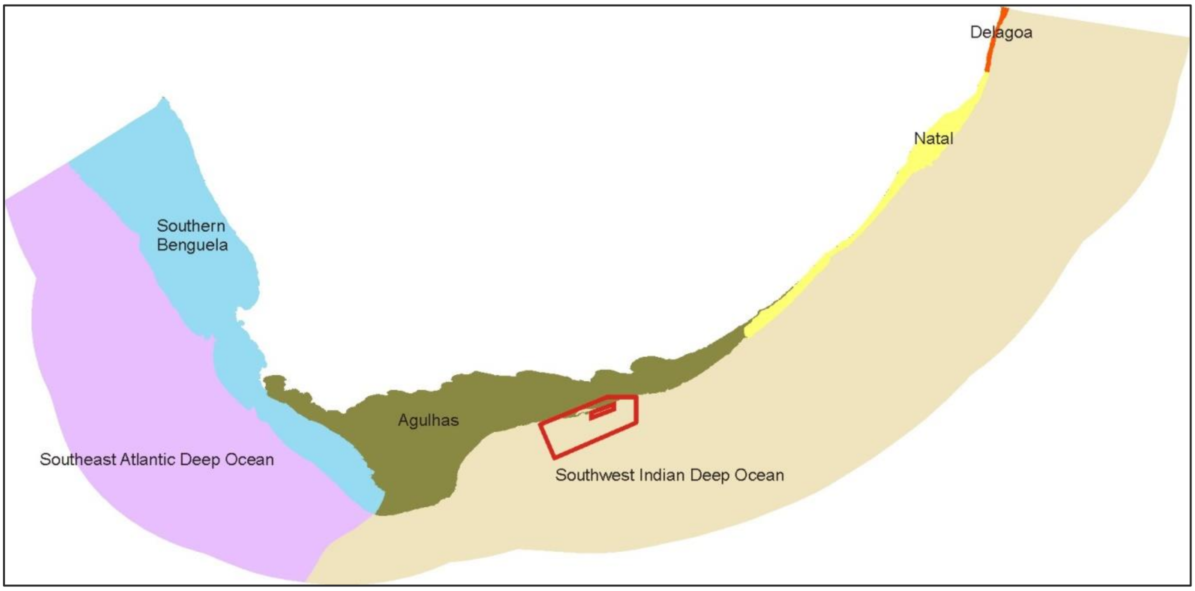


Figure 7-12: The Reconnaissance Permit Area in relation to the South African inshore and offshore ecoregions (adapted from Sink *et al*. 2019)

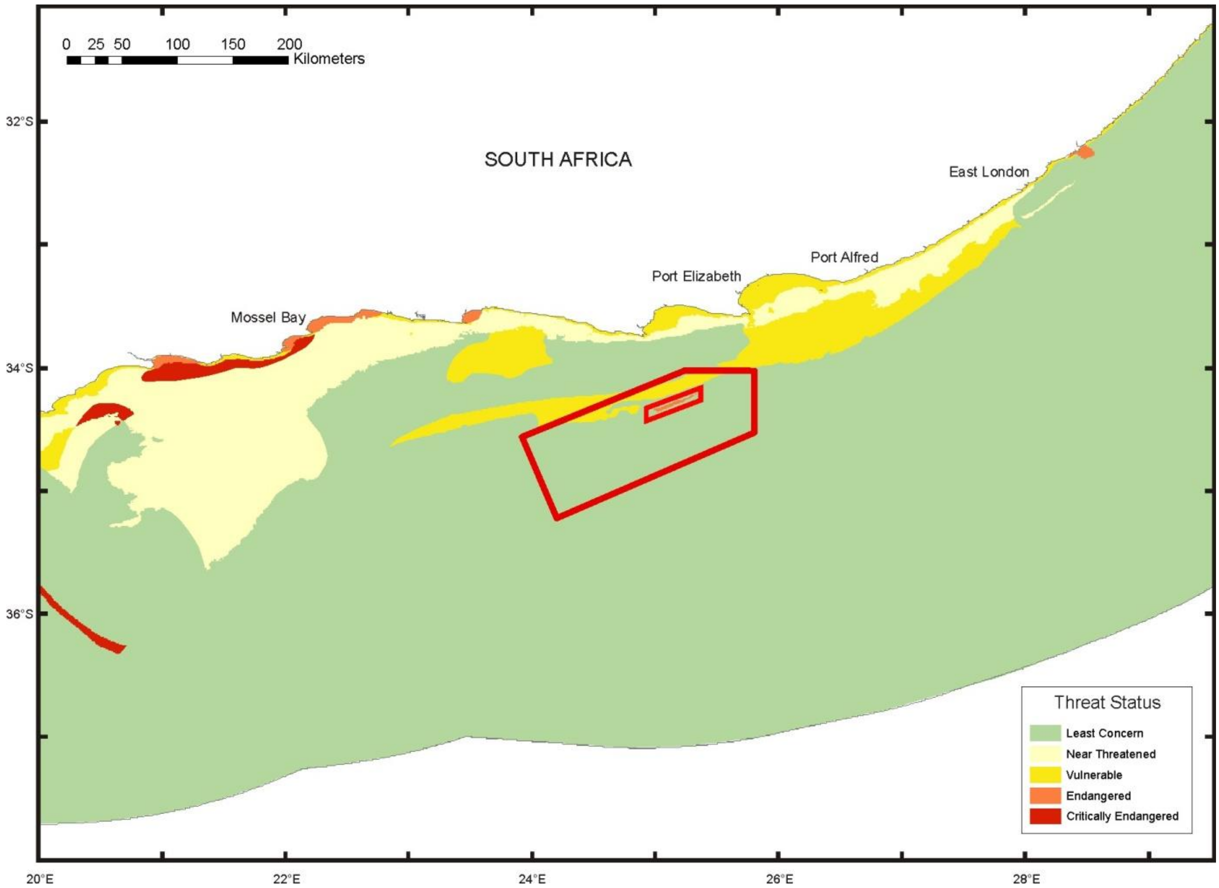


Figure 7-13: The Reconnaissance Permit Area (red polygon) in relation to the ecosystem threat status for coastal and offshore benthic habitat types (adapted from Sink *et al.* 2019)

Due to limited opportunities for sampling, information on the pelagic and demersal communities of the continental slope, lower bathyal and abyss are very poorly known. Consequently, much of the information on the baseline environment provided below relates to the continental shelf (<200 m) regions, which fall within the Agulhas Ecoregion (see Figure 7-12).

The benthic communities within these deepwater habitats are generally ubiquitous throughout the southern African Southeast Coast region, being particular only to substratum type and/or depth zone. They consist of many hundreds of species, often displaying considerable temporal and spatial variability. The biological communities 'typical' of each of these habitats are described briefly below, focusing both on dominant, commercially important and conspicuous species, as well as potentially threatened or sensitive species, which may be affected by the speculative seismic survey.

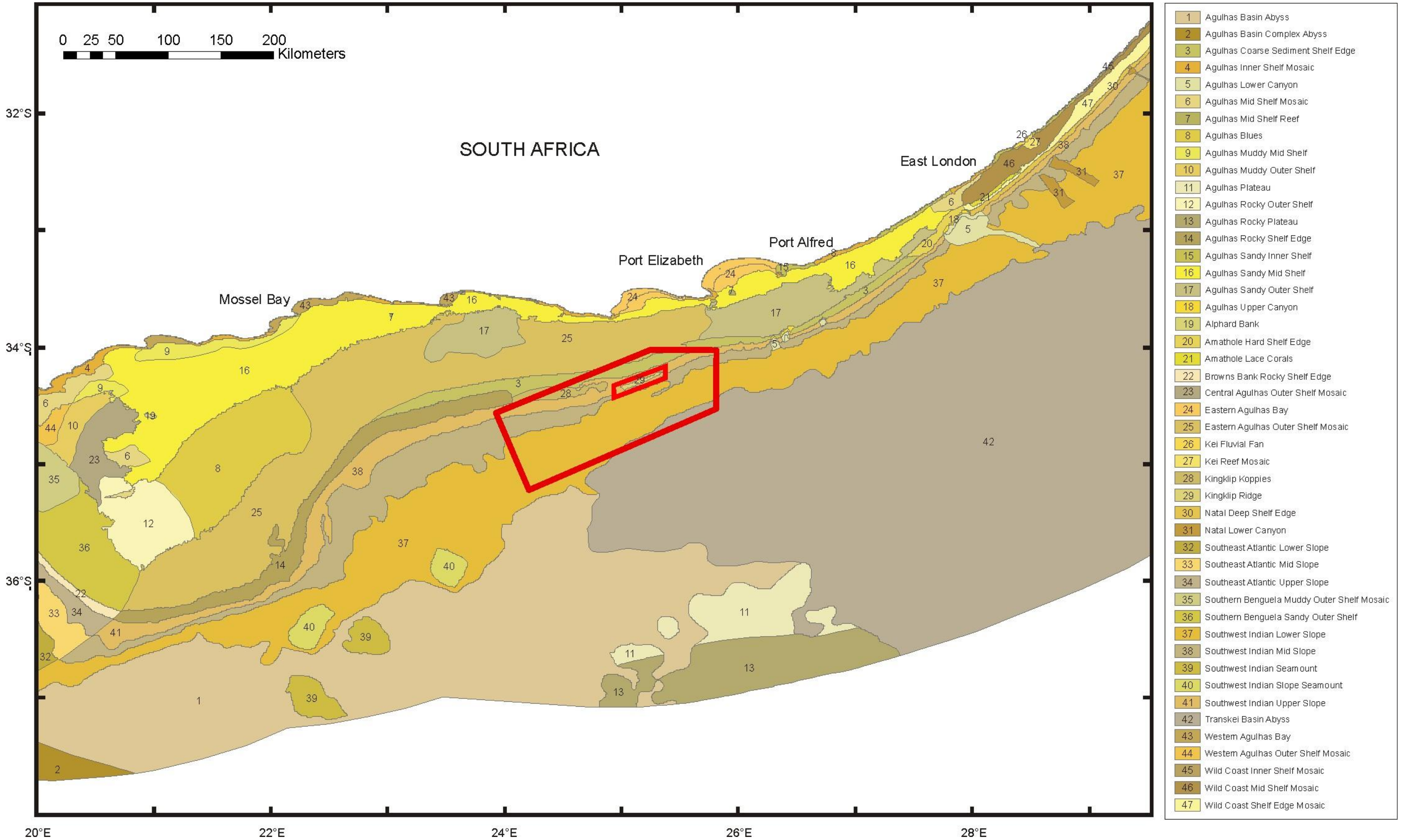


Figure 7-14: The Reconnaissance Permit Area (red) in relation to ecosystem types along the Southeast coast (adapted from Sink *et al.* 2019)

7.4.2 Plankton

The nutrient-poor characteristics of the Agulhas Current water are reflected in comparatively low primary productivity on the continental shelf inshore throughout most of the Reconnaissance Permit area. Mean *chlorophyll a* concentrations average between 1-2 mg/m^3 over the whole year in the top 30 m of the water column. *Chlorophyll a* concentrations vary seasonally, being minimal in winter and summer (<1 – 2 mg/m^3), and maximal (2 - 4 mg/m^3) in spring and autumn (Brown 1992). On the South Coast, lower concentrations are partly due to nutrient limitation due to the strong summer thermoclines or light limitations due to deep mixing in winter (Probyn *et al.* 1994), but if the thermocline falls within the 1% light depth, phytoplankton biomass can increase dramatically, with sub-surface chlorophyll concentration maxima often being in excess of 10 mg/m^3 (Carter *et al.* 1987; Hutchings 1994). Chlorophyll concentrations can also be high where upwelling occurs at the coast (Probyn *et al.* 1994). Along the eastern half of the South Coast (Knysna to Cape Padrone), phytoplankton concentrations are usually higher than further west, and the phytoplankton comprises predominantly large cells (Hutchings 1994). The South Coast also boasts several beaches that support surf diatoms *Anaulus*, which are globally rare (Campbell 1996; Campbell & Bate 1991b). These accumulations are visible in the surf as brown patches, forming only on beaches with wide surf zones of medium to high wave energy (e.g. Algoa Bay and St Francis Bay inshore of the Reconnaissance Permit Area), with well-developed rip currents, and that are adjacent to dunes that have nutrient-rich aquifers (Campbell & Bate 1997). Further offshore throughout the project area, the pelagic environment is characterised by very low productivity, with the low variability in water-column temperature resulting in very low frequency of chlorophyll fronts.

Zooplankton and ichthyoplankton abundances in the project area will reflect localised areas of higher primary productivity (Oliff 1973; Probyn *et al.* 1994). Zooplankton communities have comparatively high species diversity (De Decker 1984). Biomass of mesozooplankton increases from west (~0.5-~1.0 gC/m^2) to east (~1.0-~2.0 gC/m^2), mirroring the eastward increase in *chlorophyll a* concentrations, peaking on the central and eastern Agulhas Bank during summer in association with the subsurface ridge of cool upwelled water. Standing stocks of mesozooplankton (>200 µm) along the eastern half of the South Coast ranges from 3 – 6 gC/m^2, and is dominated by the calanoid copepod *Calanus aghulensis*, which associates with shallow thermoclines and the mid-shelf cool water ridge (Verheye *et al.* 1994). This species may contribute up to 85% of copepod biomass in the region, and is an important food source for pelagic fishes (Peterson *et al.* 1992). Macrozooplankton (>1,600 µm) standing stocks are estimated to be 0.079 gC/m^2 between Cape Agulhas and Cape Recife (Verheye, unpublished data). Dense swarms of euphausiids dominate this zooplankton component, and form an important food source for pelagic fishes (Cornew *et al.* 1992; Verheye *et al.* 1994).

A variety of pelagic fish species, including anchovy, round herring and horse mackerel, spawn east of Cape Agulhas between the shelf-edge upwelling and the cold-water ridge (Crawford 1980; Hutchings 1994; Roel & Armstrong 1991; Hutchings *et al.* 2003) (see Figure 7-15 and Figure 7-16). Horse mackerel spawn over the east/central Agulhas Bank during winter months, while anchovies spawn on the whole Agulhas Bank, with spawning peaking during summer (November–December). Sardines spawn on the whole Agulhas Bank during November, but generally have two spawning peaks, in early spring and autumn, on either side of the peak anchovy spawning period. The eggs and larvae spawned in this area are thought to largely remain on the Agulhas Bank, although some may be carried to the West Coast or be lost to the Agulhas Current retroflection (Hutchings 1994; Duncombe Rae *et al.* 1992; Hutchings *et al.* 2003). Pilchards also spawn on the Agulhas Bank during spring and summer (Crawford 1980), with recruits being found inshore along the South Coast and adults moving eastwards and northwards after spawning. After the "sardine run" in June and July (see later), pilchard eggs occur in inshore waters along the Eastern Cape and the southern KwaZulu-Natal coast (Anders 1975; Connell 1996). There is also recent evidence for winter (June-July) spawning of sardines on the central Agulhas Bank in patches of high concentrations of phytoplankton (van der Lingen *et al.* 2006). The sardine and other clupeid eggs persist in inshore waters throughout winter – spring, before disappearing in early summer as the shoals break up and move northwards and further offshore (Connell 2010). Anchovy (*Engraulis japonicus*) eggs have also been reported in the water column during December extending from Gqeberha eastwards to as far north as St Lucia (Anders 1975).

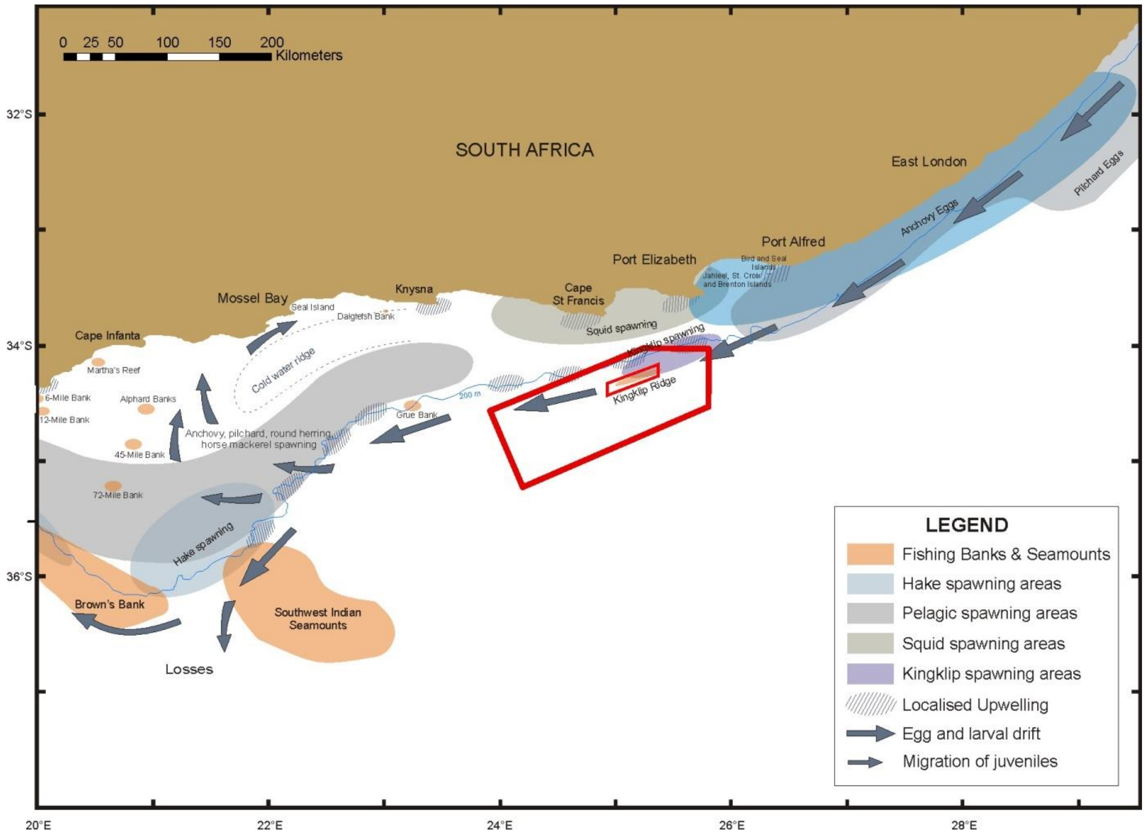


Figure 7-15: The Reconnaissance Permit Area (red polygon) in relation to important pelagic and demersal fish and squid spawning areas (after Anders 1975; Crawford *et al.* 1987; Hutchings 1994).

Demersal species that spawn along the Southeast coast include the cape hakes and kingklip. Spawning of the shallow-water hake occurs primarily over the shelf (<200 m) whereas that by the deep-water hake occurs off the shelf. Although hake are reported to spawn throughout the year (Strømme *et al.* 2015), they move to the western Agulhas Bank and southern West Coast to spawn in late winter and early spring (key period), when offshore Ekman losses are at a minimum. Their eggs and larvae drift northwards and inshore to the West Coast nursery grounds, where the greatest concentration of eggs and larvae occurs between September – October (Stenevik *et al*. 2008). **The closest hake spawning areas are located inshore and northeast of the survey area of interest.**

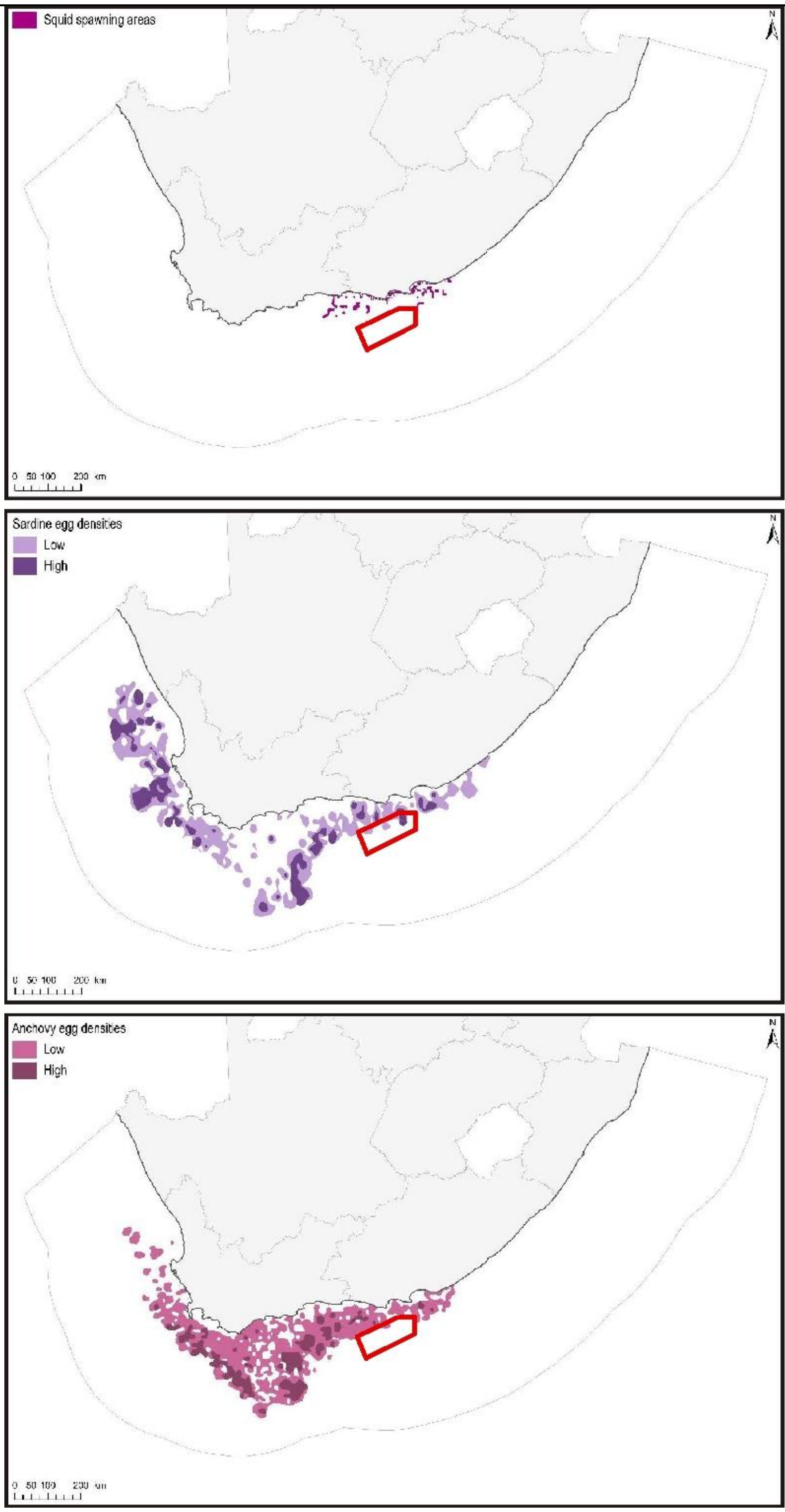


Figure 7-16: The Reconnaissance Permit Area (red polygon) in relation to squid spawning areas (top), and the distribution of sardine (middle) and anchovy (bottom) spawning areas (adapted from Harris *et al*. 2022).

Similarly, kingklip aggregate to spawn in an isolated area off the shelf edge to the south of St Francis and Algoa Bay referred to as the 'spawning box' (Shelton 1986; Hutchings 1994) (see Figure 7-15).

Spawning starts from August through to September and is habitat associated, occurring mostly in areas dominated by deep-water corals at depths of between 300 m and 500 m. The 'spawning box' is closed to fishing over the spawning period (Leslie 2004). Squid (*Loligo* spp.) spawn principally in the inshore waters (<50 m) between Knysna and Gqeberha, reaching a peak between September and December, with larvae and juveniles spreading westwards (see Figure 7-16). Their distribution and abundance are highly erratic and linked to temperature, turbidity, and currents (Augustyn *et al.* 1994). **The survey area of interest only overlaps with the kingklip spawning area. With the proposed survey planned to commence at the earliest in January 2024, it would not overlap with any key spawning events of any of the commercially fished species.**

The inshore area of the Agulhas Bank, especially between the cool water ridge and the shore, serve as an important nursery area for numerous linefish species (e.g. dusky kob *Argyrosomus japonica*, elf *Pomatomus saltatrix*, seventy-four *Polysteganus undulosus*, steenbras *Petrus rupestrus*, black musselcracker *Cymatoceps nasutus*, leervis *Lichia amia*, white musselcracker *Sparodon durbanensis*, silverbream *Rhabdosargus holubi,* strepie *Sarpa salpa,* geelbek *Atractoscion aequidens,* carpenter *Argyrozona argyrozona* and 80uryale *Lichia amia*) (Wallace *et al.* 1984; Smale *et al.* 1994). Adults undertake spawning migrations along the Southeast coast into KZN waters during the winter months (Van der Elst 1976, 1981; Griffiths 1987; Garret 1988; Beckley & van Ballegooyen 1992). Following spawning during spring and summer (November to April), the eggs and larvae are dispersed southwards by the Agulhas Current, with juveniles occurring on the inshore Agulhas Bank (Van der Elst 1976, 1981; Garret 1988). In the case of the carpenter, a high proportion of the reproductive output comes from the central Agulhas Bank and the Tsitsikamma MPA Section of the Garden Route National Park, and two separate nursery grounds appear to exist, one near Port Elizabeth and a second off the deep reefs off Cape Agulhas, with older fish spreading eastwards and westwards (van der Lingen *et al.* 2006).

The inshore portions of the project area thus overlap with major fish spawning and migration routes, and **ichthyoplankton abundance in inshore waters over the continental shelf (<200 m) is likely to be seasonally high**. Larval concentrations vary between 0.005 and 4.576 larvae/m^3 decreasing rapidly with distance offshore (Beckley & Van Ballegooyen 1992). **In the offshore portion of the project area, ichthyoplankton abundance is, however, expected to be low.**

7.4.3 Benthic and Pelagic Invertebrate Communities

The seabed communities in the Reconnaissance Permit application area lie within the Agulhas sub-photic and continental slope biozones, which extend from a 30 m depth to the shelf edge, and beyond to the lower slope, respectively. These biozones lie within the 'minimal protected category' (1 - 5%) and portions of the shelf area were defined as 'Vulnerable', 'Endangered' or 'Critically Endangered' as existing MPAs were insufficient for conserving marine habitats and their associated biodiversity (Lombard *et al.* 2004; Sink *et al.* 2012a). With the establishment of a network of offshore MPAs in 2019 (see Figure 7-46), the ocean protection within the South African EEZ was increased to 5% resulting in a re-assessment of the ecosystem threat status in the 2018 National Biodiversity Assessment (Sink *et al.* 2019). Whereas the majority of the benthic habitats in the Reconnaissance Permit area now falls within the 'Least Threatened' category, the inshore portions of the Reconnaissance Permit area along the shelf edge are still considered 'Vulnerable' with the Kingklip Ridge habitat being rated as

'Endangered' due to the presence of potentially vulnerable deepwater coral and bryozoan species (see Figure 7-13). This unique ridge feature on the upper slope in the Southwest Indian Deep Ocean ecoregion, is 40 km long but only 500 m wide and rises from -700 m to -350 m. The area inside of the ridge forms part of the kingklip spawning aggregation area (Sink *et al.* 2019). Similarly, the coastal area in the vicinity of Mossel Bay has been recognised as one of seven areas in the biozone in need of additional protection based on the high endemism known to occur there and consequently much of the inshore regions between Wilderness and Cape Infanta have been rated as 'Endangered' and 'Critically Endangered' (see Figure 7-13). These, however, lie over 200 km inshore and to the northwest of the Reconnaissance Permit area. Extractive utilisation of marine resources has been identified as the greatest threat to biodiversity in these biozones (Lombard *et al.* 2004; Sink *et al.* 2012a).

The benthic biota of the offshore substrates constitutes invertebrates that live on (epifauna), or burrow within (infauna), the sediments, and are generally divided into megafauna (animals >10 mm), macrofauna (>1 mm) and meiofauna (<1 mm). The structure and composition of benthic communities is primarily a function of abiotic factors such as water depth and substratum (e.g. sediment grain size in unconsolidated sediments; reef structure/topography in areas of hard ground), but others such as current velocity and organic content abundance also play a role (Snelgrove & Butman 1994; Flach & Thomsen 1998; Ellingsen 2002). Further shaping of community composition is derived from biotic factors such as predation, food availability, larval recruitment and reproductive success. In unconsolidated sediments, the high spatial and temporal variability of these factors, results in seabed communities being both patchy and variable. In nearshore waters (<50 m) where sediment composition is naturally patchy, and significant sediment movement may be induced by the dynamic wave and current regimes (Fleming & Hay 1988), the benthic macrofauna are typically adapted to frequent disturbance. In contrast, further offshore (>100 m depth) where near-bottom conditions are more stable, the macrofaunal communities will primarily be determined by sediment characteristics and depth.

The seabed communities in the Reconnaissance Permit Area primarily lie on the continental slope within the Southwest Indian Deep Ocean ecoregion, with only minimal overlap over the Agulhas shelf ecoregion. To date there have been no studies examining connectivity between slope, plateau or abyssal ecosystems in South Africa and there is thus limited knowledge on the benthic biodiversity of all three of these broad ecosystem groups in South African waters (Sink *et al.* 2019). There is no quantitative data describing bathyal ecosystems in South Africa and hence limited understanding of ecosystem functioning and sensitivity (Anderson & Hulley 2000).

The concept of a 'Vulnerable Marine Ecosystem' (VME) centres upon the presence of distinct, diverse benthic assemblages that are limited and fragmented in their spatial extent, and dominated (in terms of biomass and/or spatial cover) by rare, endangered or endemic component species that are physically fragile and vulnerable to damage (or structural/biological alteration) by human activities (Parker *et al.* 2009; Auster *et al.* 2011; Hansen *et al.* 2013). As the component species of VMEs typically exhibit traits of slow growth, late maturity, low fecundity, unpredictable recruitment and high longevity, VMEs are characterised by sensitivity to changes in environmental conditions and slow recovery from damage (FAO 2008).

VMEs are known to be associated with higher biodiversity levels and indicator species that add structural complexity, resulting in greater species abundance, richness, biomass and diversity compared to surrounding uniform seabed habitats (Buhl-Mortensen *et al.* 2010; Hogg *et al.* 2010; Barrio Froján *et al.* 2012; Beazley *et al.* 2013, 2015). Compared to the surrounding deep-sea environment, VMEs typically form biological hotspots with a distinct, abundant and diverse fauna, many species of which remain unidentified. Levels of endemism on VMEs are also relatively high compared to the deep sea. The coral frameworks offer refugia for a great variety of invertebrates and fish (including commercially important species) within, or in association with, the living and dead coral framework thereby creating spatially fragmented areas of high biological diversity. The skeletal remains of Scleractinia coral rubble and Hexactinellid poriferans can also represent another important deep-sea habitat, acting to stabilise seafloor sediments allowing for colonisation by distinct infaunal taxa that show elevated abundance and biomass in such localised habitats (Bett & Rice 1992; Raes & Vanreusel 2005; Beazley *et al.* 2013; Ashford *et al.* 2019).

VMEs are also thought to contribute toward the long-term viability of a stock through providing an important source of habitat for commercial species (Pham *et al.* 2015; Ashford *et al.* 2019). They can provide a wide range of ecosystem services ranging from provision of aggregation- and spawning sites to providing shelter from predation and adverse hydrological conditions (Husebø & Nøttestad *et al.* 2002; Krieger & Wing, 2002; Tissot *et al.*, 2006; Baillon *et al.* 2012; Pham *et al.* 2015). Indicator taxa for VMEs are also known to provide increased access to food sources, both directly to associated benthic fauna, and indirectly to other pelagic species such as fish and other predators due to the high abundance and biomass of associated fauna (Krieger & Wing, 2002; Husebø & Nøttestad *et al.* 2002; Buhl-Mortensen *et al*. 2010; Hogg *et al.* 2010; Auster *et al.* 2011).

VME frameworks are typically elevated from the seabed, increasing turbulence and raising supply of suspended particles to suspension feeders (Krieger & Wing 2002; Buhl-Mortensen & Mortensen 2005; Buhl-Mortensen *et al.* 2010). Poriferans and cold-water corals further shown to provide a strong link between pelagic and benthic food webs (Pile & Young 2006., Cathalot *et al.* 2015). VMEs are increasingly being recognised as providers of important ecosystem services due to associated increased biodiversity and levels of ecosystem functioning (Ashford *et al.* 2019).

As information on offshore benthic invertebrate communities occurring along the Southeast coast is sparse, and no formally, peer-reviewed literature is currently available, PetroSA funded a study through a sponsorship agreement with WWF, to assess the offshore benthic biodiversity on the Agulhas Bank (Sink *et al.* 2010). Much of the description below is taken from that report, and from the specialist reports by Quick & Sink (2005) and Shipton & Atkinson (2010) compiled as part of the EIAs for the South Coast Gas project and development of the F-O Gas Field off Mossel Bay, respectively.

These authors categorised the benthic communities expected to occur on the Agulhas Bank, inshore and to the west of the Reconnaissance Permit Area, into four main groups, based on the distribution of the main seabed types identified by Dingle *et al.* (1987).

These were:

- **Terrigenous muds**: although no studies have specifically examined the biota of this habitat type in South Africa, a high biodiversity of benthic macrofauna (polychaetes, nematodes, amphipods, isopods, molluscs, echinoderms etc.) is expected.

- **Relict sands**: sandy habitats of varying grain size typically provide relatively stable environments and are thus able to support highly diverse benthic communities, including seapens, molluscs, echinoderms (brittle stars and heart urchins), cerianthids (tube anemones), sponges and the deep-water rock lobster *Palinurus gilchristi*. A wide diversity of infauna also occurs, including polychaetes, amphipods, isopods, molluscs, etc.
- **Pre-Mesozoic basement rock:** this low profile habitat typically hosts sponges, black corals, gorgonians and ascidians (Sink *et al.* 2006). Although often covered in a thin layer of sediment, the scattered, emergent rock fragments or debris support colonisation by colonial benthic invertebrates.
- **Pre-Mesozoic rock outcrops** – these highly structured reef areas are likely to be characterised by highly diverse benthic and motile biota including sponges, azooxanthellate corals, octocorals, gorgonians, black corals, cerianthids and stylasterine lace corals, bryozoans, ascidians, basket stars and the South Coast rock lobster *Palinurus gilchristi*. Fauna occurring in the deeper reef areas and canyons have community assemblages distinctly different to those from shallower reefs, as also evident in the Greater St Lucia Wetland Park, where deep reefs and canyons support unique and diverse invertebrate fauna (Sink *et al.* 2006).

These stable habitats have been identified as sensitive, as the fauna typically associated with them are frequently slow-growing, slow to mature and long-lived, making them particularly vulnerable to disturbance.

The Agulhas Shelf ecoregion hosts diverse and complex benthic communities, including hard corals, octocorals, bryozoans and sponges, many of which are South African endemics (Griffiths & Robinson 2016; Atkinson & Sink 2018). A diversity of deep-water corals and sponges (Sink & Samaai, 2009; Sink *et al.* 2011) have been reported from the Agulhas Bank (see Figure 7-17 and Figure 7-18). These communities have established themselves below the thermocline where there is a continuous and regular supply of concentrated particulate organic matter, caused by the flow of a relatively strong current. Reef-building cold water corals have also been documented within the Southwest Indian Upper Bathyal, Agulhas Sandy Shelf Edge and in association with deep reefs and submarine canyons on the Agulhas Inner Shelf and Shelf Edge respectively (Sink & Samaai 2009; Sink *et al.* 2011; Sink 2016 in Sink *et al*. 2019). Substantial shelf areas should thus potentially be capable of supporting rich, deep-water benthic, filter-feeding communities. Corals and sponges add structural complexity to otherwise uniform seabed habitats thereby creating areas of high biological diversity (Breeze *et al.* 1997; MacIssac *et al.* 2001). Their frameworks offer refugia for a great variety of invertebrates and fish (including commercially important species) within, or in association with, the living and dead frameworks.

The deep water habitats on the Agulhas Bank are thought to be characterised by a number of VME indicator species such as sponges, soft corals and hard corals. The distribution of 22 potential VME indicator taxa for the South African EEZ were recently mapped, with those from the eastern Agulhas Bank listed in Table 7-1 (Atkinson & Sink 2018; Sink *et al.* 2019).

Figure 7-17: Examples of offshore benthic communities on reefs at <50 m depth on the central Agulhas Bank (left) and sandy seabed (right)

Note: Photo left –shows protected cold-water porcelain coral *Styllastera nobilis,* sponges, crinoids and bryozoans; Photo right shows habitat forming sponges, colonial ascidians and hydoids. Photos: Andrew Penney

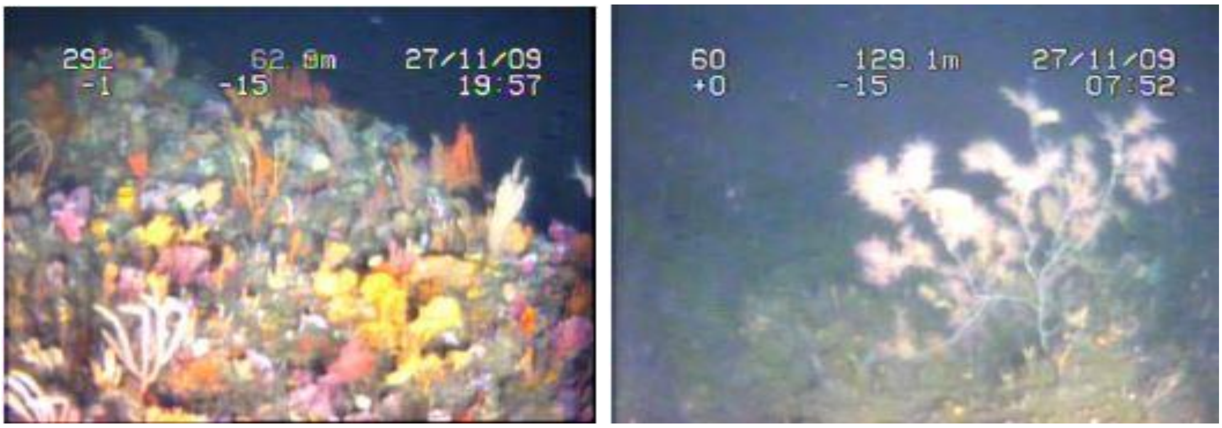


Figure 7-18: Vulnerable sponge- and soft coral–dominated biota at 60 m depth on the Alphard Bank (left) and black coral at 130 m depth on the 72-Mile Bank (from Sink *et al.* 2010).

Table 7-1: Potential VME species from the eastern Agulhas Bank and shelf edge.

Phylum	Name	Common Name
Porifera	*Rossella* cf. *antarctica*	Glass sponge
Cnidaria	*Melithaea* spp.	Colourful sea fan
	Thouarella spp.	Bottlebrush sea fan
Family: Isididae	?	Bamboo coral
	Anthoptilum grandiflorum	Large sea pen*
	Lophelia pertusa	Reef-building cold water coral
	Solenosmilia cf. *variabilis*	Thicket coral
	Goniocorella dumosa	Fine bridge coral
	Cladopsammia spp.	Right angled coral
	Eguchipsammia spp.	Right angled coral
	Enallopsammia	Zigzag coral
	Stylaster nobilis	Noble coral
	Stylaster spp.	Fine-branching hydrocoral
	Errina spp.	Red Hydrocoral
	Errinopsis cf. spp.	Fenestrate hydrocoral

Phylum	Name	Common Name
	Inferiolabiata cf. spp.	Spiny lace coral
Bryozoa	*Adeonella* spp.	Sabre bryozoan
	Aspidstoma sp.	Pore-plated bryozoan
	Phidoloporidae spp.	Honeycomb false lace coral
Hemichordata	*Cephalodiscus gilchristi*	Agar animal

The Deep Secrets Offshore Research survey undertaken by the NRF and ACEP in 2016 provided further insight into potential VMEs off the South Coast. A key feature mapped during this expedition was the rocky ridge off Port Elizabeth, which has come to be known as Kingklip Ridge and Kingklip Koppies. The feature spans a broad depth range of -150 to -800 m with a rocky feature rising to form a long narrow ridge 530 m wide and approximately 40 km long. The crest and edges of the northern end of the feature hosted reef-forming Scleractinia corals. However, much of the coral was broken, with evidence of recent and past (6 months) mortality. Some of the coral rubble areas were colonised by deep-water soft corals and brisingid sea stars (Sink *et al.* 2016, cited in Sink *et al.* 2019). In addition, a number of urchins characteristic of sandy habitats on the Agulhas shelf edge and slopes were recorded as well as a diversity of crabs, cerianthid tube anemone and various Foraminifera, as well as various starfish, basket stars, brittlestars and crinoids (Sink *et al.* 2016). The dominant octocoral *Thouarella* was present in rocky areas, with the presence of several associates (brittlestar, scale worm) and fish eggs and larvae within these bottebrush corals.

The Kingklip Ridge and Kingklip Koppies ecosystems were characterised by stony and lace corals (Sink *et al.* 2019) and have been included in the Kingklip Corals Ecologically and Biologically Significant Marine Area (EBSA) (refer to Section 7.5.3).

Nonetheless, our understanding of the invertebrate fauna of the sub-photic zone is relatively poor (Gibbons *et al.* 1999) and the conservation status of the majority of invertebrates in this bioregion is not known. Quick & Sink (2005) collated records from the South African Museum of species from the Agulhas Bank area. These included a wide variety of seapens, alcyonacean soft corals, gorgonians and ascidians, many of which are regarded as endemic to the bioregion (see Tables 5.1 and 5.2 in Quick & Sink 2005 for details). This was supplemented by information obtained through analysis of ROV footage taken in reef and unconsolidated habitats and on gas-field infrastructure, SAT diver collections, trap sampling and grab sampling as part of the dedicated PetroSA-WWF study (Sink *et al.* 2010). Although these studies were undertaken on the Agulhas Bank west of the Reconnaissance Permit Area, similar communities would be expected in the shallower portions of Reconnaissance Permit Area. A synthesis of the invertebrate and fish fauna reported from these studies is therefore provided below.

The deep water reefs (Alphard, 45-Mile and 72-Mile Banks) (see Figure 7-3) support exceptionally diverse and dense assemblages with clear depth zonation patterns. Whereas the shallower regions of the 12-Mile Bank and Alphard Banks (16 to 90 m) supported a kelp community dominated by *Ecklonia radiate* to depths of 35 m, the invertebrate fauna in deeper regions included a high diversity of sponge species (*Antho kellyae*, *Biemna anisotoxa*, *Clathria* spp., *Isodictya elastic, I. 85uryale85* and *Polymastia* sp.), fragile bryozoans, slow-growing hydrocorals (*Allopora nobilis* and *A. subviolacea*), gorgonians (*Eunicella albicans*, *Eunicella tricorona, Leptogorgia palma* and *Homophyton verrucosum*), gorgonian whip corals (resembling *Ctenocella* sp.) and black corals (*Antipathes* sp.) (Sink *et al.* 2012; Makwela *et al.* 2016).

In the 68 – 75 m depth range of the 45-Mile Bank (60 and 100 m), the invertebrate fauna included large cup- and vase-shaped sponges (*Hemiasterella vasiformis*, *Suberites* sp. And *Axinella* spp.), Geodiid and stove-pipe sponges, black corals, gorgonians, alcyonarian soft corals and slow growing hydrocorals, as well as a diverse fish assemblage. The 110 to 140 m depth range of the 72-Mile Bank revealed a “mass occurrence” of the tubular sponge *Biemna anisotoxa*, as well as *Geodia* sp. *Geodia megastar*, *Pachastrella* sp., *Stelleta trisclera* and *Erylus* sp. Hard corals (*Balanophyllia* and *Caryophyllia*), black corals, hydrocorals and gorgonians (*Eunicella papillosa)* are also present, with high variability in terms of invertebrate diversity and abundance within the reef complex again being evident. Echinoderms included the urchin *Echinus gilchristi* and an unidentified conspicuous orange starfish. Broken bryozoans (*Reteporella* spp.) and solitary hard corals (*Caryophyllia* spp.), occurred at deeper depths.

Benthic epifaunal assemblages on unconsolidated sediments near the 45-Mile Bank were dominated by spiral whelk and various isolated sponges, bryozoans and/or soft corals, suggesting the area may be low profile reef inundated with a layer of sand. Unconsolidated sediments within Block 9 and the frequently-trawled “Blues” area were dominated by the urchins (*Spatangus capensis*, *Brissopsis lyrifera capensis* and *Echinus gilchristi*), starfish (*Marthasterias glacialis, Toraster* sp.), sponges, spiral whelk, horse mussels, crabs (*Mursia cristiata, Gonoplax angulatus*), seapens, soft corals (possibly *Alcyonarium variable*) and burrowing tube anemones (*Cerianthus* sp.).

The benthic environment within the vicinity of the F-O Gas Field, to the west of the Reconnaissance Permit Area, is characterised by sandy unconsolidated sediment with several isolated rocky outcrops (see Figure 7-19). Bioturbation at the sediment surface suggests a rich infaunal community. The rocky outcrops also support a diverse range of gorgonians, bryozoans and sponges. The combination of habitat types (soft sediments and rocky formations) results in a highly diverse benthic fauna.

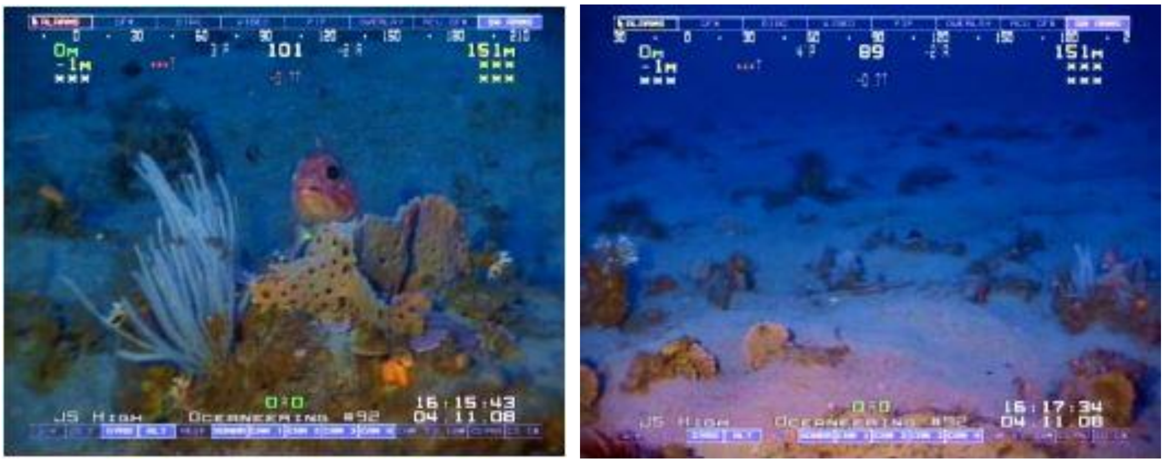


Figure 7-19: Sandy seabed with rocky outcrops characterising the F-O Field area (from Shipton & Atkinson 2008).

Inshore of the Reconnaissance Permit Area, at depths between 5 m and 30 m lie the Agulhas Inshore Reef and Agulhas Inshore Hard Ground benthic habitats, identified by Sink *et al.* (2012a) as ‘Critically endangered - Moderately protected’, and ‘Vulnerable - Moderately protected’, respectively due to their unique invertebrate assemblages. These reefs and hard grounds extend from the Mbashe River (east of East London) to Cape Point (see Figure 7-20). The reefs are considered to be warm temperate reefs, which have a more heterogeneous community structure when compared with those in the Southwestern Cape and Natal inshore regions. In the 2018 National Biodiversity Assessment (Sink *et al.* 2019) these habitats were re-classified as Agulhas Inner Shelf Mosaic and allocated a threat status of 'Vulnerable' (see Figure 7-13).

Agulhas reefs are dominated by sponges (e.g. golf ball sponge *Tethya aurantium*, the black stink sponge *Ircinia arbuscula*, the orange teat sponge *Polymastia mamillaris* and *Clathria spp*.), ascidians (e.g. *Gynandrocarpa placenta*, *Sycozoa arborescens*, *Didemnum* sp., *Pycnoclavella narcissus*, and the endemic *Clavellina lepadiformis)*, bryozoans (e.g. *Schizoretepora tessellata, Laminopora jellyae* and *Gigantopora polymorpha*) and a variety of octocorals (noble coral *Stylaster nobilis,* the sunburst soft coral *Malacacanthus capensis*, cauliflower soft coral *Drifa thyrsoidea*, purple soft coral *Alcyonium fauri,* Valdivian soft coral *A. valdiviae*, and the Variable soft coral *A. variabile*). Large gorgonians are conspicuous on these reefs with key species including *Leptogorgia palma*, *Eunicella tricoronata, E. papillosa, E. albicans,* and *Acabaria rubra.* Other important invertebrates include the red-chested sea cucumber *Pseudocnella insolens,* basketstars *Astroclades euryale*, featherstars *Comanthus wahlbergi* and *Tropiometra carinata*. Algal species include *Plocamium* spp., articulated corallines *Corallina* spp. And *Arthrocardia* spp., with the articulated coralline algae *Amphiroa ephedrae* being a dominant species in the shallow subtidal. Although abalone *Haliotis midae* were dominant space occupiers in shallow waters, poaching and overexploitation have severely depleted the population in their core habitat (Sink *et al.* 2012a).

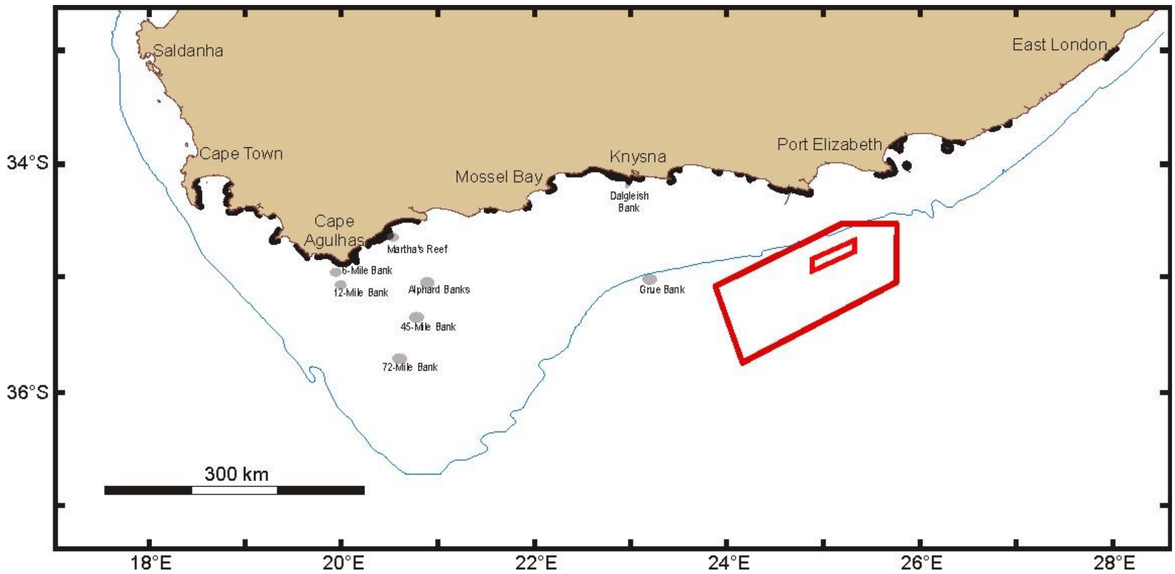


Figure 7-20: Extent of the Agulhas inshore reef and hard ground habitat types (shown in black) and deep water reefs in relation to the Reconnaissance Permit area (adapted from Sink *et al.* 2012a).

The 2018 National Biodiversity Assessment for the marine environment (Sink *et al.* 2019) points out that very few national IUCN Red List assessments have been conducted for marine invertebrate species to date owing to inadequate taxonomic knowledge, limited distribution data, a lack of systematic surveys and limited capacity to advance species red listing for these groups.

The intertidal and shallow subtidal reefs along the South Coast of South Africa support a wide diversity of marine flora and fauna and a relatively high percentage of endemic species (Turpie *et al.* 1999, Awad *et al.* 2002). In the Port Elizabeth and Mossel Bay areas, inshore reefs to -30 m depth show relatively distinct changes in community structure from those described above, being characterised by uniquely diverse reef assemblages dominated by cauliflower soft coral (Sink *et al.* 2012a) (see Figure 7-21). In particular, the islands in Algoa Bay, form ecologically distinct subtidal habitats, containing many endemic species of invertebrates and seaweeds.

Further south off Goukamma, the reefs are characterised by equally distributed high and low profile areas. The benthic taxa were dominated by bryozoans and sponges (22.9% and 21.1% respectively), followed by gorgonians (16.4%), ascidians (13.7%) and algae (10.1%). Crinoids (8.4%) and hydrozoans (7.5%) constituted <10% of the overall occurrence. Community composition in this area was found to be strongly affected by linefishing, with higher abundance of algae and crinoids at fished sites, and higher sponge cover on reefs within the Goukamma Marine Protected Area (MPA) (Sink *et al.* 2011). The Agulhas Reefs and Hard Grounds in general have been identified as being sensitive to overfishing, anchor damage and to impacts associated with pollution, mariculture, mining and petroleum. Specific reef habitats have thus been identified as 'Endangered' and 'Critically endangered' (see Figure 7-13).

Figure 7-21: Diverse and unique reef assemblages, dominated by cauliflower soft coral occur on the inshore reefs to -30 m depth off Port Elizabeth (Source: Sink *et al.* 2011).

Information on offshore benthic and pelagic invertebrates occurring in the general project area is sparse. The more motile invertebrate fauna that occurs on the Agulhas Bank includes the squid (*Loligo vulgaris reynaudii*) (see Figure 7-22, left) and the rock lobster (*Palinurus gilchristi*) (see Figure 7-22, right). The deep-water rock lobster is associated with rocky substrate in depths of 90 - 170 m between Cape Agulhas and southern KwaZulu-Natal (Groeneveld & Branch 2002). Larvae drift southwards in the Agulhas Current, settling in the southern portion of the Agulhas Bank before migrating northwards again against the current to the adult grounds (Branch *et al.* 2010). The species is fished commercially along the southern Cape Coast between the Agulhas Bank and East London, with the main fishing grounds being in the 100 – 200 m depth range south of Cape Agulhas on the Agulhas Bank.

Other deep-water crustaceans that may occur inshore of the project area are the shovel-nosed crayfish (*Scyllarides elisabethae*), which occurs primarily on gravelly seabed at depths of around 150 m, although it is sometimes found in shallower water. Its distribution range extends from Cape Point to Maputo. Another rock lobster species occurring on the south coast is the West Coast rock lobster (*Jasus lalandii*), which are typically associated with shallow-water reefs, although the West Coast lobster has been recorded at depths of 120 m (Branch *et al.* 2010).

Forty-five species of cephalopods have been recorded on the Agulhas Bank and the shelf break off the South Coast, the majority of which are cuttlefish (Lipinski 1992; Augustyn *et al.* 1995; Atkinson & Sink 2018). Cuttlefish are largely epi-benthic and occur on mud and fine sediments in association with their major prey item; mantis shrimps (Augustyn *et al.* 1995). Most of the cephalopod resource is distributed on the mid-shelf with *Sepia australis* being most abundant at depths between 60-190 m, whereas *S. hieronis* densities were higher at depths between 110-250 m. *Rossia enigmatica* occurs more commonly on the edge of the shelf to depths of 500 m. Biomass of these species was generally higher in the summer than in winter. Cuttlefish are largely epi-benthic and occur on mud and fine sediments in association with their major prey item; mantis shrimps (Augustyn *et al.* 1995). They form an important food item for demersal fish.

Figure 7-22: Squid spawn in nearshore areas off the Southeast coast (left) and South Coast rock lobster occur in deep water (right) (photos: www.mpa.wwf.org.za; Steve Kirkman and www.acquarium.co.za).

The squid (*Loligo vulgaris reynaudii*) occurs extensively on the Agulhas Bank out to the shelf edge (500 m depth contour) increasing in abundance towards the eastern boundary of the South Coast, especially between Plettenberg Bay and Algoa Bay (Augustyn 1990; Sauer *et al.* 1992; Augustyn *et al.* 1994). Adults are normally distributed in waters >100 m, except along the eastern half of the South Coast where they also occur inshore, forming dense spawning aggregations at depths between 20 - 130 m (Augusty 1990; Roberts *et al.* 2012; Downey 2014). The most important spawning grounds are between Plettenberg Bay and Algoa Bay (Augustyn 1990), these having been linked to specific spawning habitat requirements (Roberts & Sauer 1994; Roberts 2005). Spawning aggregations are a seasonal occurrence, reaching a peak between September and December (Augustyn *et al.* 1992) (also refer to Section 7.4.2). Spawning is thought to be triggered by upwelling events (Downey *et al.* 2010; Roberts 1998) or possibly a rapid temperature change (Schön *et al.* 2002). Eggs are typically laid on sand and low relief reefs in large and sheltered bays, with environmental conditions playing an important role in the migration of the adults into the spawning areas. Following passive and active planktonic phases, juveniles move offshore, dispersing over the shelf over the full range of their distribution (southern Namibia to East London), eventually returning as adults to their spawning grounds (Augustyn *et al.* 1992). The species is fished commercially along the inshore regions of the southern Cape Coast, with annual catches varying considerably (Roberts & Sauer 1994).

The giant squid Architeuthis sp. Is a deep-dwelling species usually found near continental and island slopes all around the world's oceans (see Figure 7-23). This deep-water species could thus potentially occur in the Reconnaissance Permit Area beyond the 1 000 m depth contour, although the likelihood of encounter is extremely low. Growing to in excess of 10 m in length, it is the principal prey of the sperm whale, and is also taken by beaked whaled, pilot whales, elephant seals and sleeper sharks. Nothing is known of their vertical distribution, but data from trawled specimens and sperm whale diving behaviour suggest they may span a depth range of 300 – 1 000 m. Giant squid lack gas-filled swim bladders and maintain neutral buoyancy through an ammonium chloride solution occurring throughout their bodies.

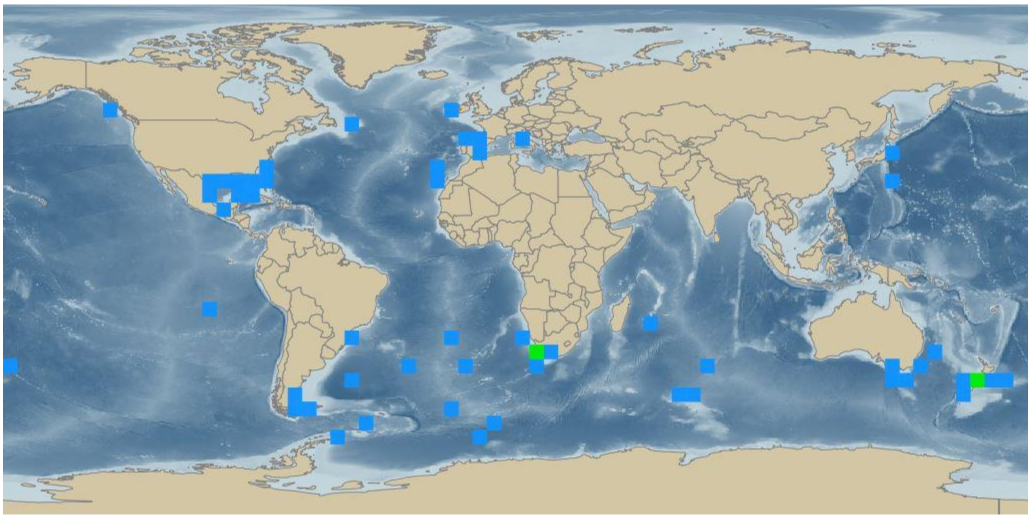


Figure 7-23: Distribution of the giant squid (http://iobis.org). Blue squares <5 records, green squares 5-10 records.

7.4.4 Pelagic and Demersal Fish

The ichthyofauna of the Southeast coast is diverse, comprising a mixture of temperate and tropical species. As a transition zone between the Agulhas and Benguela current systems, the Southeast coast ichthyofauna includes many species also occurring along the West and/or East Coasts. Pelagic species are those associated with the water column, whereas demersal species are associated with the seabed.

Small pelagic shoaling species occurring along the Eastern Cape include anchovy (*Engraulis encrasicolus*), pilchard (*Sardinops sagax*) (see Figure 7-24, left), round herring (*Etrumeus japonicas*), chub mackerel (*Scomber japonicas*) and horse mackerel (*Trachurus trachurus capensis*) (see Figure 7-24, right). Anchovies are usually located between the cool upwelling ridge and the Agulhas Current (Hutchings 1994). Having spawned intensively in an area around the 200 m depth contour between

Mossel Bay and Plettenberg Bay between October and January, most adults move inshore and eastwards ahead of warm Agulhas Current water. Round herring juveniles similarly occur inshore along the South Coast, but move offshore with age (Roel *et al.* 1994; Hutchings 1994).

Pilchards are typically found in water between 14 °C and 20 °C. The shift in the distributions of anchovy and sardine to the south and east during the 1990s and early 2000s was attributed to improved conditions for spawning by these species to the east of Cape Agulhas (van der Lingen *et al.* 2005; 2006; Roy *et al.* 2007; Coetzee *et al.* 2008). In late summer and during winter, the penetration of northerly-flowing cooler water along the Eastern Cape coast effectively expands the suitable habitat available for this species, resulting in a 'leakage' of large shoals northwards into southern KwaZulu-Natal in what has traditionally been known as the 'sardine run'. The shoals begin gathering in Algoa Bay as early as late February, moving northwards up the coast between March and May and reach the KwaZulu-Natal coastline in June. The cool band of inshore water is critical to the 'run' as the sardines will either remain in the south or only move northwards further offshore if the inshore waters are above 20 °C. The shoals can attain lengths of 20-30 km and are typically pursued by Great White Sharks, Copper Sharks, Common Dolphins, Cape Gannets and various other large pelagic predators (www.sardinerun.co.za).

Figure 7-24: Cape fur seal preying on a shoal of pilchards (left). School of horse mackerel (right) (photos: www.underwatervideo.co.za; www.delivery.superstock.com).

Recent studies have indicated that the annual 'sardine run' constitutes a migration to localised upwelling centres inshore of the Agulhas Current (East London and Cape St Lucia) that provide a favourable temperate spawning environment for these small pelagic fish species during and subsequent to their annual migration along the East Coast (Beckley & Hewitson 1994; Coetzee *et al.* 2010).

Other pelagic species that migrate along the coast include elf (*Pomatomus saltatrix*), geelbek (*Atractoscion aequidens*), yellowtail (*Seriola lalandi*), kob (*Argyrosomus* sp) seventy-four (*Cymatoceps nasutus*), strepie (*Sarpa salpa*), Cape stumpnose (*Rhabdosargus holubi*) and mackerel (*Scomber japonicus*)(Van der Elst 1988).

The fish most likely to be encountered on the shelf, beyond the shelf break and in the offshore waters of the Reconnaissance Permit Area are the large migratory pelagic species, including various tunas (see Figure 7-25, left), billfish (see Figure 7-25, right) and sharks (see Figure 7-26) (Van der Elst 1988; Smale *et al.* 1994), many of which are considered threatened by the International Union for the Conservation of Nature (IUCN), primarily due to overfishing (see Table 7-2). Tuna and swordfish are targeted by high seas fishing fleets and illegal overfishing has severely damaged the stocks of many of these species. Similarly, pelagic sharks, are either caught as bycatch in the pelagic tuna longline fisheries, or are specifically targeted for their fins, where the fins are removed and the remainder of the body discarded.

Figure 7-25: Large migratory pelagic fish such as longfin tuna (left) and sailfish (right) occur in offshore waters (photos: www.arkive.org; www.osfimages.com).

Table 7-2: Some of the more important large migratory pelagic fish likely to occur in the offshore regions of the South and East Coasts and their conservation status.

Common Name	Species	IUCN Conservation Status
Tunas		
Southern Bluefin Tuna	*Thunnus maccoyii*	Endangered
Bigeye Tuna	*Thunnus obesus*	Vulnerable
Longfin Tuna/Albacore	*Thunnus alalunga*	Least concern
Yellowfin Tuna	*Thunnus albacares*	Least concern
Frigate Tuna	*Auxis thazard*	Least concern
Eastern Little Tuna/Kawakawa	*Euthynnus affinis*	Least concern
Skipjack Tuna	*Katsuwonus pelamis*	Least concern
Atlantic Bonito	*Sarda sarda*	Least concern
Billfish		
Blue Marlin	*Makaira nigricans*	Vulnerable

Common Name	Species	IUCN Conservation Status
Striped Marlin	*Kajikia audax*	Least concern
Sailfish	*Istiophorus platypterus*	Vulnerable
Swordfish	*Xiphias gladius*	Near threatened
Black Marlin	*Istiompax indica*	Data deficient
Pelagic Sharks		
Great Hammerhead Shark	*Sphyrna mokarran*	Endangered
Smooth Hammerhead shark	*Sphyrna zygaena*	Vulnerable
Pelagic Thresher Shark	*Alopias pelagicus*	Endangered
Bigeye Thresher Shark	*Alopias superciliosus*	Vulnerable
Common Thresher Shark	*Alopias vulpinus*	Vulnerable
Dusky Shark	*Carcharhinus obscurus*	Endangered
Great White Shark	*Carcharodon carcharias*	Vulnerable
Shortfin Mako	*Isurus oxyrinchus*	Endangered
Longfin Mako	*Isurus paucus*	Endangered
Whale Shark	*Rhincodon typus*	Endangered
Blue Shark	*Prionace glauca*	Near Threatened

Figure 7-26: The great white shark *Carcharodon carcharias* (left) and the dusky shark *Charcharhinus obscurus* (right) (photos: www.flmnh.ufl.edu).

Three species likely to be encountered in the Reconnaissance Permit Area are singled out for further discussion, namely the great white shark *Carcharodon carcharias*, the whale shark *Rhincodon typus* and the shortfin mako *Isurus oxyrinchus.* All three species have a cosmopolitan distribution. Although not necessarily threatened with extinction, the great white shark is described as 'vulnerable' and the whale shark and shortfin mako as 'endangered' in the IUCN Red listing, and are listed in Appendix II (species in which trade must be controlled in order to avoid utilization incompatible with their survival) of CITES (Convention on International Trade in Endangered Species) and Appendix I and/or II of the Bonn Convention for the Conservation of Migratory Species (CMS). The great white shark and whale shark are both also listed as 'vulnerable' in the List of Marine Threatened or Protected Species (TOPS) as part of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA). In response to global declines in abundance, white sharks were legislatively protected in South Africa in 1991. Long-term catch-per-unit-effort data from protective gillnets in KwaZulu-Natal, however, suggest a 1.6% annual increase in capture rate of this species following protection, although high interannual variation in these data lessen the robustness of the trend (Dudley & Simpfendorfer 2006). The shortfin mako is not listed in TOPS.

The great white shark *Carcharodon carcharias* is a significant apex predator in the Algoa Bay area, particularly in the vicinity of the seal colony at Black Rocks. Currently there is no consensus on the number of white sharks in South Africa (Cliff *et al*. 1996; Towner *et al*. 2013; Andreotti *et al*. 2016; Irion *et al*. 2017). White sharks migrate along the entire South African coast, typically being present at seal colonies during the winter months, but moving nearshore during summer (Johnson *et al.* 2009). The species is known to seasonally aggregate at specific localities along the South African coast, including False Bay, Gans Bay, Struisbaai, Mossel Bay (Kock & Johnson 2006; Kock *et al.* 2013; Towner *et al.* 2013) and Algoa Bay (Dicken *et al.* 2013). Recent research at Mossel Bay into the residency patterns of white sharks revealed that male sharks display low site fidelity, often rapidly moving in an out of the area. Females in contrast, display high site fidelity and may remain resident in the area for up to two months (Koch & Johnson 2006; see also Jewell *et al.* 2013, 2014; Ryklief *et al.* 2014). Longer-term emigration of great whites from aggregation sites in response to predation by killer whales has also recently been reported (Towner *et al.* 2022), with their absence inducing some degree of trophic cascade, triggering the emergence of another predator, the bronze whaler shark *Carcharhinus brachyurus.* Great white sharks are, however, capable of transoceanic migrations (Pardini *et al.* 2001; Bonfil *et al.* 2005; Koch & Johnson 2006), with recent electronic tag data suggesting links between widely separated populations in South Africa and Australia and possible natal homing behaviour in the species. Although during transoceanic migrations they appear to spend most of the time just below the sea surface, frequent deep dives to a much as 980 m are made whilst *en route*. Long-distance return migrations along the South African coast are also frequently undertaken (see Figure 7-27), particularly by immature individuals (Bonfil *et al.* 2005). These coastal migrations, which are thought to represent feeding-related events, traverse the project area.

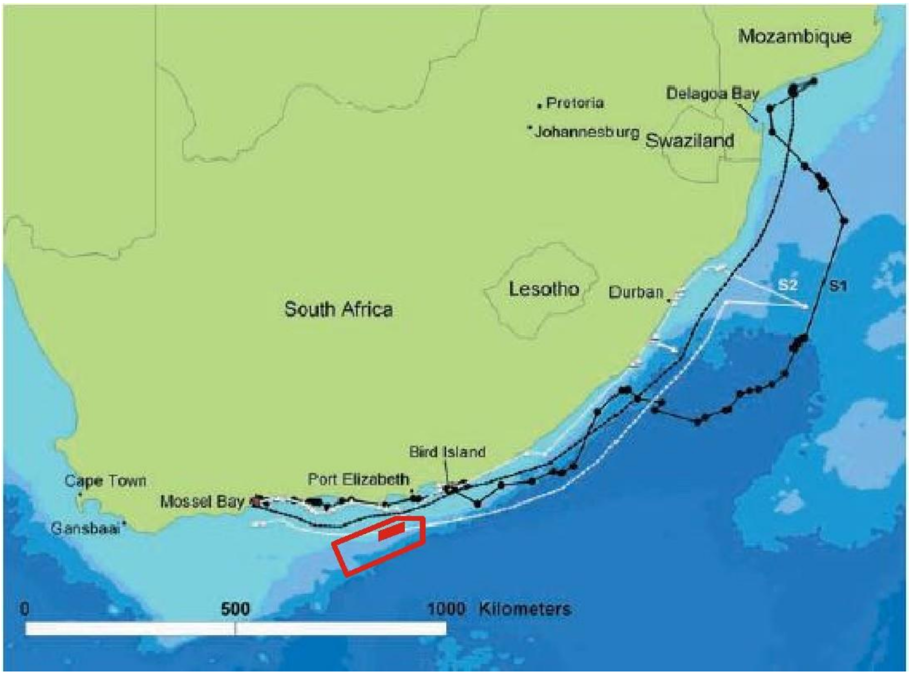


Figure 7-27: The Reconnaissance Permit Area (red polygon) in relation to the long-distance return migrations of two tracked great white sharks along the South African coast. The black trace shows a migration from 24 May – 2 November 2003; the white trace shows a migration from 31 May – 1 October 2004 (adapted from Bonfil *et al.* 2005).

Whale sharks are regarded as a broad ranging species typically occurring in offshore epipelagic areas with sea surface temperatures of 18–32°C (Eckert & Stewart 2001). Adult whale sharks reach an average size of 9.7 m and 9 tonnes, making them the largest non-cetacean animal in the world. They are slow-moving filter-feeders and therefore particularly vulnerable to ship strikes (Rowat 2007). Although primarily solitary animals, seasonal feeding aggregations occur at several coastal sites all over the world, those closest to the project area being off Sodwana Bay in KZN in the Greater St. Lucia Wetland Park, Tofo Reef near Inhambane in Mozambique, Nosy Be off the northwest coast of Madagascar, and the Tanzanian islands of Mafia, Pemba, and Zanzibar (Cliff *et al.* 2007).

Satellite tagging of whale sharks has revealed that individuals may travel distances of tens of 1,000s of kilometres (Eckert & Stewart 2001; Rowat & Gore 2007; Brunnschweiler *et al.* 2009). Although the fish spend most time in the upper 25 m of the water column while on the continental shelf, once in deep water, the occurrence of dives into mesopelagic and bathypelagic zones increased, with dives to a depth of 1 286 m being recorded. These dives were thought to represent search behaviour for feeding opportunities on deep-water zooplankton (Brunnschweiler *et al.* 2009). Although these slow swimming sharks are vulnerable to ship strikes, the likelihood of an encounter in the Area of Interest is relatively low.

The shortfin mako shark *Isurus oxyrinchus* inhabits offshore tempertate and tropical seas worldwide. It can be found from the surface to depths of 500 m, and as one of the few endothermic sharks is seldom found in waters <16 °C (Compagno 2001; Loefer *et al.* 2005). This apex predator is targeted by both sport anglers and commercial longline fisheries, and contributes substantially to the bycatch in pelagic driftnet fisheries. They are also taken as an incidental catch in bather protection nets of KwaZulu Natal (Dudley & Cliff 2010; Cliff & Dudley 2011). As the fastest species of shark, shortfin makos have been recorded to reach speeds of 40 km/h with burst of up to 74 km/h, and can jump to a height of 9 m (http://www.elasmo-research.org/education/shark_profiles/ i_oxyrinchus.htm). Most makos caught by longliners off South Africa are immature, with reports of juveniles and sub-adults sharks occurring near the edge of the Agulhas Bank and off the South Coast between June and November (Groeneveld *et al.* 2014), whereas larger and reproductively mature sharks were more common in the inshore environment along the East Coast (Foulis 2013).

The varied habitat of rocky reefs and soft-bottom substrates supports a high diversity of Teleosts (bony fish) and Chondrichthyans (cartilaginous fish) associated with the inshore and shelf waters off the South and East Coasts, many of which are endemic to Southern Africa (Smale *et al.* 1994) and form an important component of the demersal trawl and long-line fisheries. The Cape hake (*Merluccius capensis*), is distributed widely on the continental shelf along the Eastern Cape and onto the Agulhas Bank, while the deep-water hake (*Merluccius paradoxus*) is found further offshore in deeper water (Boyd *et al.* 1992; Hutchings 1994). The nursery grounds for both species are located off the west coast and fish move southwards onto the Agulhas Bank as they grow. Juveniles of both species occur throughout the water column in shallower water than the adults. Kingklip (*Genypterus capensis*) is also an important demersal species, with adults distributed in deeper waters along the coast west of

Algoa Bay, especially on rocky substrate (Japp *et al.* 1994). As noted in Section 7.4.2, spawning takes place in an isolated area between Cape St Francis and Gqeberha, along the inshore areas of the Reconnaissance Permit Area during spring (see Figure 7-15). Juveniles occur further inshore along the entire South Coast. The Agulhas or East Coast sole (*Austroglossus pectoralis*) inhabits inshore muddy seabed (<125 m) on the shelf between Cape Agulhas and Algoa Bay (Boyd *et al.* 1992). Apart from the above-mentioned target species, numerous other by-catch species are landed by the South Coast demersal trawling fishery, including panga (*Pterogymnus laniarius)*, kob (*Argyrosomus hololepidotus*), gurnard (*Chelidonichthyes* spp.), monkfish (*Lophius* sp.), John Dory (*Zeus capensis*) and angel fish (*Brama brama*).

There is a high diversity of endemic sparid and other teleost species along the South Coast (Smale *et al.* 1994) (see Figure 7-28), some of which move into inshore protected bays to spawn (Buxton 1990) or undertake spawning migrations eastwards up the coast into KZN waters. Those species that undertake migrations along the South and East Coasts include Red Steenbras, White Steenbras (summer), Kob, Geelbek and Elf (winter). Spawning of the majority of species endemic to the area occurs in spring and summer. Many of these species, as well as numerous pelagic species that frequent nearshore waters are targeted by line-fishermen and form an important component of the commercial and recreational linefishery (see Table 7-3). These linefish are typically associated with shallow- and deep-water reefs inshore of the Reconnaissance Permit Area.


Figure 7-28: The Agulhas Inshore and offshore reefs support a wide diversity of teleost species including musselcracker (left) and red stumpnose (right) (photos: http://spearfishingsa.co.za, www.easterncapescubadiving.co.za).

Table 7-3: Some of the more important demersal and pelagic linefish species along the inshore shallow water areas along the South Coast.

Name	Species Name	National Assessment	Global Assessment
Demersal teleosts			
Bank steenbras	*Chirodactylus grandis*	Least Concern	Not Assessed
Belman	*Umbrina canariensis*	Near Threatened	Near Threatened
Blacktail	*Diplodus sargus*	Not Assessed	Least Concern
Blue hottentot	*Pachymetopon aeneum*	Not Assessed	Least Concern
Bronze bream	*Pachymetopon grande*	Not Assessed	Near Threatened

Name	Species Name	National Assessment	Global Assessment
Cape stumpnose	*Rhabdosargus holubi*	Not Assessed	Least Concern
Carpenter	*Argyrozona argyrozona*	Not Assessed	Near Threatened
Dageraad	*Chrysoblephus christiceps*	Not Assessed	Critically Endangered
Englishman	*Chrysoblephus anglicus*	Not Assessed	Near Threatened
Fransmadam	*Boopsoidea inornata*	Not Assessed	Least Concern
Galjoen	*Dichistius capensis*	Near Threatened	Not Assessed
Silver Kob	*Argyrosomus inodorus*	Vulnerable	Vulnerable
Mini kob	*Johnius dussumieri*	Least Concern	Least Concern
White Musselcracker	*Sparodon durbanensis*	Not Assessed	Near Threatened
Natal stumpnose	*Rhabdosargus sarba*	Not Assessed	Least Concern
Poenskop	*Cymatoceps nasutus*	Not Assessed	Vulnerable
Pompano	*Trachinotus africanus*	Data deficient	Not assessed
Red roman	*Chrysoblephus laticeps*	Not Assessed	Near Threatened
Red steenbras	*Petrus rupestris*	Not Assessed	Endangered
Red stumpnose	*Chrysoblephus gibbiceps*	Not Assessed	Endangered
Picnic sea bream	*Acanthopagrus berda*	Not Assessed	Least Concern
Yellowbelly Rockcod	*Epinephalus* marginatus.	Vulnerable	Vulnerable
Catface rockcod	*Epinephalus andersoi*	Near Threatened	Near Threatened
Sand steenbras	*Lithognathus mormyrus*	Not Assessed	Least Concern
Santer	*Cheimerius nufar*	Not Assessed	Data deficient
Scotsman	*Polysteganus praeorbitalis*	Not Assessed	Vulnerable
Seventyfour	*Polysteganus undulosus*	Not Assessed	Critically Endangered
Slinger	*Chrysoblephus puniceus*	Not Assessed	Least Concern
Snapper salmon	*Otolithes ruber*	Least Concern	Least Concern
Spotted grunter	*Pomadasys commersonnii*	Vulnerable	Not assessed
Squaretail kob	*Argyrosomus thorpei*	Vulnerable	Endangered
Steentjie	*Spondyliosoma emarginatum*	Not Assessed	Least Concern
White steenbras	*Lithognathus lithognathus*	Not Assessed	Endangered
White stumpnose	*Rhabdosargus globiceps*	Not Assessed	Vulnerable
Zebra	*Diplodus cervinus*	Not Assessed	Least Concern
Pelagic teleosts			
Elf/shad	*Pomatomus saltatrix*	Vulnerable	Vulnerable
Garrick/leerfish	*Lichia amia*	Vulnerable	Least Concern
Geelbek	*Atractoscion aequidens*	Vulnerable	Vulnerable
Green jobfish	*Aprion virescens*	Data deficient	Least Concern
King mackerel	*Scomberomorus commerson*	Least Concern	Near Threatened
Kingfish species	*Caranx* spp.	Data deficient	Least Concern
Queenfish	*Scomberoides commersonianus*	Data deficient	Least Concern
Queen mackerel	*Scomberomorus plurilineatus*	Least Concern	Data deficient
Tenpounder/Springer	*Elops machnata*	Data deficient	Least Concern
Wahoo	*Acanthocybium solandri*	Least Concern	Least Concern

Name	Species Name	National Assessment	Global Assessment
Yellowtail	*Seriola lalandi*	Least Concern	Least Concern

Furthermore, a wide variety of chondrichthyans occur in nearshore waters along the Eastern Cape, (see Table 7-4), some of which, such as St Joseph shark (*Callorhincus capensis*), Soupfin shark (*Galeorhinus galeus*) and Biscuit skate (*Raja straeleni*), are also landed by the trawl and line fishery. The distribution of some of these species is shown in Figure 7-29.

There is limited information about bathyal fish communities in South Africa. South Africa defines its bathyal zone as extending from 500 m to 3 500 m, recognising an upper slope (500-1 000 m, mid slope (1 000-1 800m) and lower slope (1 800-3 500m). Typical upper slope fishes (200-2 000 m) include rattails (Macrouridae), greeneyes (*Chlorophthalmus* species), notacanthids, halosaurs, chimaeras, skates, bythitids such as *Cataetyx* spp. And morids (deepsea cods) (Smith & Heemstra 2003). Rattails, bythitids, liparidids (snail fishes) and notacanthids (*Polyacanthonotus* species and halosaurs) are characteristic of the lower bathyal (see also Iwamoto & Anderson 1994; Jones 2014).

Table 7-4: Some of the chondrichthyan species occurring along the South Coast and their conservation status (CCA & CMS 2001; Harris *et al*. 2022).

Name	Species Name	National Assessment	Global Assessment
Great white shark	*Carcharodon carcharias*	Least Concern	Vulnerable
Ragged-tooth shark	*Odontaspis taurus*	Data deficient	Near Threatened
Bronze whaler shark	*Carcharhinus brachyurus*	Data deficient	Vulnerable
Dusky shark	*Carcharhinus obscurus*	Data deficient	Endangered
Blacktip shark	*Carcharhinus limbatus*	Least Concern	Vulnerable
Lesser Guitarfish	*Acroteriobatus annulatus*	Least Concern	Vulnerable
Spotted Gully shark	*Triakis megalopterus*	Data deficient	Least Concern
Biscuit skate	*Raja straeleni*	Not Assessed	Near Threatened
Spearnose skate	*Rostroraja alba*	Not Assessed	Endangered
Slime skate	*Dipturus pullopunctatus*	Not Assessed	Least Concern
Blue stingray	*Dasyatis chrysonota*	Data deficient	Near Threatened
St Joseph shark	*Callorhincus capensis*	Least Concern	Least Concern
Soupfin shark	*Galeorhinus galeus*	Endangered	Critically Endangered
Sevengill cowshark	*Notorynchus cepedianus*	Least Concern	Vulnerable
Sixgill Sawshark	*Pliotrema warreni*	Not Assessed	Least Concern
Spinner shark	*Carcharhinus brevipinna*	Not Assessed	Vulnerable
Sandbar shark	*Carcharhinus plumbeus*	Not Assessed	Endangered
Tiger catshark	*Halaelurus natalensis*	Not Assessed	Vulnerable
Triangular Legskate	*Cruriraja 'triangularis'*	Not Assessed	Least Concern
African Angelshark	*Squatina africana*	Not Assessed	Near Threatened
Twineye skate	*Raja miraletus*	Not Assessed	Least Concern
Spotted spiney dogfish	*Squalus acanthias*	Least Concern	Vulnerable
Puffadder shyshark	*Haploblepharus edwardsii*	Not Assessed	Endangered
Dark shyshark	*Haploblepharus pictus*	Not Assessed	Least Concern
Houndshark	*Mustelus mustelus*	Data deficient	Endangered

Name	Species Name	National Assessment	Global Assessment
Whitespotted smoothhound	*Mustelus palumbes*	Not Assessed	Least Concern
Yellowspotted catshark	*Scyliorhinus capensis*	Not Assessed	Near Threatened
Yellowspotted skate	*Leucoraja wallacei*	Not Assessed	Vulnerable
Leopard catshark	*Poroderma pantherinum*	Least Concern	Least Concern
Pyjama shark	*Poroderma africanum*	Least Concern	Least Concern
Common Eagle ray	*Myliobatis aquila*	Least Concern	Critically Endangered
Electric ray	*Torpedo fuscomaculata*	Not Assessed	Data deficient

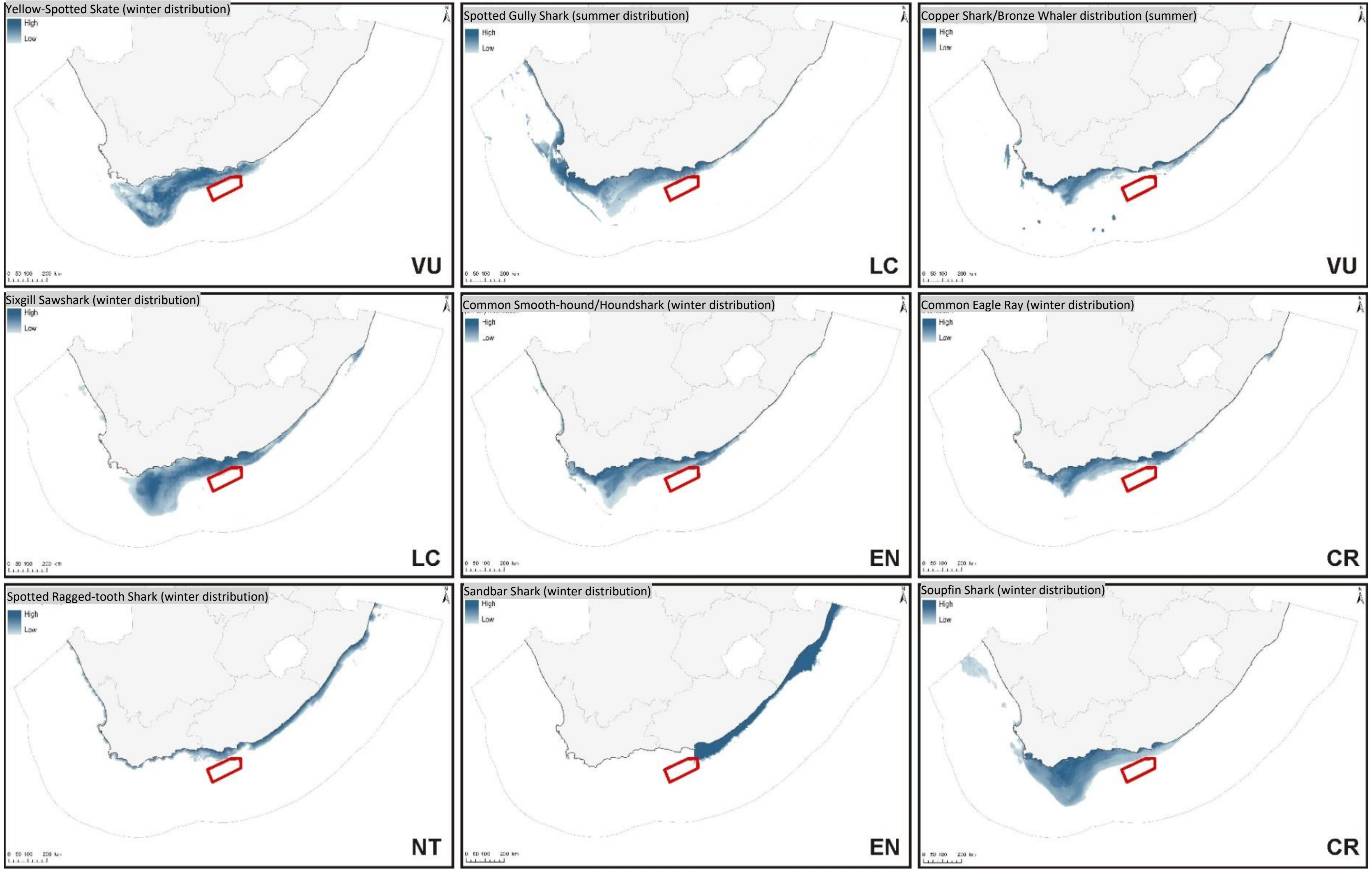


Figure 7-29: The distribution of various cartilaginous species mentioned in Table 7-4 in relation to the Reconnaissance Permit area (red polygon) (adapted from Harris *et al*. 2022). The IUCN conservation status is provided.

7.4.5 Turtles

Five species of sea turtles occur along the East Coast of South Africa; the green turtle (*Chelonia mydas*), olive ridley (*Lepidochelys olivacea*), leatherback (*Dermochelys coriacea*) (see Figure 7-30, left), hawksbill (*Eretmochelys imbricata*) and loggerhead (*Caretta caretta*)(see Figure 7-30, right). Green turtles are non-breeding residents often found feeding on inshore reefs. They nest mainly along the coast of Mozambique and on both Europa and Tromelin Islands (Lauret-Stepler *et al*. 2007), well to the north of the Reconnaissance Permit Area. Hawksbills also occur on inshore reefs but nest along the coastlines of Madagascar and the Seychelles (Mortimer 1984). Olive ridleys are infrequent visitors to South African waters and nest throughout the central and northern regions of Mozambique (Pereira *et al*. 2008). Leatherback turtles inhabit the deeper waters of the Atlantic Ocean and are considered a pelagic species. They travel the ocean currents in search of their prey (primarily jellyfish) and may dive to over 600 m and remain submerged for up to 54 minutes (Eckert *et al.* 1989; Hays *et al.* 2004; Lambardi *et al.* 2008). They come into coastal bays and estuaries to mate, and lay their eggs on the adjacent beaches. Loggerheads tend to keep more inshore, hunting around reefs, bays and rocky estuaries along the African East Coast, where they feed on a variety of benthic fauna including crabs, shrimp, sponges, and fish. In the open sea their diet includes jellyfish, flying fish, and squid (www.oceansafrica.com/turtles.htm).

Loggerheads and leatherbacks nest along the sandy beaches of the northeast coast of KZN (and thus over 500 km to the north of the Reconnaissance Permit Area), as well as southern Mozambique during summer months. These loggerhead and leatherback nesting populations are the southern-most in the world (Nel *et al*. 2013). Even though these populations are smaller (in nesting numbers) than most other populations, they are genetically unique (Dutton *et al.* 1999; Shamblin *et al.* 2014) and thus globally important populations in terms of conservation of these species.

Figure 7-30: Leatherback (left) and loggerhead turtles (right) occur along the East Coast of South Africa (Photos: Ketos Ecology 2009; www.aquaworld-crete.com).

Loggerhead and leatherback females come ashore to nest from mid-October to mid-January each year. The eggs incubate for two months and hatchlings emerge from their nests from mid-January to mid-March. The mean hatching success for loggerheads (73 %) and leatherbacks (76 %) on the South African nesting beaches (de Wet 2013) is higher than reported at other nesting sites globally. Nevertheless, eggs and emerging hatchlings are nutritious prey items for numerous shoreline predators, resulting in the mean emergence success and hatchling success being slightly lower than the hatching success. However, emergence and hatchling success for both species is similarly higher in South Africa than reported at other nesting beaches as mortality is largely limited to natural sources due to strong conservation presence on the nesting beach, which has reduced incidents of egg poaching and female harvesting to a minimum (Nel 2010). The production of both loggerhead and leatherback hatchlings is thus remarkably high in South Africa, making the nesting beaches in northern KZN some of the most productive (relative to nesting numbers) in the world.

Those hatchlings that successfully escape predation *en route* to the sea, enter the surf and are carried ~10 km offshore by coastal rip currents to the Agulhas Current (Hughes 1974b). As hatchlings are not powerful swimmers they drift southwards in the current, and may therefore be encountered in the inshore portions of the Reconnaissance Permit Area and therefore overlapping with the area of interest. During their first year at sea, the activities of the post-hatchlings largely remaining unknown (Hughes 1974a). After ~10 years, juvenile loggerheads return to coastal areas to feed on crustaceans, fish and molluscs and subsequently remain in these neritic habitats (Hughes 1974b). In contrast, leatherbacks remain in pelagic waters until they become sexually mature and return to coastal regions to breed. Loggerheads reach sexual maturity at about 36 years of age whereas leatherbacks reach maturity at ~15 years (Tucek *et al.* 2014). It has been estimated that only 1 to 5 hatchlings survive to adulthood (Hughes 1974b); de Wet 2013).

Sea turtles are highly migratory and travel extensively throughout their entire life cycle. Adult turtles migrate thousands of kilometres between foraging and breeding grounds, returning to their natal beaches (Hughes 1996; Papi *et al.* 2000; Schroeder *et al.* 2003) by using geomagnetic (Lohmann *et al.* 2007) and olfactory cues (Grassman *et al.* 1984), hearing (Wyneken & Witherington 2001) as well as vision (Witherington 1992) to find their way back to the beach. Post-nesting females and hatchlings use natural ambient light to orientate towards the ocean (Bartol & Musick 2002). Artificial light, however, acts as deterrents for nesting females (Witherington 1992; Salmon 2003; Brazier 2012) and brightly lit beaches thus have reduced female emergences. In contrast, hatchlings are attracted to light even if the source is inland and may consequently suffer higher mortality rates due to desiccation and increased predation (Witherington & Bjorndal 1991; Salmon 2003).

Satellite tracking of female loggerhead and leatherback turtles during inter-nesting periods revealed that loggerheads remained close to the shore (within the boundaries of the iSimangaliso Wetland Park) between nesting events, whereas leatherbacks travelled greater distances (more than 300 km) and beyond the borders of the MPA. This led to a southward extension of the Marine Protected Area (MPA) in order to include a greater portion of the core range of inter-nesting leatherbacks and provide better protection. The speculative 3D survey areas lie over 500 km to the south of the inter-nesting migration area.

Female turtles do not nest every year due to the high energetic costs of reproduction (Wallace & Jones 2008). During this remigration interval they travel thousands of kilometres (particularly leatherbacks) with ocean currents in search of foraging grounds (Luschi *et al.* 2003a; Luschi *et al.* 2003b). Turtles marked with titanium flipper tags have revealed that South African loggerheads and leatherbacks have a remigration interval of 2 – 3 years, migrating to foraging grounds throughout the South Western Indian Ocean (SWIO) as well as in the eastern Atlantic Ocean. They follow different post-nesting migration routes (Hughes *et al.* 1998; Luschi *et al.* 2006), with loggerheads preferring to stay inshore whilst travelling northwards to foraging grounds along the southern Mozambican coastline or crossing the Mozambique Channel to forage in the waters off Madagascar (see Figure 7-31). In contrast, leatherbacks move south with the Agulhas Current to deeper water in high-sea regions to forage (Hughes *et al.* 1998; Luschi *et al.* 2003b; Luschi *et al.* 2006), with some individuals following the Benguela Current along the west coast of South Africa, as far north as central Angola (see Figure 7-31, de Wet (2013). **Both species are thus highly likely to be encountered in the Reconnaissance Permit Area during their foraging migrations.**

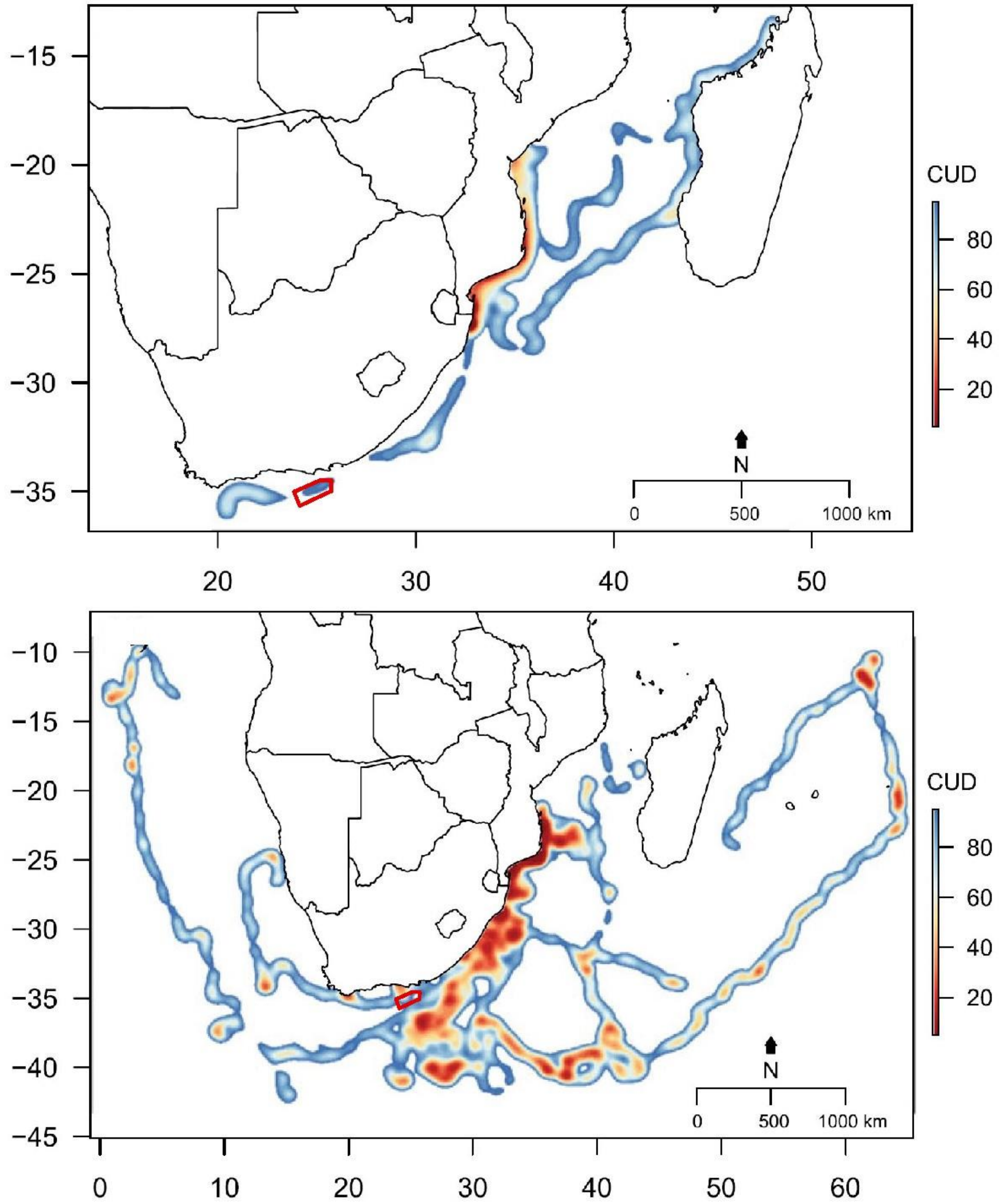


Figure 7-31: The Reconnaissance Permit Area (red polygon) in relation to the migration corridors of loggerhead (top) and leatherback (bottom) turtles in the south-western Indian Ocean.

Note: Relative use (CUD, Cumulative Utilization Distribution) of corridors is shown through intensity of shading: light, low use; dark, high use. Adapted from Harris *et al.* 2018.

The South African nesting populations of loggerhead and leatherback sea turtles have been actively protected since 1963 when an annual monitoring and conservation programme was established (Hughes 1996). During the more than 50 years of sea turtle conservation the loggerhead nesting population has increased exponentially from ~ 80 to approximately 700 individuals. The leatherback nesting population showed an initial increase from ~20 to approximately 80 individuals and has remained relatively stable over the last few decades. This conservation programme is considered a global success story and has inspired the inception and persistence of numerous other programmes (Hughes 2012). Nonetheless, the extensive migrations undertaken by these species not only exposes them to threats such as becoming incidental bycatch in commercial and artisanal fisheries but makes protecting them from such potential threats very difficult.

In the IUCN Red listing, the leatherback is described as 'Critically Endangered', and the loggerhead and green turtles are 'Endangered' on a global scale. Leatherback Turtles are thus in the highest categories in terms of need for conservation in CITES and CMS. As a signatory of CMS, South Africa has endorsed and signed two sister agreements specific to the conservation and management of sea turtles (these are the Africa-Atlantic and Indian Ocean South East Asia Memoranda of Understanding). South Africa, as a nation, is therefore committed to the protection of all species of sea turtles occupying its national waters, whether they are non-resident nesters (loggerhead and leatherback turtles) or resident foragers (hawksbill and green turtles; Oceans and Coast, unpublished data). In addition to sea turtle habitat and physical protection in the St. Lucia and Maputaland Marine Reserves, turtles in South Africa are protected under the Marine Living Resources Act (1998).

The most recent conservation status, which assessed the species on a sub-regional scale, is provided in Table 7-5.

Table 7-5: Global and Regional Conservation Status of the turtles occurring off the South Coast showing variation depending on the listing used.

Listing	Leatherback	Loggerhead	Green	Hawksbill	Olive Ridley
IUCN Red List:					
Species (date)	V (2013)	V (2015)	E (2004)	CR (2008)	V (2008)
Population (RMU)	CR (2013)	NT (2017)	*		*
Sub-Regional/National					
NEMBA (2007)	CR	E	E	CR	E
Sink & Lawrence (2008)	CR	E	E	CR	E
Hughes & Nel (2014)	E	V	NT	NT	DD

NT – Near Threatened V – Vulnerable E – Endangered CR – Critically Endangered
DD – Data Deficient UR – Under Review * - not yet assessed

7.4.6 Sea Birds

Along the Southeast coast, 60 species are known or thought likely to occur. South Coast seabirds can be categorised into three categories: 'breeding resident species', 'non-breeding migrant species' and 'rare vagrants' (Shaughnessy 1977; Harrison 1978; Liversidge & Le Gras 1981; Ryan & Rose 1989). Fifteen species breed within the Southeast Coast region (see Table 7-6), including Cape Gannets (Algoa Bay islands) (see Figure 7-32, left), African Penguins (Algoa Bay islands) (see Figure 7-32, right), Cape Cormorants (a small population at Algoa Bay islands and mainland sites), White-breasted Cormorant, Roseate Tern (Bird and St Croix Islands), Swift Term (Stag Island) and Kelp Gulls. Although none of these breed within the Reconnaissance Permit Area, a number of species breed along the adjacent mainland coast; a breeding colony of Cape Cormorant has recently established on Robberg Peninsula (Marnewick *et al.* 2015), kelp gulls breed in high numbers on the Keurbooms River estuary spit (Witteveen 2015, but see also Whittington *et al.* 2006) and African Black Oystercatcher, Caspian Tern and White-fronted Plover breed on many of the beaches between Plettenberg Bay and the eastern boundary of the Tsitsikamma Section of the Garden Route National Park (http://www.birdlife.org.za /component/k2/item/240-sa098-tsitsikamma-plettenberg-bay). African Black Oystercatchers breed as far east as East London while breeding of Whitefronted Plovers extends into KwaZulu-Natal (Hockey *et al.* 2005). Damara Terns breed inshore between Cape Agulhas and Cape Infanta on the South Coast,, with the bulk of the South African population breeding in Algoa Bay (Taylor *et al.* 2015; Whittington *et al.* 2015).

Recent changes in bird populations along the South Coast include eastward extensions of the breeding range of Hartlaub's gull (*Larus hartlaubii*) and crowned cormorant (*Phalacrocorax coronatus*) (Whittington 2004; van der Lingen *et al.* 2006; Crawford *et al.* 2012), White-breasted Cormorants (Crawford *et al.* 2013), and Cape Gannet (Crawford *et al.* 2015). Bird Island in Algoa Bay now hosts >70% of all Cape Gannets globally (Sherley *et al*. 2019), with the Algoa Bay islands supporting 40% of African Penguins globally. Plettenberg Bay has also recently been identified as a suitable area in which to establish a new African Penguin colony, in attempts to conserve this species.

Table 7-6: Breeding resident seabirds present along the Southeast coast (adapted from CCA & CMS 2001).

Common Name	Species Name	National Assessment	Global Assessment
African Penguin	*Spheniscus demersus*	Endangered	Endangered
African Black Oystercatcher	*Haematopus moquini*	Least Concern	Near Threatened
White-breasted Cormorant	*Phalacrocorax carbo*	Least Concern	Least Concern
Cape Cormorant	*Phalacrocorax capensis*	Endangered	Endangered
Bank Cormorant	*Phalacrocorax neglectus*	Endangered	Endangered
Crowned Cormorant	*Phalacrocorax coronatus*	Near Threatened	Near Threatened
White Pelican	*Pelecanus onocrotalus*	Vulnerable	Least Concern
Cape Gannet	*Morus capensis*	Endangered	Endangered
Kelp Gull	*Larus dominicanus*	Least Concern	Least Concern
Greyheaded Gull	*Larus cirrocephalus*	Least Concern	Least Concern
Hartlaub's Gull	*Larus hartlaubii*	Least Concern	Least Concern
Caspian Tern	*Hydroprogne caspia*	Vulnerable	Least Concern
Swift Tern	*Sterna bergii*	Least Concern	Least Concern
Roseate Tern	*Sterna dougallii*	Endangered	Least Concern
Damara Tern	*Sterna balaenarum*	Vulnerable	Vulnerable

Figure 7-32: Typical diving seabirds on the South Coast are the Cape Gannets (left) (Photo: NACOMA) and the flightless African Penguin (right) (Photo: Klaus Jost).

Most of the breeding resident seabird species feed on fish (with the exception of the gulls, which scavenge, and feed on molluscs and crustaceans), at times intensively target shoals of pelagic fish, particularly during the 'sardine run'. Small pelagic species such as anchovy and pilchard form important prey items for Agulhas Bank seabirds, particularly the Cape Gannet and the various cormorant species. Feeding strategies include surface plunging (gannets and terns), pursuit diving (cormorants and penguins), and scavenging and surface seizing (gulls). All these species feed relatively close inshore, although gannets and kelp gulls may feed further offshore and may be encountered in the Area of Interest (see Figure 7-33). Increases in numbers of breeding pairs at eastern colonies of kelp gull (*L. dominicanus*), crowned cormorant, swift terns (*Sterna bergii*), and Cape gannet (*Morus capensis*) but not African penguins, in response to the eastward shift of sardines have been reported (van der Lingen *et al.* 2006).

African Penguin colonies in the vicinity of the Reconnaissance Permit Area occur at Cape Recife, and on the Algoa Bay islands (St Croix Island, Jaheel Island, Bird Island, Seal Island, Stag Island and Brenton Rocks), located 30 km and between 56 km and 70 km inshore of the survey area of interest, respectively. This species forages at sea with most birds being found within 20 km of the coast (see Figure 7-34). The majority of Algoa Bay penguins forage to the south and east of Cape Recife and thus inshore of the area of interest. During their pre- and post-moult periods (October to March) penguins forage in inshore areas between Cape Recife and the Robberg Peninsula. African Penguins mainly consume pelagic shoaling fish species such as anchovy, round herring, horse mackerel and pilchard and their distribution is consistent with that of the pelagic shoaling fish, which occur within the 200 m isobath. They are thus unlikely to be encountered in the Area of Interest.

Large numbers of pelagic seabirds exploit the pelagic fish stocks of the Southern Benguela and Agulhas Bank. Of the 49 species of seabirds that occur in the Benguela region, 14 are defined as resident, 10 are visitors from the northern hemisphere and 25 are migrants from the Southern Ocean. The 18 species classified as being common in the southern Benguela are listed in Table 7-7. Pelagic seabirds are therefore likely to be relatively frequently encountered in the offshore waters of the proposed survey area (see Figure 7-35). Most of the species in the region reach highest densities offshore of the shelf break (200 – 500 m depth), with highest population levels during their non-breeding season (winter). Pintado petrels and Prion spp. show the most marked variation here.

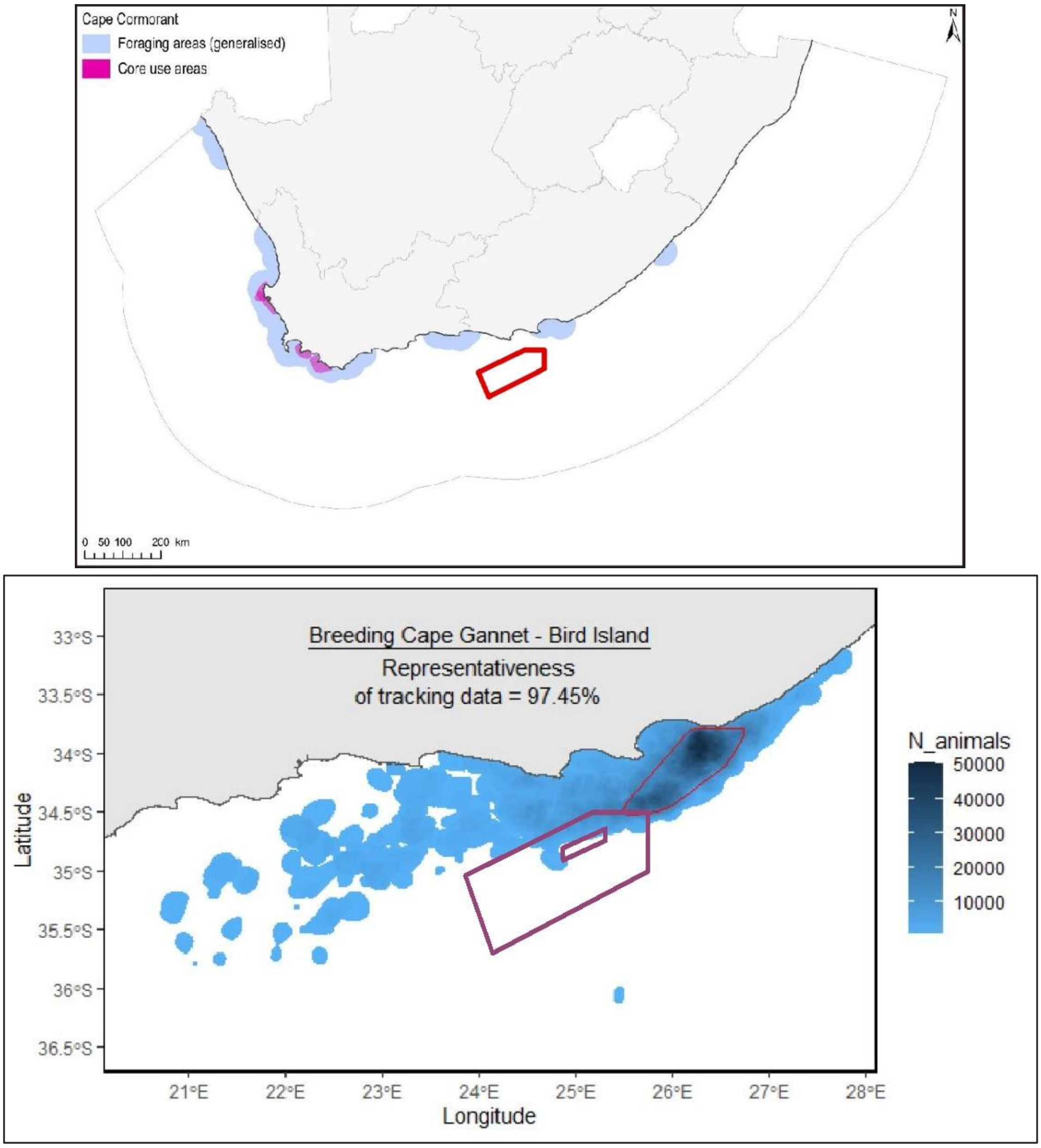


Figure 7-33: The Reconnaissance Permit Area (red polygon) in relation to the foraging and core usage areas of Cape Cormorant (top) and the core usage areas (red line) and general distribution (blue shading) of breeding Cape Gannets from Bird Island (bottom)(adapted from Harris *et al*. 2022; BirdLife South Africa 2022).

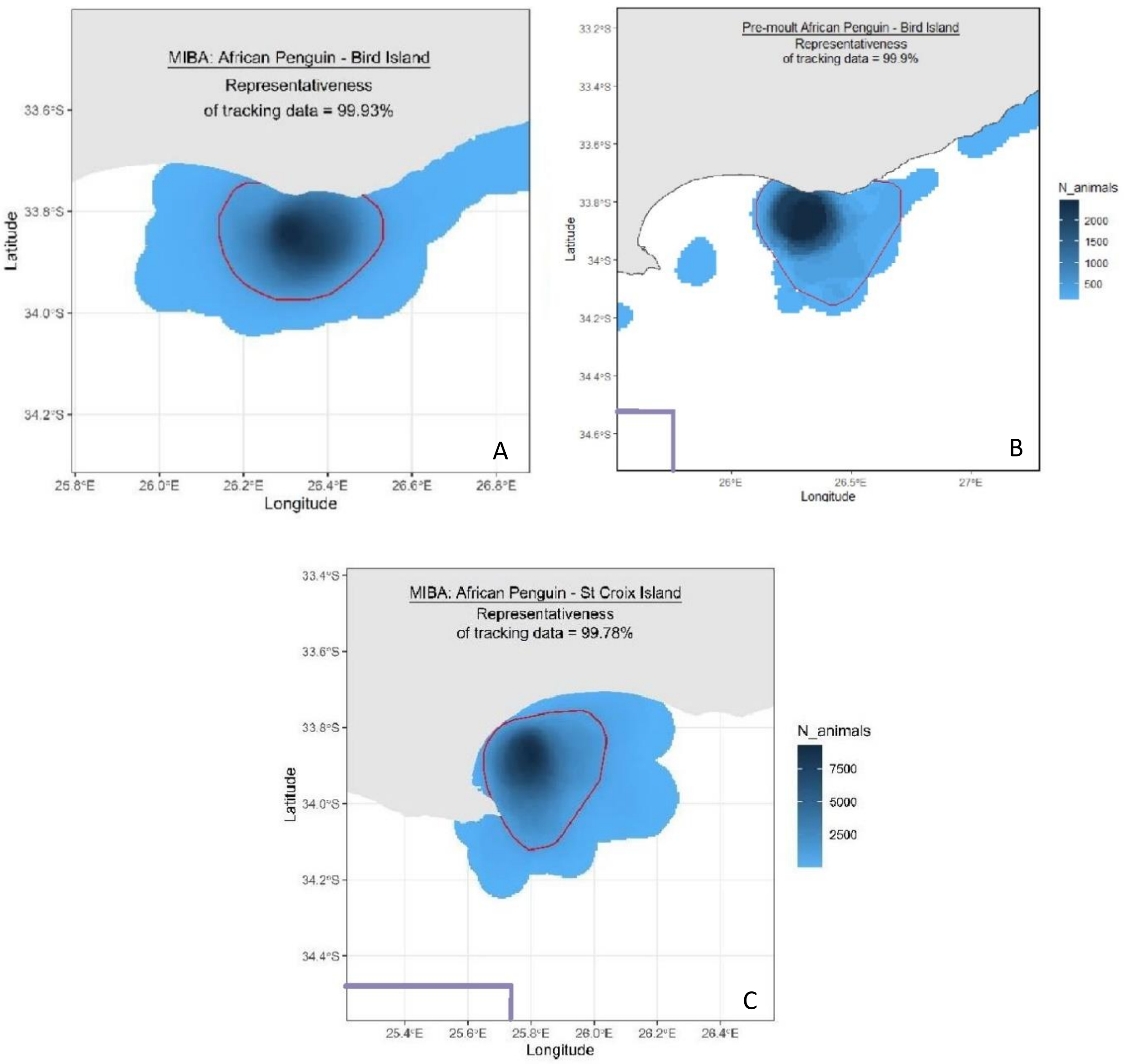


Figure 7-34: The north-eastern corner of the Reconnaissance Permit Area (purple polygon) in relation to the core usage area (red line) and general distribution (blue shading) of A) breeding and B) pre-moult African penguins from Bird Island and C) St Croix Island (Source: BirdLife South Africa 2022).

Table 7-7: Pelagic seabirds common off Southern Africa (BirdLife South Africa).

Common Name	Species Name	Regional Assessment	Global Assessment
Shy Albatross	*Thalassarche cauta*	Near Threatened	Near Threatened
Black-browed Albatross	*Thalassarche melanophrys*	Endangered	Least concern
Atlantic Yellow-nosed Albatross	*Thalassarche chlororhynchos*	Endangered	Endangered
Indian Yellow-nosed Albatross	*Thalassarche carteri*	Endangered	Endangered
Wandering Albatross	*Diomedea exulans*	Vulnerable	Vulnerable
Tristan Albatross	*Diomedea dabbenena*	Critically Endangered	Critically Endangered

Common Name	Species Name	Regional Assessment	Global Assessment
Giant Petrel sp.	*Macronectes halli/giganteus*	Near Threatened	Least concern
Pintado Petrel	*Daption capense*	Least concern	Least concern
Greatwinged Petrel	*Pterodroma macroptera*	Near Threatened	Least concern
Soft plumaged Petrel	*Pterodroma mollis*	Near Threatened	Least concern
Arctic Prion	*Pachyptila desolata*	Least concern	Least concern
Salvin's Prion	*Pachyptila salvini*	Near Threatened	Least concern
Fairy Prion	*Pachyptila turtur*	Near Threatened	Least concern
Broad-billed Prion	*Pachyptila* vittata	Least concern	Least concern
White-chinned Petrel	*Procellaria aequinoctialis*	Vulnerable	Vulnerable
Cory's Shearwater	*Calonectris diomedea*	Least concern	Least concern
Great Shearwater	*Puffinus gravis*	Least concern	Least concern
Sooty Shearwater	*Puffinus griseus*	Near Threatened	Near Threatened
European Storm Petrel	*Hydrobates pelagicus*	Least concern	Least concern
Leach's Storm Petrel	*Oceanodroma leucorhoa*	Critically Endangered	Vulnerable
Wilson's Storm Petrel	*Oceanites oceanicus*	Least concern	Least concern
Blackbellied Storm Petrel	*Fregetta tropica*	Near Threatened	Least concern
Subantarctic Skua	*Catharacta antarctica*	Endangered	Least concern
Sabine's Gull	*Larus sabini*	Least concern	Least concern

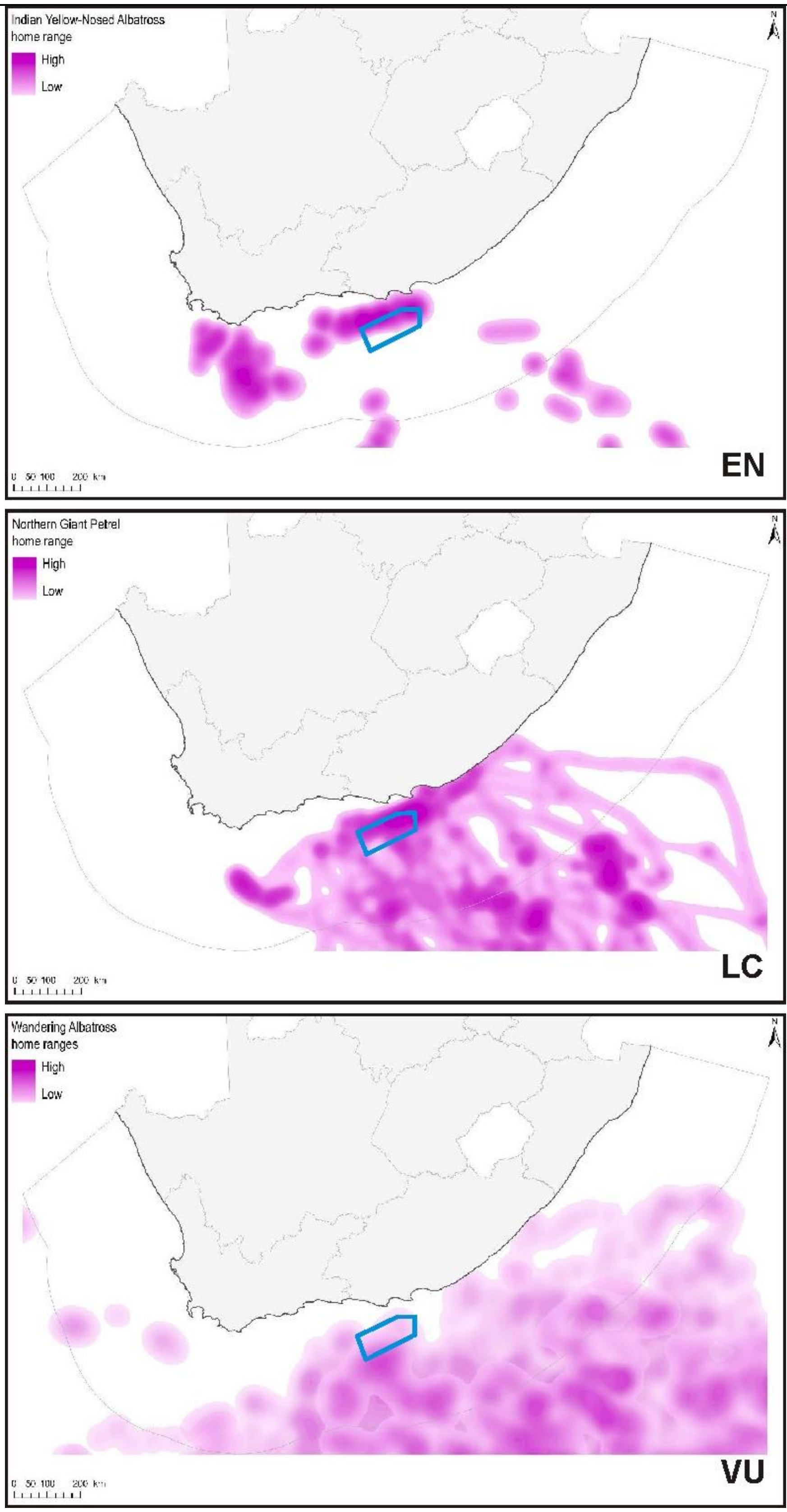


Figure 7-35: The Reconnaissance Permit area (blue polygon) in relation to the foraging areas of Indian Yellow-Nosed Albatross (top), Northern Giant Petrels (middle and Wandering Albatross (bottom) (adapted from Harris et al. 2022; BirdLife South Africa 2022).

7.4.7 Marine Mammals

The marine mammal fauna of the eastern coast of southern Africa comprises between 28 and 38 species of cetaceans (whales and dolphins) known (historic sightings or strandings) or likely (habitat projections based on known species parameters) to occur here (see Table 7-8, Figure 7-36 and Figure 7-37) and one seal species, the Cape fur seal (*Arctocephalus pusillus*) (Best 2007).

7.4.7.1 Cetaceans

The offshore areas have been particularly poorly studied with almost all available information from deeper waters (>200 m) arising from historic whaling records, although in the past ten years, passive acoustic monitoring and satellite telemetry have begun to shed light on current patterns of seasonality and movement for some large whale species (Mate *et al.* 2011; DEFF 2015; Trudelle *et al.* 2017) but information on smaller cetaceans in deeper waters remains poor outside of reports from seismic surveys themselves. Of the migratory cetaceans listed in Table 7-8, the blue, sei and humpback whales are listed as 'Endangered' and the Southern Right, South African inshore Bryde's and fin whale as 'Vulnerable' in the IUCN Red Data book. Knowledge of cetacean distribution patterns in the proposed survey area is poor as it falls between the main east and west coast whaling grounds while most recent research in the area has been very coastal in nature (e.g. Caputo *et al.* 2020). The distribution of whales and dolphins on the Southeast coast can largely be split into species associated with the continental shelf and species which occur in deep, oceanic waters. Species from both environments may, however, be found associated with the shelf break (200 – 1,000 m), so the shelf area is typically the most species-rich area for cetaceans. Cetacean density on the continental shelf is usually higher than in pelagic waters, as species associated with the pelagic environment tend to be wide-ranging across 1 000s of km.

Cetaceans comprise two basic taxonomic groups: the mysticetes (filter-feeding baleen whales) and the odontocetes (toothed predatory whales and dolphins). Due to large differences in their size, sociality, communication abilities, ranging behaviour and acoustic behaviour, these two groups are considered separately.

<u>Mysticetes (baleen whales)</u>

The majority of baleen whales fall into the family Balaenopteridae (rorqual whales). Those potentially occurring in the offshore portions of the proposed exploration area include the blue, fin, sei, minke, and dwarf minke, although the most likely to be seen are the humpback whale, southern right whale and inshore Bryde's which are more strongly associated with the continental shelf. Most of the 'offshore' species occur in pelagic waters, with only occasional visits onto the shelf. These species show some degree of migration either to, or through, the proposed exploration area when *en route* between higher-latitude feeding grounds (Antarctic or Subantarctic) and lower-latitude breeding grounds. Depending on the ultimate location of these feeding and breeding grounds, seasonality off South Africa can be either unimodal (usually in June-August, e.g. minke and blue whales) or bimodal (usually May-July and October-November, e.g. fin whales), reflecting a northward and southward migration through the South Coast area. As whales follow geographic or oceanographic features, the northward and southward migrations may take place at different distances from the coast, thereby influencing the seasonality of occurrence at different locations. Due to the complexities of the migration patterns, each species is discussed in further detail below. Seasonality of baleen whales within the broader project area is provided in Table 7-8.

Table 7-8: Cetaceans occurrence off the Southeast coast of South Africa, their seasonality and likely encounter frequency with proposed seismic survey operations (adapted from S. Elwen, Mammal Research Institute, pers. comm., Best 2007). IUCN Conservation Status is based on the SA Red List Assessment (2014) (Child *et al.* 2016).

Common Name	Species	Hearing Frequency	Shelf (<200 m)	Offshore (>200 m)	Seasonality	IUCN Conservation Status
Delphinids						
Common bottlenose dolphin	*Tursiops truncatus*	HF	Yes	Yes	Year round	Least Concern
Indo-Pacific bottlenose dolphin	*Tursiops aduncus*-Ifafa-Kosi Bay subpopulation	HF	Yes		Year round	Vulnerable
	T. aduncus-Ifafa-False Bay subpopulation	HF	Yes		Year round	Near threatened
	T. aduncus-Seasonal subpopulation	HF	Yes		Year round	Data Deficient
Common (short beaked) dolphin	*Delphinus delphis*	HF	Yes	Yes	Year round	Least Concern
Common (long beaked) dolphin	*Delphinus capensis*	HF	Yes		Year round	Least Concern
Fraser's dolphin	*Lagenodelphis hosei*	HF		Yes	Year round	Least Concern
Spotted dolphin	*Stenella attenuata*	HF	Yes	Yes	Year round	Least Concern
Striped dolphin	*Stenella coeruleoalba*	HF		Yes	Year round	Least Concern
Spinner dolphin	*Stenella longirostris*	HF	Yes		Year round	Least Concern
Indo-Pacific humpback dolphin	*Sousa plumbea*	HF	Yes		Year round	Endangered
Long-finned pilot whale	*Globicephala melas*	HF		Yes	Year round	Least Concern
Short-finned pilot whale	*Globicephala macrorhynchus*	HF		Yes	Year round	Least Concern
Killer whale	*Orcinus orca*	HF	Occasional	Yes	Year round	Least Concern
False killer whale	*Pseudorca crassidens*	HF	Occasional	Yes	Year round	Least Concern
Risso's dolphin	*Grampus griseus*	HF	Yes (edge)	Yes	Year round	Least Concern

Common Name	Species	Hearing Frequency	Shelf (<200 m)	Offshore (>200 m)	Seasonality	IUCN Conservation Status
Pygmy killer whale	*Feresa attenuata*	HF		Yes	Year round	Least Concern
Sperm whales						
Pygmy sperm whale	*Kogia breviceps*	VHF		Yes	Year round	Data Deficient
Dwarf sperm whale	*Kogia sima*	VHF		Yes	Year round	Data Deficient
Sperm whale	*Physeter macrocephalus*	HF		Yes	Year round	Vulnerable
Beaked whales						
Cuvier's	*Ziphius cavirostris*	HF		Yes	Year round	Least Concern
Arnoux's	*Beradius arnouxii*	HF		Yes	Year round	Data Deficient
Southern bottlenose	*Hyperoodon planifrons*	HF		Yes	Year round	Least Concern
Strap-toothed whale	*Mesoplodon layardii*	HF		Yes	Year round	Data Deficient
Longman's	*Mesoplodon pacificus*	HF		Yes	Year round	Data Deficient
True's	*Mesoplodon mirus*	HF		Yes	Year round	Data Deficient
Gray's	*Mesoplodon grayi*	HF		Yes	Year round	Data Deficient
Blainville's	*Mesoplodon densirostris*	HF		Yes	Year round	Data Deficient
Strap-toothed whale	*Mesoplodon layardii*	HF		Yes	Year round	Data Deficient
Baleen whales						
Antarctic Minke	*Balaenoptera bonaerensis*	LF	Yes	Yes	>Winter	Least Concern
Dwarf minke	*B. acutorostrata*	LF	Yes		Year round	Least Concern
Southern Hemisphere Fin whale	*B. physalus*	LF		Yes	MJJ & ON, rarely in summer	Endangered
Pygmy Blue whale	*B. musculus brevicauda*	LF		Yes	MJJ	Data Deficient

Common Name	Species	Hearing Frequency	Shelf (<200 m)	Offshore (>200 m)	Seasonality	IUCN Conservation Status
Blue whale	*B. musculus intermedia*	LF		Yes	Winter	Critically Endangered
Sei whale	*B. borealis*	LF		Yes	MJ & ASO	Endangered
Bryde's (inshore)	*B. edeni (inshore form)*	LF		Yes	Year round	Vulnerable
Pygmy right	*Caperea marginata*	LF	Yes		Year round	Least Concern
Humpback	*Megaptera novaeangliae*	LF	Yes	Yes	AMJJASOND	Least Concern
Southern right	*Eubalaena australis*	LF	Yes		JJASON	Least Concern
Underwater Hearing groups: VHF = Very High Frequency; HF = High Frequency; LF = Low Frequency						

Table 7-9: Seasonality of baleen whales in the broader project area (Best 2007 and other sources) and data from stranding events (NDP unpubl data). Values of high (H), Medium (M) and Low (L) are relative within each row (species) and not comparable between species.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bryde's Inshore	L	L	L	L	M	M	M	L	L	M	M	L
Sei	L	L	L	L	**H**	**H**	H	L	L	**H**	**H**	L
Fin	M	M	M	M	**H**	**H**	**H**	L	L	**H**	**H**	M
Blue	L	L	L	L	L	**H**	**H**	**H**	L	M	L	L
Minke	M	M	M	**H**	**H**	**H**	M	**H**	**H**	**H**	M	M
Humpback	**H**	M	L	L	L	M	M	M	**H**	**H**	**H**	**H**
Southern right	**H**	M	L	L	L	M	M	M	**H**	**H**	**H**	**H**

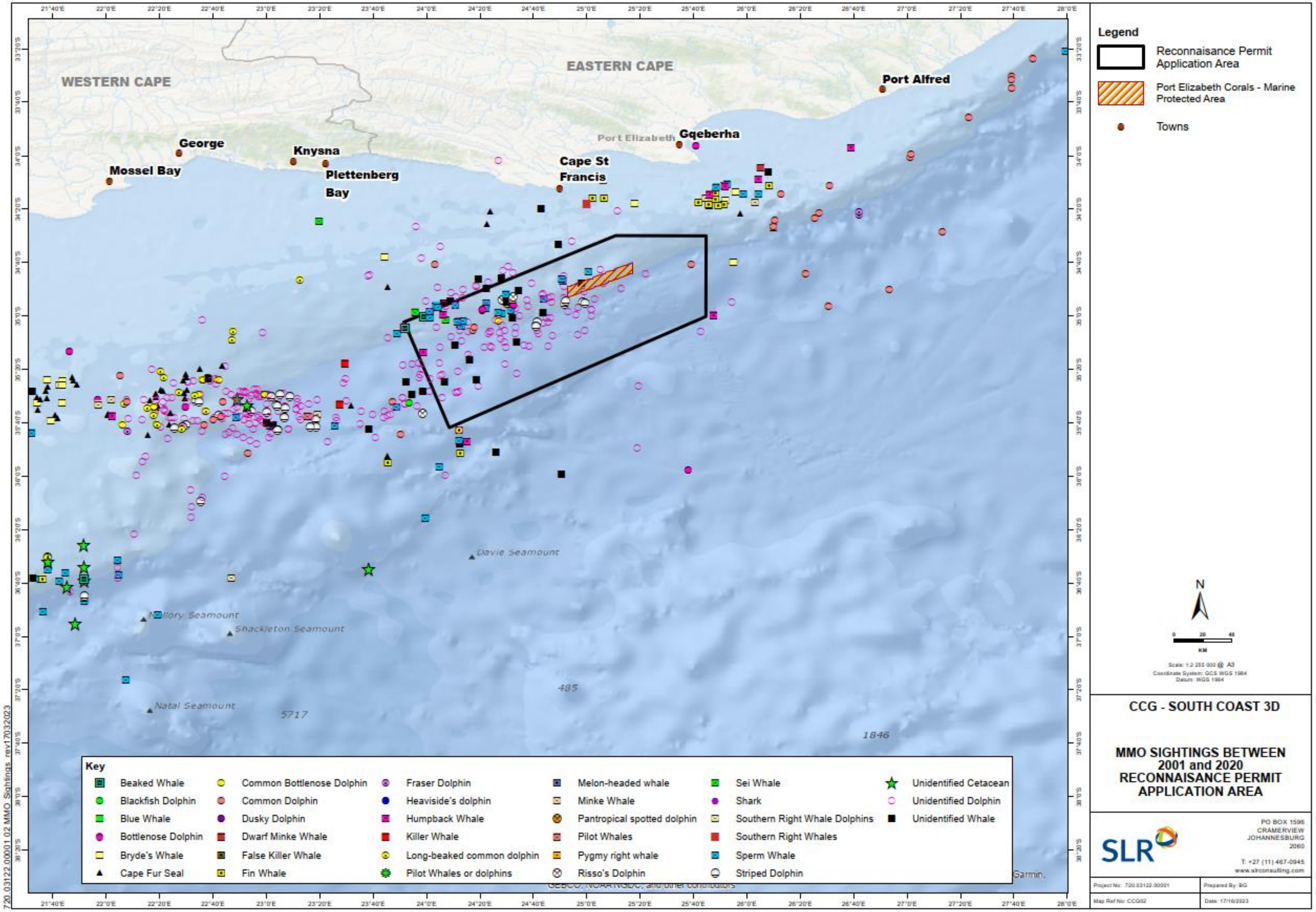


Figure 7-36: The Reconnaissance Permit Area (black polygon) in relation to the distribution and movement of cetaceans in the broader project area collated between 2001 and 2020 (SLR MMO database).

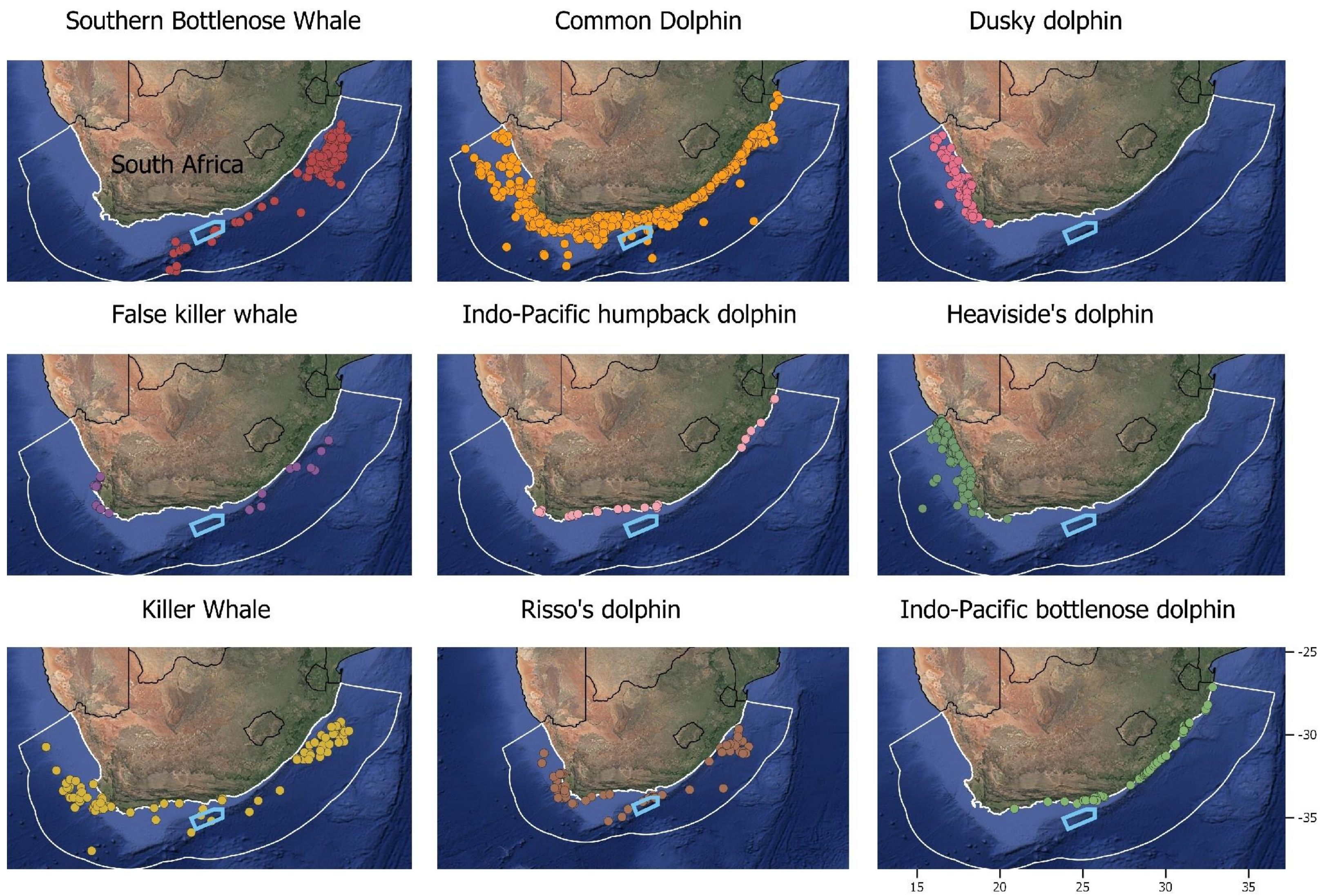


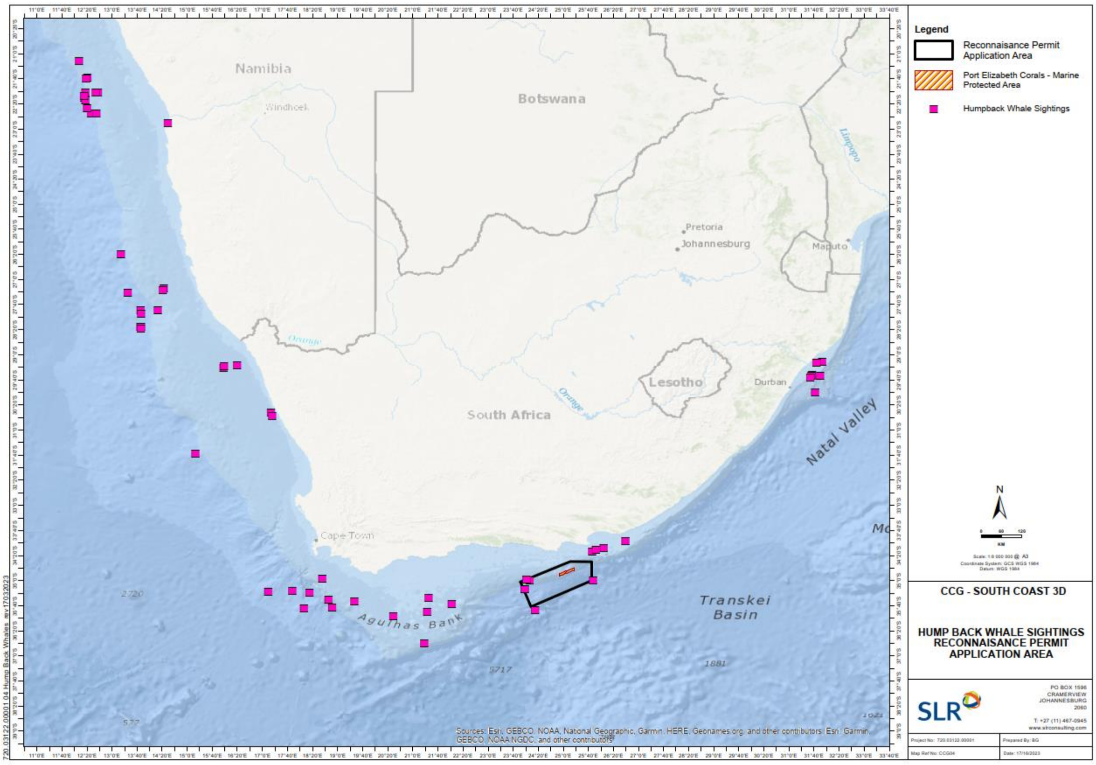
Figure 7-37: The Reconnaissance Permit area in relation to projections of predicted distributions for nine odontocete species off the coast of South Africa (adapted from Purdon et al. 2020a)

Southern right whales (*Eubalaena australis*): Southern right whales migrate to the southern African subregion to breed and calve, inhabiting shallow coastal waters in sheltered bays (90% were found <2 km from shore; Best 1990; Elwen & Best 2004). The southern African population of southern right whales (see Figure 7-38, right) historically extended from southern Mozambique (Maputo Bay) to southern Angola (Baie dos Tigres) and is considered a single population within this range (Roux *et al.* 2015). The main winter breeding concentration is in the bays off the Cape South Coast between Cape Town and Gqeberha, with the highest density between Walker Bay and St Sebastian Bay. **Southern right whale sightings east and offshore of Algoa Bay are thus likely to be very rare**. They typically occur in coastal waters off the south coast between June and November, although animals may be sighted as early as April and as late as January.

The most recent abundance estimate for this population (2017), estimated the population at ~6 116 individuals including all age and sex classes (Brandão *et al.* 2018). This is thought to be at least 30 % of the original population size and with the population growing at ~6.5% per year since monitoring began (Brandão *et al.* 2018). Although the population is likely to have continued growing indications are that food shortages have resulted in changes in breeding cycles and feeding areas (Van Den Berg *et al.* 2020) with concomitant changes in the numbers of different classes of right whales seen along the SA coast (Roux *et al.* 2015; Vermeulen *et al.* 2020). These changes in behaviour and distribution patterns are indications of a population undergoing nutritional stress and disturbance during these times should be avoided.

Figure 7-38: The humpback whale (left) and the southern right whale (right) migrate along the Southeast coast during winter (Photos: www.divephotoguide.com; www.aad.gov.au).

Humpback whales (*Megaptera novaeangliae*): Humpback whales (see Figure 7-38, left) are known to migrate between their Antarctic feeding grounds and their winter breeding grounds in tropical waters e.g. Angola, Mozambique and Madagascar. During this migration they use subtropical coastal areas as important migratory corridors (Best 2007). Although they have a cosmopolitan distribution (Best 2007) they exhibit a distinct seasonality in occurrence along the South African East Coast. This species can be observed between May and February, with peak sightings in June and November/December (Banks 2013). These peaks correspond to the northward migration, as animals pass through the Reconnaissance Permit Area *en-route* to their breeding grounds off Mozambique and Madagascar, and the southward migration when they migrate back to their Southern Ocean feeding grounds. Cow-calf pairs can be seen closer to the coast during the southward migration than non-calf groups, and they appear to use the relatively protected bays along the South Coast to rest during their migration, while Banks (2013) showed the migration stream to extend to at least 16 km offshore with opportunistic sightings suggesting animals are spread across the entire shelf (see Figure 7-39). Recent satellite tagging of animals during the northward migration on the Transkei coast (well into what is historically through of as the 'east coast population area', showed them to turn around and end up feeding in the Southern Benguela (DEFF 2015) and the population origin of these animals remains unknown. Unexpected results such as this highlight the complexities of understanding whale movements and distribution patterns and the fact that descriptions of broad season peaks in no way captures the wide array of behaviours exhibited by these animals. **The chance of encountering the species within the survey area of interest from January to May is considered to be low.**



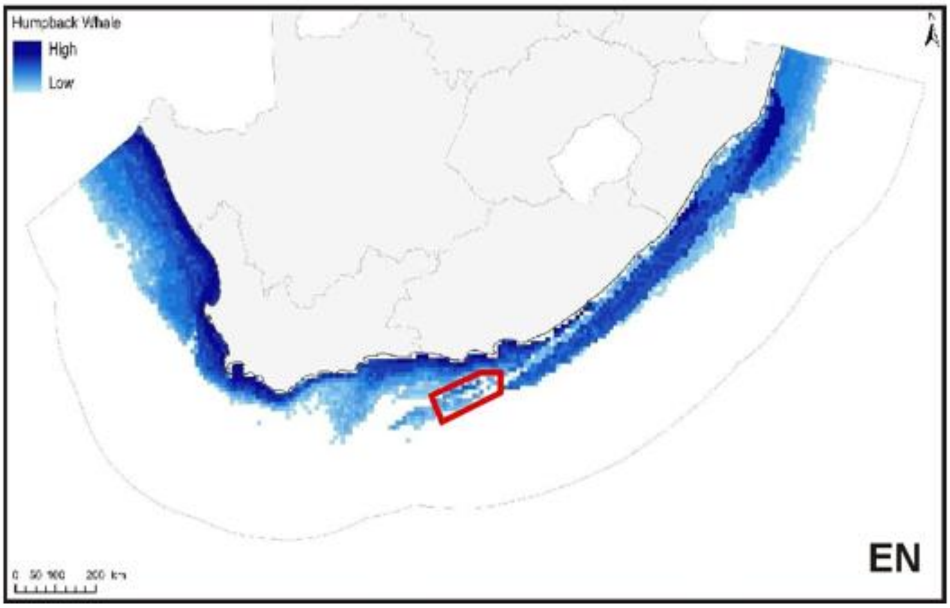


Figure 7-39: The project area in relation to the distribution and movement of humpback whales along the southern African coast collated between 2001 and 2020 (SLR MMO database; top) and predicted distributions (adapted from Harris *et al*. 2022; bottom)

Sei whales (*Balaenoptera borealis*): Sei whales migrate through South African waters, where they were historically hunted in relatively high numbers, to unknown breeding grounds further north. Their migration pattern thus shows a bimodal peak with numbers on the east coast highest in June (on the northward migration), and with a second larger peak in September. All whales were caught in waters deeper than 200 m with most deeper than 1,000 m (Best & Lockyer 2002). A recent sighting (January 2020) by a tour operator in Algoa Bay, confirms their current presence along the coast in low numbers. Almost all information is based on whaling records 1958-1963 and there is no current information on abundance or distribution patterns in the region. Sightings have, however, been recorded in the western inshore areas of the survey area of interest (SLR MMO database) (see Figure 7-36). **The likelihood of encountering the species in the survey area of interest from January to May is considered to be low.**

Fin whales (*Balaenoptera physalus*): Fin whales were historically caught off the East Coast of South Africa, with a unimodal winter (June-July) peak in catches off Durban. However, as northward moving whales were still observed as late as August/September, it is thought that the return migration may occur further offshore. Some juvenile animals may feed year-round in deeper waters off the shelf (Best 2007). There are no recent data on abundance or distribution of fin whales off Southern Africa. Sightings have, however, been recorded in the vicinity of Gqeberha, inshore of the survey area of interest (SLR MMO database) (see Figure 7-36). **The likelihood of encountering the species in the survey area of interest from January to May is considered to be low.**

Blue whales (*Balaenoptera musculus*): Blue whales were historically caught in high numbers off Durban, showing a single peak in catches in June/July. Sightings of the species in the area between 1968-1975 were rare and concentrated in March to May (Branch *et al.* 2007). Data from the Antarctic and western Africa provide evidence of regular detection of this species there, with likely similar trends in recovery on the east coast. Detections of blue whales in the Antarctic peak between December and January (Tomisch *et al.* 2016) and off western South Africa (Shabangu *et al.* 2019) and in northern Namibia between May and July (Thomisch 2017) supporting observed timing from whaling records. **The chance of encountering the species in the Area of Interest is considered low.**

Figure 7-40: The Bryde's whale Balaenoptera brydei (left) and Minke whale Balaenoptera bonaerensis (right) Photos: www.dailymail.co.uk; www.marinebio.org

Bryde's whales (*Balaenoptera brydei* spp.): Two types of Bryde's whales are recorded from South African waters - a smaller neritic 'inshore' form which recent research indicates is a subspecies of the larger pelagic form described as *Balaenoptera brydei* (see Figure 7-40; left) which occurs off the west coast and outside of the survey area (Olsen 1913; Penry 2010). The inshore population is unique in that it is resident year-round on the Agulhas Bank, only undertaking occasional small seasonal excursions up the east coast in winter during the annual sardine migration. Sightings over the last two decades suggest that the distribution of this population has shifted eastwards, most likely in response to a shift in their prey distribution (Best 2001, 2007; Penry *et al.* 2011). Peak encounter rates in Plettenberg Bay are during late summer and Autumn (Mar – May) (Penry *et al.* 2011), while in Algoa Bay sightings are lowest Aug-Oct but roughly similar in other months of the year suggesting an effective year-round residence (see Figure 7-41). Its current distribution thus implies that this species **highly likely to be encountered in the survey area of interest throughout the year.** This is a small population (~600 individuals), which is possibly decreasing in size; an abundance estimate of 150 – 250 individuals was made for Bryde's whales using the Plettenberg Bay/Knysna area in 2005-2008 (Best *et al.* 1984; Penry 2010). As a small, genetically isolated population with a small distributional range largely concentrated on the Agulhas Banks – it is the most vulnerable of the baleen whales to anthropogenic threats. The recent South African National Red Data list assessment has also reclassified this population as 'Vulnerable' (Penry *et al.* 2016).

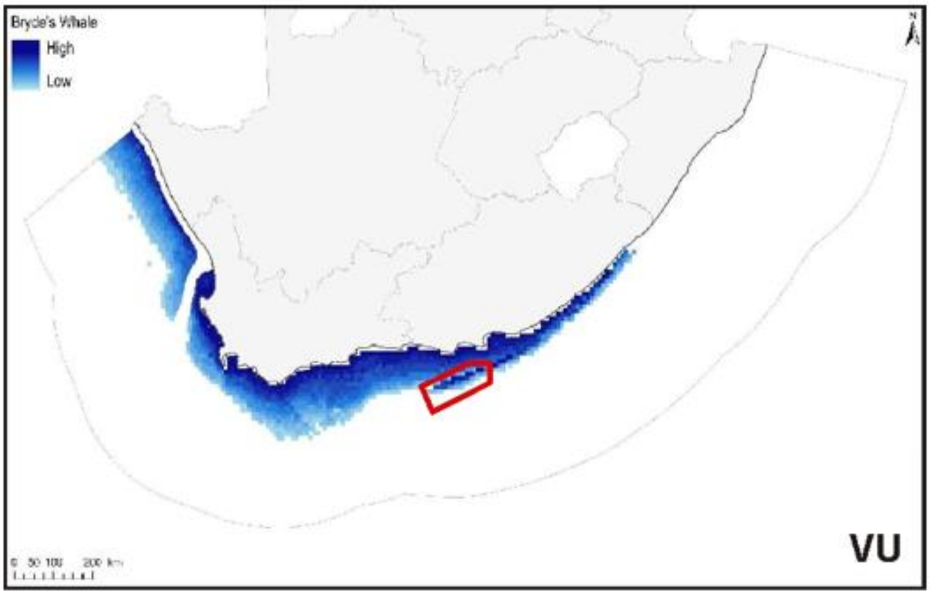


Figure 7-41: The project area in relation to projections of predicted distribution of Bryde's whales (adapted from Harris *et al*. 2022)

Minke whales: Two forms of minke whale occur in the southern Hemisphere, the Antarctic minke whale (*Balaenoptera bonaerensis*; see Figure 7-40; right) and the dwarf minke whale (*B. acutorostrata* subsp.); both species occur off the East Coast (Best 2007). Antarctic minke whales range from the pack ice of Antarctica to tropical waters and are usually seen more than ~50 km offshore. Although adults of the species do migrate from the Southern Ocean (summer) to tropical/temperate waters (winter) where they are thought to breed, some animals, especially juveniles, are known to stay in tropical/temperate waters year-round. Off Durban, Antarctic minke whales were reported to increase in numbers in April and May, remaining at high levels through June to August and peaking in September (Best 2007).

The dwarf minke whale has a more temperate distribution than the Antarctic minke and they do not range further south than 60-65°S. Dwarf minke whales have a similar migration pattern to Antarctic minkes with at least some animals migrating to the Southern Ocean in summer months. Dwarf minke whales occur closer to shore than Antarctic minkes and have been seen <2 km from shore on several occasions around South Africa, particularly on the East Coast during the 'sardine run' (O'Donoghue *et al.* 2010a, 2010b, 2010c). Historic whaling records indicate that off Durban they were taken mainly between April and June. Both species are generally solitary and **densities are likely to be low in the Reconnaissance Permit Area**.

Minke whales are present year-round, with a large portion of this population consisting of small, sexually immature animals that primarily occur beyond 30 nautical miles from the coast during summer and autumn.

Pygmy right whales: The smallest of the baleen whales, the pygmy right whale, occurs along the southern African East Coast to as far north as 30°S. There are no data on the abundance or conservation status of this species, but it was not subjected to commercial whaling, so the population is expected to be near to original numbers. Sightings of this species at sea are rare (Best 2007) due in part to their small size and inconspicuous blows. **Density in the Reconnaissance Permit Area is likely to be low.**

In summary, the majority of data available on the seasonality and distribution of large whales on the East Coast of South Africa is largely the result of commercial whaling activities mostly dating from the 1960s, and stranding or by catch records (Meÿer *et al.* 2011) although passive acoustic monitoring (mostly west coast) and satellite tagging is providing some new insights into current patterns. The large whale species for which there are current data available are the humpback, southern right and inshore Bryde's whale, for which additional information on their occurrence in the exploration area has been provided. Even those species, which are relatively well studied around southern Africa, are not fully understood and significant changes in behaviour, movements and timing (e.g. right whale numbers and timing along the coast, humpback whales changing coasts) reveal that much of our assumed knowledge is far from complete and that many changes continue to occur both in response to population recover and local and large scale environmental changes.

Odontocetes (toothed whales)

The Odontoceti are a varied group of animals including the dolphins, porpoises, beaked whales and sperm whales. Species occurring within the broader project area display a diversity of features, for example their ranging patterns vary from extremely coastal and highly site-specific to oceanic and wide ranging. Those in the region can range in size from 1.9 m long (Spinner dolphin) to 17 m (bull sperm whale).

Sperm whales (*Physeter macrocephalus*): Almost all information about sperm whales in the southern African subregion results from data collected during commercial whaling activities prior to 1985 (Best 2007). Sperm whales (see Figure 7-42, left) are the largest of the toothed whales and have a complex, well-structured social system with adult males behaving differently to younger males and female groups. Sperm whales live in deep ocean waters over 1 000 m deep; however, males occasionally move into depths of 500-200 m on the shelf (Best 2007). **They are therefore likely to be encountered in the Reconnaissance Permit Area** (see Figure 7-43). Seasonality of catches off the East Coast suggest that medium- and large-sized males are more abundant during winter (June to August), while female groups are more abundant in summer (December - February), although animals occur year-round (Best 2007). Although considered relatively abundant worldwide (Whitehead 2002), no current data are available on density or abundance of sperm whales on the Southeast coast of southern Africa, but passive acoustic monitoring southwest of Cape Town revealed near year-round presence of sperm whale echolocation clicks. Sperm whales feed at great depth, during dives of more than 30 minutes, making them difficult to detect visually. The regular echolocation clicks made by the species when diving, however, make them relatively easy to detect acoustically using Passive Acoustic Monitoring (PAM).

Figure 7-42: Sperm whales *Physeter macrocephalus* (left) and killer whales *Orcinus orca* (right) are toothed whales likely to be encountered in offshore waters (Photos: www.onpoint.wbur.org; www.wikipedia.org).

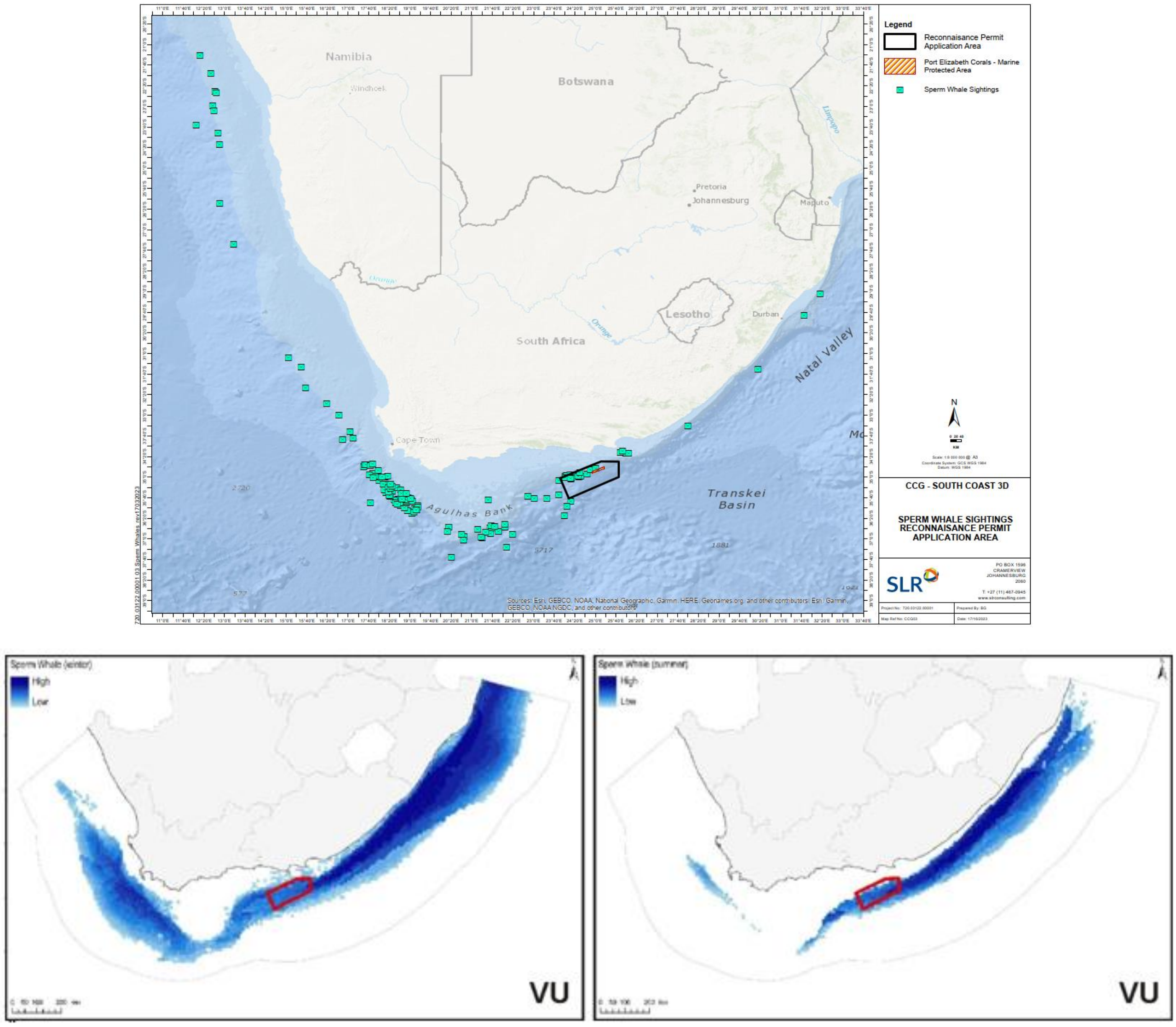


Figure 7-43: The project area in relation to the distribution and movement of sperm whales along the southern African coast collated between 2001 and 2020 (SLR MMO database; top) and projections of predicted winter (bottom left) and summer (bottom right) distributions (adapted from Harris *et al*. 2022).

There are almost no data available on the abundance, distribution or seasonality of the smaller odontocetes (including the beaked whales and dolphins) known to occur in oceanic waters off the shelf of the southeast coast. Beaked whales are all considered to be true deep water species usually being seen in waters in excess of 1 000 – 2 000 m depth (see various species accounts in Best 2007). Their presence in the area may fluctuate seasonally, but insufficient data exist to define this clearly. Of the smaller odontocetes, the long-beaked common dolphin, Indo-Pacific bottlenose dolphin and Indian Ocean humpback dolphin regularly occur along the southeast coast of South Africa and are frequently encountered in Mossel Bay, Knysna, Plettenberg Bay and Tsitsikamma area (Phillips 2006; Best 2007; Greenwood 2013; James *et al.* 2015). Figure 7-37 provides the projections of predicted distributions for nine odontocete species off the coast of South Africa (Purdon *et al.* 2020a) in relation to the Reconnaissance Permit Area.

Humpback dolphins (*Sousa plumbea*): Humpback dolphins (see Figure 7-44, right) occur along the South African South and East coasts in two apparently separate populations. These populations range from False Bay to approximately East London and from Durban to Richards Bay. Humpback dolphins in the western Indian Ocean were only recognised as a separate species in 2014 (Jefferson & Rosenbaum 2014). Globally they are listed as 'vulnerable' and within South Africa as 'endangered' on the IUCN Red List (Plön *et al.* 2015), and are considered to be South Africa's most endangered marine mammal.

Recent studies in Plettenberg Bay and Algoa Bay indicated a decrease in sightings and group sizes in both locations by approximately 50% in the last decade and a reduction in mean group sizes from 7 to 4 individuals (Greenwood 2013; Koper *et al.* 2016). Several hypotheses have been put forward as likely reasons for the decline; a decrease in prey availability, prolonged disturbance from whale and dolphin watching tourism and other marine recreation, coastal development and sustained pollution that contaminates the prey on which this species depends.

Humpback dolphins inhabit the extreme inshore coastal environment rarely encountered much beyond 20 m water depth and a few hundred meters of land. Although this zone is well away from the expected areas of seismic survey, it is not known how much of the sound from seismic surveys travels into this area. Given their highly endangered nature a precautionary approach is strongly advised.

Figure 7-44: Toothed whales that occur on the South Coast include the Indo-Pacific bottlenose dolphin (left) and the Indian Ocean humpback dolphin (right) (Photos: www.fish-wallpapers.com; www.shutterstock.com).

Indo-Pacific Bottlenose dolphins (*Tursiops aduncus*): The Indo-Pacific bottlenose dolphin (see Figure 7-44, left) occurs throughout coastal and shallow offshore waters of the temperate and tropical regions of the Indian Ocean and south-west Pacific to as far west as the Cape Peninsula. Off South Africa, they inhabit waters less than 50 m deep between the Mozambique border in the east and False Bay in west (Ross 1984; Ross *et al.* 1987). They occur year-round in the coastal habitat inshore of the Reconnaissance Permit area. Indo-Pacific bottlenose dolphins are often seen in large groups of 10s to 100s of animals (Saayman *et al.* 1972; Ross 1984; Melly 2011) with calves seen year-round along the southeast coast (Cockcroft *et al.* 1990; Best 2007). In Algoa Bay peak sightings were recorded in April/May (autumn) and October/November (spring) (Melly *et al.* 2017).

A mark-recapture study conducted in Knysna-Tsitsikamma area estimated a population of approximately 1 873 – 2 479 individuals (Vargas-Fonseca *et al.* 2020), which is a substantial reduction from the ~7 000 bottlenose dolphins in only the Plettenberg Bay area estimated by Phillips (2006). They are thought to be part of a larger population of between 16 000 and 41 000 that ranges along a broader southeast coast area (Reisinger & Karczmarski 2010; Caputo *et al.* 2020). The large decline in the Plettenberg Bay area is not currently understood and it is not known if it represents a total decline of the population or a more regional shift in habitat use associated with a shift in food resources or increase in human pressures in Plettenberg Bay area (e.g. marine tourism). Regardless, such a large decrease in a population of a significant section of its range (145 km) suggests the population is likely to be stressed at some level making it more vulnerable to external impacts.

Although their distribution is essentially continuous from Cape Agulhas eastwards to southern Mozambique, along the KZN coast the Indo-Pacific bottlenose dolphin seems to have ‘preferred areas’ (Ross *et al.* 1987; Ross *et al.* 1989; Cockcroft *et al.* 1990, 1991). Areas in which it is more frequently encountered are about 30 km apart, and are thought to correspond to discrete home ranges. Genetic assessments have identified a resident population North of Ifafa (KZN coast, listed as ‘vulnerable’), a resident population south of Ifafa (listed as ‘near threatened’), as well as a migratory population South of Ifafa (‘data deficient’), which appears to undertake seasonal migrations into KZN waters in association with the ‘sardine run’ (Natoli *et al.* 2008; Cockcroft *et al.* 2016). Little is known about the offshore form of the species, and nothing about their population size or conservation status. They sometimes occur in association with other species, such as pilot whales or false killer whales (Best 2007) and are likely to be present year-round in waters deeper than 200 m. **Densities in the survey area of interest are likely to be low.**

Common dolphins (*Delphinus spp.*): Two species of common dolphin are currently recognised, the short-beaked common dolphin (*Delphinus delphis*) and the long-beaked common dolphin (*Delphinus capensis*). The long-beaked common dolphin (*D. capensis*) is resident to the temperate Agulhas Bank (cf. Agulhas Eco-region) with sightings extending as far up the West Coast as St Helena Bay and up the East coast to Richards Bay, in waters less than 500 m deep. Individuals of this species are wide ranging within this area and may move hundreds of kilometers in short periods of time. They are not known to show any degree of residency to coastal areas. Group sizes in this species tend to be large: 100s to even 1000s of animals. No population estimate is available for the two species, but they are thought to be large (15 000 – 20 000; Cockcroft & Peddemors 1990; Peddemors 1999). The short-beaked common dolphin prefers offshore habitats and is likely to be encountered only in the offshore portions of the Reconnaissance Permit Area. Estimates of the population size and seasonality for the subregion are lacking.

A few studies have suggested that common dolphins inhabit the Eastern Cape coastline during summer, with movements towards the southern KwaZulu-Natal coastline during winter (Ross 1984; Cockcroft &

Peddemors 1990; O'Donoghue *et al.* 2010a, 2010b, 2010c), associated with the annual sardine migration up the east coast in winter (Best 2007). Aerial surveys carried out between Port Elizabeth and East London in the late 1980s detected common dolphins in low densities throughout the year (Cockcroft & Peddemors 1990) and surveys along the Eastern Cape (East London to Port Edward) by the KZN Sharks Board from 1996-2014 (May to August only) showed common dolphins to be the most populous cetacean along this coast with 10s of sightings of large groups per month. **Long-beaked common dolphins can thus be assumed to be present in high numbers year round, and are likely to be encountered in the Area of Interest.**

<u>Other species</u>

Killer whales, false killer whales and common bottlenose dolphins are regularly reported by fishermen operating in deeper waters off the Southeast coast of South Africa. These species are therefore likely to occur in the Reconnaissance Permit Area. Rarely encountered dwarf and pygmy sperm whales, pygmy killer whales, Risso's and Frazer's dolphins, striped, spinner and Pan-tropical spotted dolphins, and several beaked whale species have distributions that overlap with the project area (Findlay *et al.* 1992; Best 2007); their occurrence is thought to be rare, but insufficient data is available on the abundance and spatio-temporal distribution of these species to make an accurate assessment of their susceptibility to the proposed seismic exploration.

The genus *Kogia* currently contains two recognised species, the **pygmy (*K. breviceps*) and dwarf (*K. sima*) sperm whales**. Due to their small body size, cryptic behaviour, low densities and small school sizes, these whales are difficult to observe at sea, and morphological similarities make field identification to species level problematic. The majority of what is known about Kogiid whales in the southern African subregion results from studies of stranded specimens (e.g. Ross 1979; Findlay *et al.* 1992; Plön 2004; Elwen *et al.* 2013). *Kogia* species most frequently occur in pelagic and shelf edge waters, are thus likely to occur in the Reconnaissance Permit Area at low levels; seasonality is unknown. Dwarf sperm whales are associated with warmer tropical and warm-temperate waters. **However, abundance in the Reconnaissance Permit Area is likely to be very low.**

Killer whales (see Figure 7-42, right) have a cosmopolitan distribution, being found in all oceans from the equator to the ice edge (Best 2007). Killer whales occur year-round in low densities off the South Africa coast (Best *et al.* 2010), although on the East Coast whaling grounds their abundance was reported to be correlated with that of baleen whales, especially sei whales on their southward migration. **Killer whales are found in all water depths from the coast to deep open ocean environments and may thus be encountered in the Reconnaissance Permit Area at low levels.**

Although the **false killer whale** is globally recognized as one species, clear differences in morphological and genetic characteristics between different study sites show that there is substantial difference between populations and a revision of the species' taxonomy may be needed (Best 2007). The species has a tropical to temperate distribution and most sightings off Southern Africa have occurred in waters deeper than 1 000 m but with a few close to shore as well (Findlay *et al.* 1992). False killer whales usually occur in groups ranging in size from 1-100 animals (mean 20.2) (Best 2007), and are thus likely to be fairly easily seen in most weather conditions. However, the strong bonds and matrilineal social structure of this species makes it vulnerable to mass stranding (8 instances of 4 or more animals stranding together have occurred in the western Cape, between St Helena Bay and Cape Agulhas), which may exaggerate the consequences of any injury or harassment by seismic airguns or associated activities. There is no information on population numbers or conservation status and no evidence of seasonality in the region (Best 2007).

Short-finned pilot whales display a preference for warmer tropical waters than their counterparts, the long-finned pilot whales. Although distinguishing between the two pilot whale species at sea is difficult, those occurring in the survey areas are most likely to be the short-finned pilot whales (Best 2007). **The species is usually associated with the continental shelf or deep water adjacent to it, and is likely to be among the most commonly encountered odontocete in the vicinity of the seismic survey area.**

Beaked whales were never targeted commercially and their pelagic distribution makes them largely inaccessible to most researchers, making them the most poorly studied group of cetaceans. beaked whales are all considered to be true deep water species, usually being seen in waters in excess of 1 000 – 2 000 m in depth (see various species accounts in Best 2007). With recorded dives of well over an hour to depths in excess of 2 km, beaked whales are amongst the most extreme divers of air breathing animals (Tyack *et al.* 2011). All the beaked whales that may be encountered in the survey areas are pelagic species that tend to occur in small groups of usually less than five individuals, although larger aggregations of some species are known (MacLeod & D'Amico 2006; Best 2007). The long, deep dives of beaked whales make them difficult to detect visually, but PAM will increase the probability of detection as animals are frequently echo-locating when on foraging dives. Beaked whales are particularly vulnerable to certain types of man-made noise, particularly mid-frequency naval sonar. The exact reason why is not yet fully understood, but necropsy of stranded animals has revealed gas embolisms and hemorrhage in the brain, ears and acoustic fat - injuries consistent with decompression sickness (acoustically mediated bubble formation) may also play a role (Fernadez *et al.* 2005).

In summary, the majority of data available on the seasonality and distribution of large whales in the speculative survey areas is largely the result of commercial whaling activities mostly dating from the 1960s. Changes in the timing and distribution of migration may have occurred since these data were collected due to extirpation of populations or behaviour (e.g. migration routes may be learnt behaviour). The large whale species for which there are current data available are the humpback and southern right whale, although almost all data are limited to the continental shelf. Whaling data indicate that several other large whale species are also abundant on the East Coast for much of the year: fin whales peak in May-July and October-November and sei whale numbers peak in May-June and again in August-October. Data on the abundance, distribution or seasonality of the smaller odontocetes (including the beaked whales and dolphins) known to occur in oceanic waters off the shelf of eastern South Africa is lacking. Beaked whales are all considered to be true pelagic species, usually being seen in small groups in waters in excess of 1 000 – 2 000 m depth. Their presence in the area may fluctuate seasonally, but insufficient data exist to define this clearly.

All whales and dolphins are given protection under the South African Law. The Marine Living Resources Act, 1998 (No. 18 of 1998) states that no whales or dolphins may be harassed, killed or fished. No vessel or aircraft may approach closer than 300 m to any whale and a vessel should move to a minimum distance of 300 m from any whales if a whale surfaces closer than 300 m from a vessel or aircraft.

7.4.7.2 Seals

The Cape fur seal (*Arctocephalus pusillus pusillus*) (see Figure 7-45) is the only seal species that has breeding colonies along the Southeast coast, namely on the northern shore of the Robberg Peninsula in Plettenberg Bay and at Black Rocks (Bird Island group) in Algoa Bay (see Figure 7-46), approximately 120 km and 90 km inshore of the survey area of interest, respectively. The timing of the annual breeding cycle is very regular occurring between November and January, after which the breeding colonies break up and disperse. Breeding success is highly dependent on the local abundance of food, territorial bulls and lactating females being most vulnerable to local fluctuations as they feed in the vicinity of the colonies prior to and after the pupping season (Oosthuizen 1991).

Seals are highly mobile animals with a general foraging area covering the continental shelf up to 120 nautical miles offshore (Shaughnessy 1979), with bulls ranging further out to sea than females. The movement of seals from the three South Coast colonies are poorly known, however, limited tracking of the Algoa Bay colony has suggested these seals generally feed in the inshore region south of Cape Recife. The diet varies with season and availability and includes pelagic species such as horse mackerel, pilchard, and hake, as well as squid and cuttlefish.

Historically the Cape fur seal was heavily exploited for its luxurious pelt. Sealing restrictions were first introduced to southern Africa in 1893, and harvesting was controlled until 1990 when it was finally prohibited. The protection of the species has resulted in the recovery of the populations, and numbers continue to increase. Consequently, their conservation status in not regarded as threatened.

Figure 7-45: Colony of Cape fur seals (Photo: Dirk Heinrich).

7.5 MARINE PROTECTED AREAS AND POTENTIAL VULNERABLE MARINE ECOSYSTEMS

Several MPAs and other recently identified sensitive marine areas which exist in the vicinity of the survey area of interest along the Southeast Coast are discussed below (see Figure 7-46).

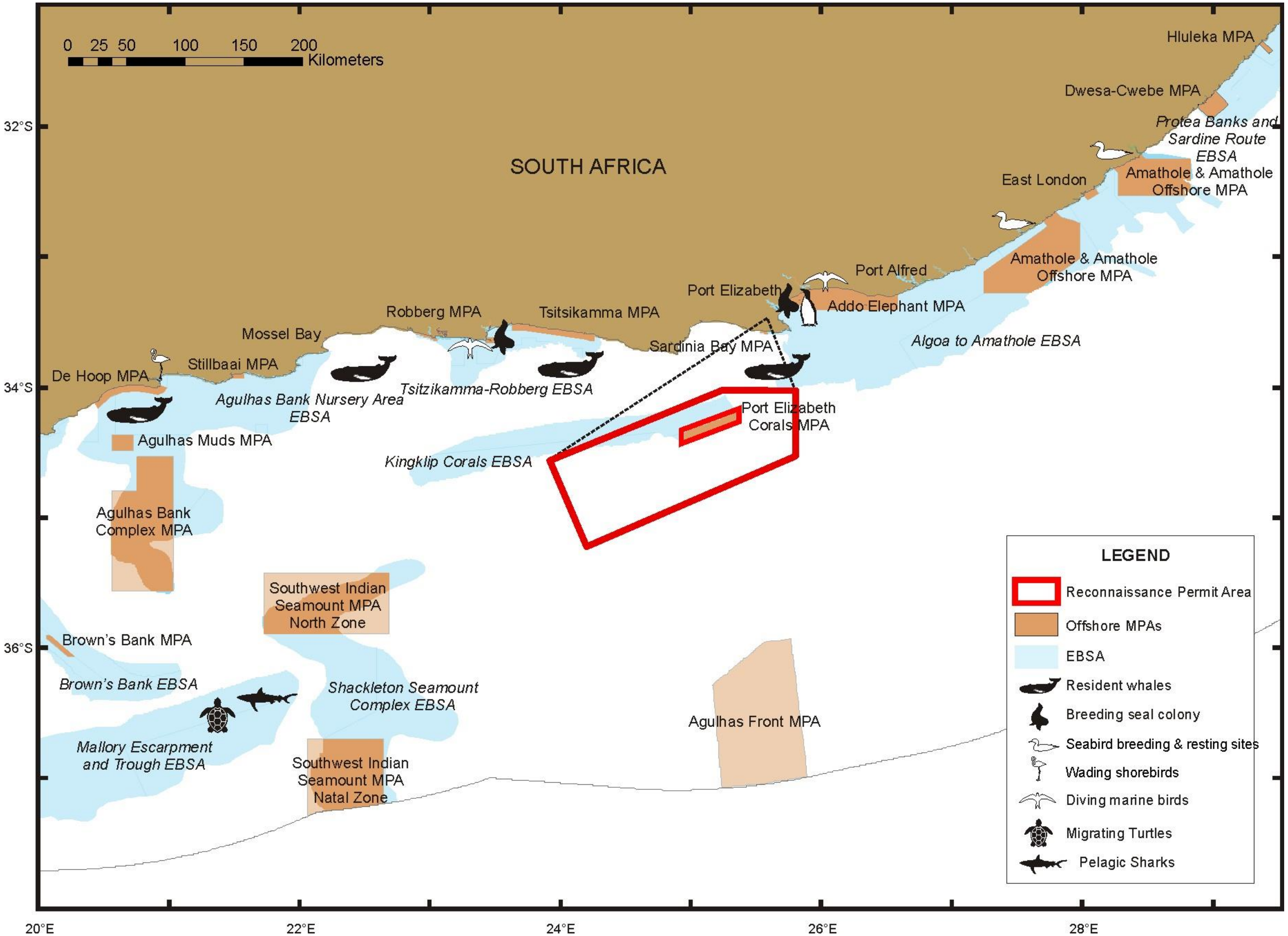


Figure 7-46: The Reconnaissance Permit Area (red polygon) in relation to Marine Protected Areas (MPAs) and Ecologically and Biologically Significant Areas (EBSAs) on the Southeast Coast. The location of seabird and seal colonies and seasonal whale populations are also shown.

7.5.1 Coastal Marine Protected Areas

'No-take' MPAs offering protection of the offshore biozones (sub-photic, deep-photic and shallow-photic) were until recently absent around the South African coast. This resulted in substantial portions of the shelf-edge marine biodiversity in the area being assigned a threat status of 'Critically endangered', 'Endangered' or 'Vulnerable' (Lombard *et al.* 2004; Sink *et al.* 2012). Using biodiversity data mapped for the 2004 and 2011 National Biodiversity Assessments a systematic biodiversity plan was developed for the Southwest Coast (Majiedt *et al.* 2013) with the objective of identifying both coastal and offshore priority areas for MPA expansion. Potential VMEs that were explicitly considered during the planning included the shelf break, seamounts, submarine canyons, hard grounds, submarine banks, deep reefs and cold water coral reefs. The biodiversity data were used to identify numerous focus areas for protection on the South Coast. These focus areas were carried forward during Operation Phakisa, which identified potential offshore MPAs. A network of 20 MPAs was gazetted on 23 May 2019, thereby increasing the ocean protection within the South African EEZ to 5%. The approved MPAs within the broad project area are shown in Figure 7-46. The coastal MPAs inshore or in relatively close proximity of the proposed area of interest are briefly described below.

There is one coastal MPA between approximately 80 and 110 km inshore of the western extent of the survey area of interest, namely the **Tsitsikamma MPA** which partly falls within the Western Cape. It is included in the Tsitsikamma Section of the Garden Route National Park, proclaimed in 1964, and is known as the oldest and largest 'no-take' MPA in Africa. The MPA extends from Groot River West (33°59´S, 23°34´E) to the Groot River East (34°04´S, 24°12´E) and covers 57 km of coastline with a total surface area of 32,300 hectares. The seaward extent of the MPA is 3 nautical miles. Considered a biodiversity 'hotspot', the MPA provides extensive reef habitats for benthic invertebrates and algae, as well as many endemic slow-growing, and long-lived linefish fish species, many of which are over-exploited. The MPA is thus crucial for the conservation of species such as dageraad, red stumpnose, red steenbras, seventy-four, musselcracker, poenskop, white steenbras and dusky kob.

At Plettenberg Bay, the **Robberg MPA** is located adjacent to Robberg Nature Reserve, which forms a peninsula with a single access point. The length of the Robberg MPA shoreline is 9 km and includes rocky platforms, sandy beaches, subtidal rocky reefs and subtidal sandy benthos. A Cape Fur Seal colony is also present. The MPA is located approximately 120 km inshore and to the west of the survey area of interest.

Eastern Cape coastal MPAs inshore of the area of interest include the Sardinia Bay MPA at Cape Recife and the Addo Elephant MPA in Algoa Bay (which includes the former Bird Island MPA).

The **Sardinia Bay MPA** has a shoreline 7 km in length and extends one nautical mile seawards of the high-water mark, between Schoenmakerskop and Bushy Park. It contains representative habitat including rocky platforms, sandy beaches, subtidal rocky reefs, and subtidal sandy benthos. The MPA is located 50 km inshore of the survey area of interest.

The **Addo Elephant MPA**, which incorporates the Algoa Bay Islands was gazetted in May 2019. This 1 200 km^2 MPA expands on the original Bird Island MPA (comprising Bird, Seal, Stag and Black Rock Islands) to protect sandy beaches, rocky shores, reefs, an estuary and islands and aid recovery of valuable fisheries resources such as abalone and kob, as well as great white sharks and whales (brydes, minke, humpback and right). The MPA protects important feeding areas for the 9 000 pairs of Endangered African penguins breeding at St Croix Island and the 60 000 pairs of Endangered Cape gannets breeding at Bird Island. These islands are the only important seabird islands along a 1 800 km stretch of coastline between Dyer Island near Hermanus in the Western Cape and Inhaca Island in Mozambique. Together with St Croix, Jahleel and Brenton Islands (also in Algoa Bay) they are classed as Important Bird Areas (IBAs) because they regularly support significant numbers of globally threatened bird species and hold large concentrations of seabirds. Six of the 14 South African resident seabird species breed either on the islands or at the adjacent coast. The islands play an important national and international role in the conservation of Cape Gannet, African Penguin and Roseate Tern. The islands form ecological distinct subtidal habitats, containing many endemic invertebrates, algae and linefish (e.g. santer and red roman). Black Rocks is an important seal breeding colony and serves as a great white shark feeding area. The MPA is also of particular importance to the threatened abalone as abalone poaching activities are strictly controlled. **The northeastern corner of the Area of Interest lies approximately 70 km south of this MPA at its closest point.**

In addition to the above, the Nelson Mandela University's Institute for Coastal and Marine Research is also managing the "Algoa Bay Project" which supports six multidisciplinary projects with national and international collaborators. This project uses Algoa Bay as its area of focus for Marine Spatial Planning and includes the compilation of MPA Management Plans. The study area stretches from the coast to a 12 nm territorial sea outer limit (https://www.algoabayproject.com/community-of-practice). **The area of interest is located approximately 20 km offshore of the "Algoa Bay Project" study area boundary at its closest point.**

7.5.2 Offshore Marine Protected Areas

The **Port Elizabeth Corals MPA,** which was proclaimed in 2019, lies offshore between Gqeberha and Cape St. Francis and **falls within the area of interest**. This 270 km^2 MPA features a long narrow rocky ridge and series of underwater hills creating a unique seascape on the continental slope ranging from 200 m to 5 000 m. The area is recognized as an 'Ecologically and Biologically Significant Area' because of its importance in the life history of a wide variety of marine species, including Kingklip. A seasonal fisheries management area that borders on the MPA was established to protect kingklip during their spawning season, when they aggregate in large numbers. To gather in the same place, the fish use specialised drumming muscles to communicate across the ocean. The MPA protects important seabed features that provide important habitat for corals. The three-dimensional structure of these deep coral reefs are important nursery areas for kingklip, as they provide protection to young fish.

A buffer of 2 km around the MPA has been incorporated within the reconnaissance permit area in order to exclude any survey activities within 2 km of the MPA. No other offshore MPAs are located within the boundaries of the proposed survey area of interest.

7.5.3 Ecologically or Biologically Significant Areas

Despite the development of the offshore MPA network a number of 'Vulnerable' ecosystem types (i.e. Kingklip Koppies, Agulhas Coarse Sediment Shelf Edge, Agulhas Sandy Outer Shelf) are currently 'poorly protected' or 'not protected' and further effort is needed to improve protection of these threatened ecosystem types (Sink *et al.* 2019) (see Figure 7-46). Ideally, all highly threatened ('Critically Endangered' and 'Endangered') ecosystem types should be well protected. Currently, however, most of the Agulhas Coarse Sediment Shelf Edge and Southwest Indian Mid Slope are poorly protected receiving only 0.2-10% protection, whereas the Kingklip Koppies, Southwest Indian Lower Slope and Southwest Indian unclassified Abyss receive no protection at all (Sink *et al.* 2019).

As part of a regional Marine Spatial Management and Governance Programme (MARISMA) the Benguela Current Commission (BCC) and its member states have identified a number of Ecologically or Biologically Significant Areas (EBSAs) both spanning the border between Namibia and South Africa (see Figure 7-46) and along the South African West, South and East Coasts, with the intention of implementing improved conservation and protection measures within these sites. South Africa currently has 12 EBSAs solely within its national jurisdiction with a further three having recently been proposed. It also shares eight trans-boundary EBSAs with Namibia (3) Mozambique (2) and the high seas (3). The principal objective of these EBSAs is identification of features of higher ecological value that may require enhanced conservation and management measures. They currently carry no legal status. The impact management and conservation zones within the EBSAs are currently being reviewed and additional zones may be proposed.

The following summaries of the EBSAs in the project area are adapted from http://cmr.mandela.ac.za/EBSA-Portal/South Africa/. The Reconnaissance Permit Area overlaps with the Kingklip Corals EBSA and is located along the western boundary of the Algoa to Amathole EBSA. One coastal EBSA (Tsitisikamma-Robberg EBSA) is located inshore of the area of interest. The text and figures below are based on the EBSA status as of October 2020.

The proposed **Tsitsikamma-Robberg EBSA** is a coastal EBSA that includes the Tsitsikamma MPA, Robberg MPA, Goukamma MPA, and part of the Garden Route Biosphere Reserve. It extends from the shore to the -100 m isobath at the middle shelf, with some extension onto the shallow outer shelf, and includes the extent of five estuaries, including Knysna. The protection afforded to the inshore reefs from these MPAs has contributed to a high diversity and abundance of species, including fragile, vulnerable, sensitive and slow-growing species, that in turn support many top predators. Numerous threatened species occur within this EBSA, including the Endangered endemic Knysna seahorse and several Critically Endangered fish species, with the area also supporting important life-history stages of these threatened and other species. Several Critically Endangered and Endangered ecosystem types are also represented in the EBSA. **At its closest point, the EBSA is located approximately 70 km inshore of the survey area of interest.**

The **Kingklip Corals EBSA** was established to offer protection to Secret Reef, Kingklip Koppies and Kingklip Ridge, which lie on and extend east of Grue Bank, on the shelf edge and upper bathyal area, about 100 km offshore of Knysna (Sink 2016, cited in Sink *et al.* 2019). The feature spans a broad depth range of -150 m to -800 m. This newly discovered biogenic coral reef structure is most important for its benthic features as it includes threatened benthic habitats, particularly fragile and sensitive corals (scleractinian corals, stylasterine corals) and byrozoans, as well as vulnerable mollusc and crab species (Sink 2016, cited in Sink *et al.* 2019). Reef-forming scleratinean corals characterise the crest and edges of the northern end of the ridge, and dense clouds of plankton and hake occur above the ridge. The Kingklip Koppies, west of the ridge, are rocky hills that also support fragile benthic species. Secret Reef further west, is a newly discovered biogenic coral reef structure on the shelf edge and upper bathyal area, which includes threatened benthic habitats and fragile, sensitive, vulnerable species, such as scleractinian corals, stylasterine corals, bryozoans, molluscs, and crabs (Sink 2016). The EBSA is thus most important for benthic features, although the overlying water column is also relevant. **The inshore area of the area of interest overlaps with the eastern extent of the Kingklip Corals EBSA.**

The **Algoa to Amathole EBSA** encompasses the likely largest single collection of significant and special marine features in the country that also jointly support key ecological processes, including important land-sea connections. It spans the Eastern Cape shoreline between Sardinia Bay MPA and Amathole MPA/Kei

River mouth, extending from the dune base to approximately the continental shelf break/slope at -2000 m. Complex ocean circulation occurs where the Agulhas Current leaves the coast, following the shelf break resulting in the formation of cold-water eddies, intrusions of Agulhas water onto the shelf and large offshore meanders of the Agulhas Current. Consequently, this EBSA includes spawning areas, nursery areas and key transport pathways for demersal and pelagic fish, which in turn support a myriad of top predators, including shark and seabird breeding and foraging areas. The Algoa Bay islands support the easternmost colony of Endangered African penguins and the largest colony of Cape Gannets in southern Africa. Regionally 'Critically Endangered' leatherback and regionally 'Near Threatened' loggerhead turtles migrate through the EBSA between their nesting and foraging grounds, with hatchlings of both species also passing through during their dispersal from the nesting beaches. Green turtles have also been sighted in the area. The EBSA includes 36 ecosystem types, 18 of which are threatened and a further seven that are Near Threatened. Sensitive features and species include submarine canyons, steep shelf edge, deep reefs, outer shelf and shelf edge gravels, and reef-building cold-water corals ranging in depth between 100 and 1 000 m. It also contains several key biodiversity features, including: stromatolites; sites where coelocanths are present; a 'Critically Endangered' localised endemic estuarine pipefish, several priority estuaries, rare ecosystem types of limited spatial extent and a few existing coastal marine protected areas. **The eastern inshore area of the area of interest borders on the western edge of the Algoa to Amathole EBSA.**

7.5.4 Biodiversity Priority Areas

The National Coastal and Marine Spatial Biodiversity Plan[4] comprises a map of Critical Biodiversity Areas (CBAs), Ecological Support Area (ESAs) and accompanying sea-use guidelines. The CBA Map presents a spatial plan for the marine environment, designed to inform planning and decision-making in support of sustainable development. The sea-use guidelines enhance the use of the CBA Map in a range of planning and decision-making processes by indicating the compatibility of various activities with the different biodiversity priority areas so that the broad management objective of each can be maintained. The intention is that the CBA Map (CBAs and ESAs) and sea-use guidelines inform the Marine Spatial Planning Conservation Zones and management regulations, respectively.

The area of interest overlaps with areas mapped as Protected Area, Critical Biodiversity Area 1 (CBA 1), and Ecological Support Area (ESA) (see Figure 7-47). CBA 1 indicates irreplaceable or near-irreplaceable sites that are required to meet biodiversity targets with limited, if any, option to meet targets elsewhere, whereas CBA 2 indicates optimal sites that generally can be adjusted to meet targets in other areas. ESAs represent EBSAs outside of MPAs and not already selected as CBAs.

Activities within these management zones are classified into those that are compatible, those that are incompatible, and those that may be compatible subject to certain conditions. Non-destructive petroleum exploration is compatible in ESAs and may be compatible, subject to certain conditions, in CBAs. Destructive exploration activities with localised impact, e.g. exploration wells, may be compatible, subject to certain

[4] The latest version of National Coastal and Marine Spatial Biodiversity Plan (v1.2 was released April 2022) (Harris *et al.* 2022). The Plan is intended to be used by managers and decision-makers in those national government departments whose activities occur in the coastal and marine space, e.g., environment, fishing, transport (shipping), petroleum, mining, and others. It is relevant for the Marine Spatial Planning Working Group where many of these departments are participating in developing South Africa's emerging marine spatial plans. It is also intended for use by relevant managers and decision-makers in the coastal provinces and coastal municipalities, EIA practitioners, organisations working in the coast and ocean, civil society, and the private sector.

conditions (still to be determined), in CBAs and ESAs. Petroleum production is classified as incompatible in CBAs but may be compatible, subject to certain conditions, in ESAs (Harris *et.al*. 2020). These zones have been incorporated into the most recent iteration of the national Coastal and Marine CBA Map (v1.2) released April 2022) (Harris *et al.* 2022) (see Figure 7-47).

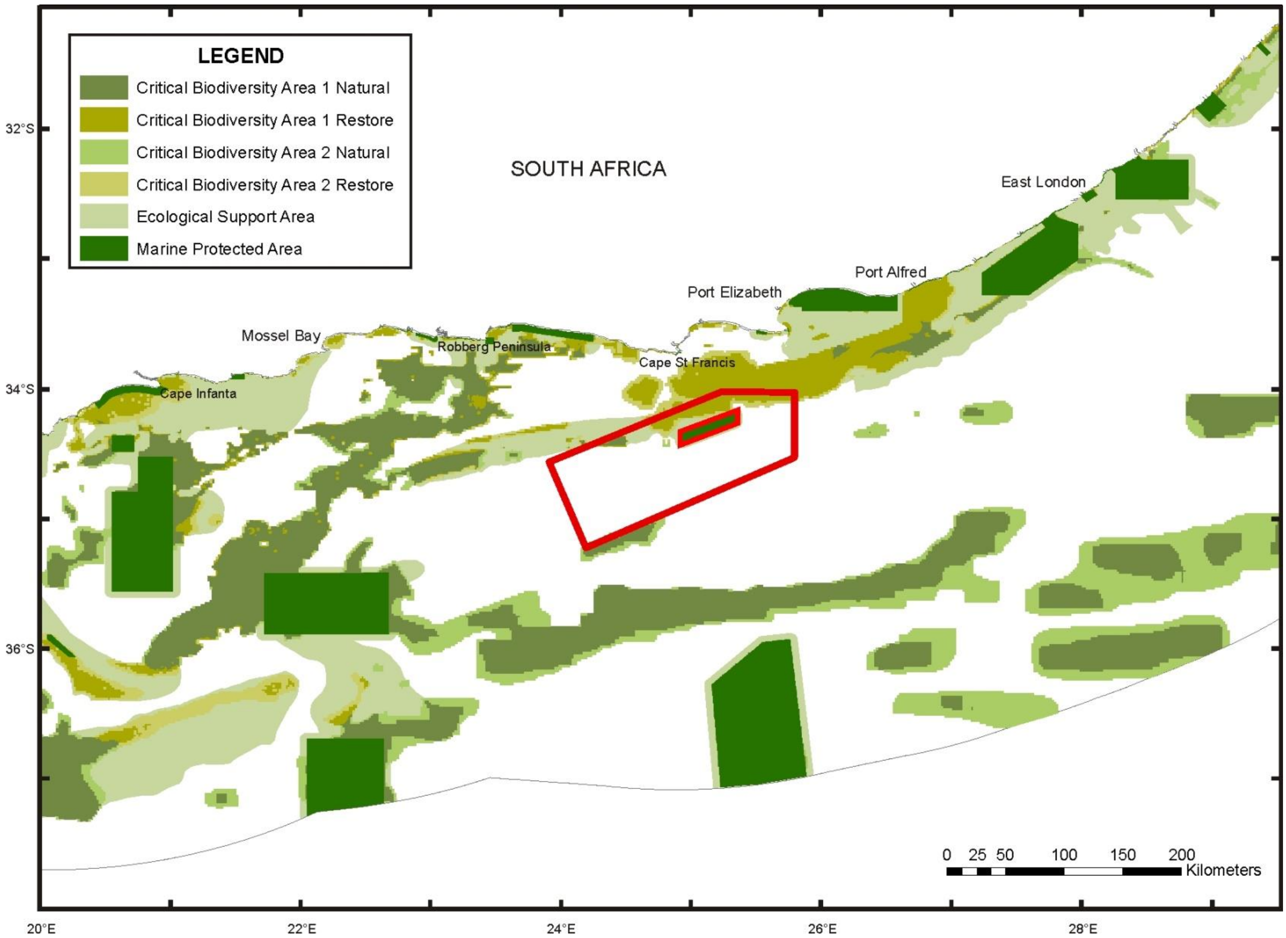


Figure 7-47: The Reconnaissance Permit Area (red polygon) in relation to Critical Biodiversity Areas and Ecological Support Area (version 1.2) (adapted from Harris *et al*. 2022)

7.5.5 Algoa Bay Systematic Conservation Plan

A fine-scale systematic conservation plan has been compiled for Algoa Bay, as part of the Algoa Bay Project (Dorrington *et al*. 2018). The spatial prioritisation included 137 biodiversity features and fine-scale cost information (Holness *et al*. in review), and sought to encourage selection of marine biodiversity priorities in areas that would also bring social benefits. It identified highest priority areas in natural or near-natural ecological condition that were inside and outside MPAs. There is no overlap of the Reconnaissance Permit Area with this conservation plan (see Figure 7-48).

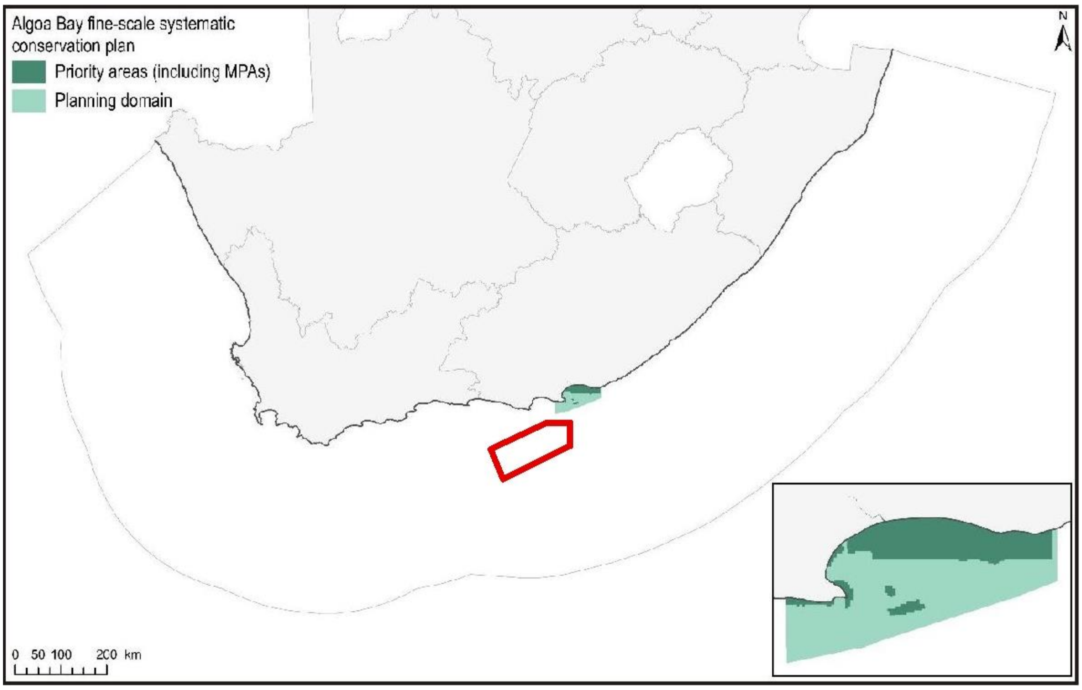


Figure 7-48: The Reconnaissance Permit area (red polygon) in relation to fine-scale marine biodiversity priority areas identified for Algoa Bay (adapted from Harris *et al*. 2022).

7.5.6 Important Bird Areas

Of the Important Bird Areas (IBAs) designated by BirdLife International in the Southern and Eastern Cape, those located along the coastline of the broader project area are shown in Figure 7-49. Marine IBAs are primarily defined for the regular presence of globally threatened species, and congregations of >1% of biogeographic or global populations. 'Confirmed' IBAs are those that have had a full assessment made of qualifying species and populations, as well as a site description and associated boundary, which have been reviewed and approved by both BirdLife Partners and the BirdLife Secretariat. In contrast, 'Proposed' sites are those that have not yet gone through this cycle but are mapped to indicate they are in the process of being identified and reviewed. Although IBA designation does not bring any legal obligation, IBAs may be used to inform the designation of MPAs under national legislation or international agreements. IBA data is submitted to the Convention on Biological Diversity (CBD) workshops to assist in describing EBSAs. **The northeastern corner of the Reconnaissance Permit Area overlap with a small portion of the proposed Alexandria coastal belt/Algoa Bay Islands Nature Reserve Marine IBA**, specifically aimed at protecting the African Penguin, Cape Gannet, Kelp Gull, Damara Tern and Roseate Tern (https://maps.birdlife.org/marineIBAs).

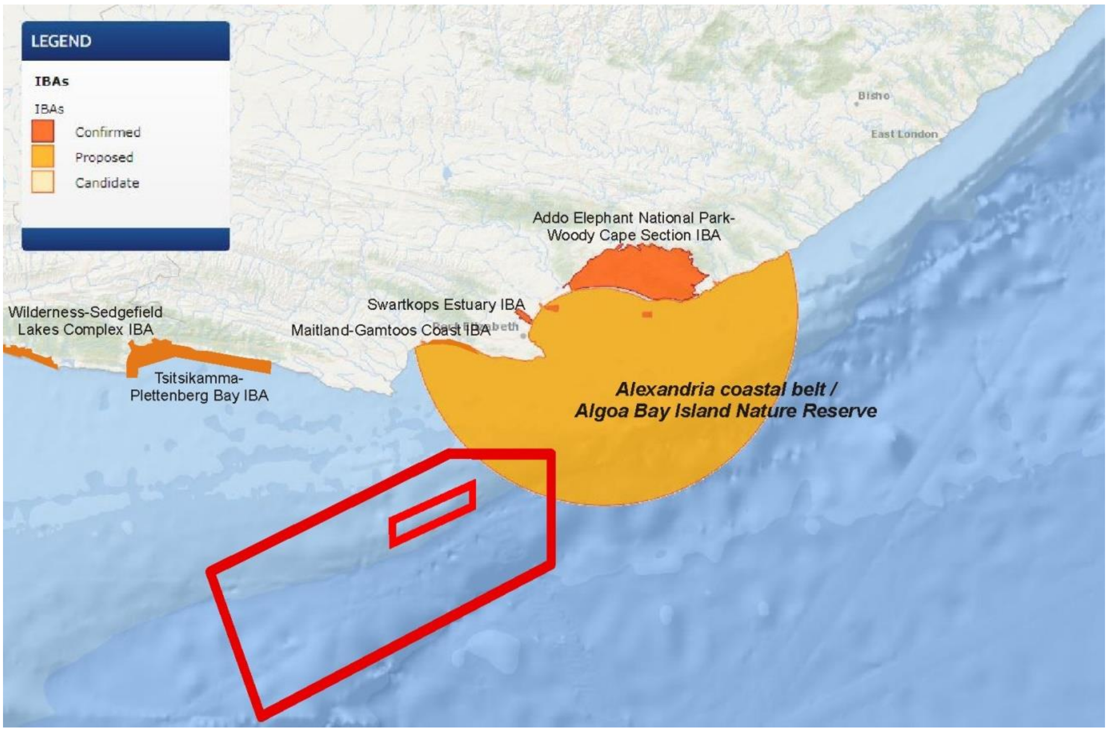


Figure 7-49: The Reconnaissance Permit Area (red polygon) in relation to confirmed and proposed coastal and marine IBAs in the Eastern Cape (https://maps.birdlife.org/marineIBAs)

7.5.7 Important Marine Mammal Areas

Important Marine Mammal Areas (IMMAs) were introduced in 2016 by the IUCN Marine Mammal Protected Areas Task Force to support marine mammal and marine biodiversity conservation. Complementing other marine spatial assessment tools, including the EBSAs and Key Biodiversity Areas (KBAs), IMMAs are identified on the basis of four main scientific criteria, namely species or population vulnerability, distribution and abundance, key life cycle activities and special attributes. Designed to capture critical aspects of marine mammal biology, ecology and population structure, they are devised through a biocentric expert process that is independent of any political and socio-economic pressure or concern. IMMAs are not prescriptive but comprise an advisory, expert-based classification of areas that merit monitoring and place-based protection for marine mammals and broader biodiversity.

Although much of the West Coast of South Africa has not yet been assessed with respect to its relevance as an IMMA, the coastline from the Olifants River mouth on the West Coast to the Mozambiquan border overlaps with the three declared IMMAs (see Figure 7-50) listed below:

- Southern Coastal and Shelf Waters of South Africa IMMA (166 700 km^2),
- Cape Coastal Waters IMMA, and
- South East African Coastal Migration Corridor IMMA (47 060 km^2).

These are described briefly below based on information provided in IUCN-Marine Mammal Protected Areas Task Force (2021) (www.marinemammalhabitat.org).

The 166 700 km^2 Southern Coastal and Shelf Waters of South Africa IMMA extends from the Olifants River mouth to the mouth of the Cintsa River on the Wild Coast. Qualifying species are the Indian Ocean Humpback dolphin (Criterion A, B1), Bryde's whale (Criterion C2), Indo-Pacific bottlenose dolphin (Criterion B1, C3, D1), Common dolphin (Criterion C2) and Cape fur seal (criterion C2). The IMMA covers the area supporting the important 'sardine run' and the marine predators that follow and feed on the migrating schools (Criterion C2) as well as containing habitat that supports an important diversity of marine mammal species (Criterion D2) including the Indian Ocean humpback dolphin, the inshore form of Bryde's whale, Indo-Pacific bottlenose dolphin, common dolphin, Cape fur seal, humpback whales, killer whales and southern right whales.

The Cape Coastal Waters IMMA extends from from Cape Point to Woody Cape at Algoa Bay and extends over some 6 359 km^2. It serves as one of the world's three most important calving and nursery grounds for southern right whales, which occur in the extreme nearshore waters (within 3 km of the coast) from Cape Agulhas to St. Sebastian Bay between June and November (Criterion B2, C1). Highest densities of cow-calf pairs occur between Cape Agulhas and the Duivenhoks River mouth (Struisbaai, De Hoop, St Sebastian Bay), while unaccompanied adult densities peak in Walker Bay and False Bay. The IMMA also contains habitat that supports an important diversity of marine mammal species including the Indian Ocean humpback dolphin and Indo-Pacific bottlenose dolphin.

The South East African Coastal Migration Corridor IMMA extends some 47 060 km^2 from Cape Agulhas to the Mozambiquan border and serves as the primary migration route for C1 substock of Southern Hemisphere humpback whales (Criterion C3). On their northward migration between June and August, they are driven closer to shore due to the orientation of the coast with the Agulhas Current, whereas during the southward migration from September to November, they remain further offshore (but generally within 15 km of the coast) utilising the southward flowing Agulhas Current as far west as Knysna. The IMMA also contains habitat that supports an important diversity of marine mammal species including the Indian Ocean humpback dolphin, Common dolphin, Indo-Pacific bottlenose dolphin, Spinner dolphin, Southern Right whale, and killer whale.

The inshore portion of the Reconnaissance Permit Area overlaps with the Southern Coastal and Shelf Waters of South Africa IMMA.

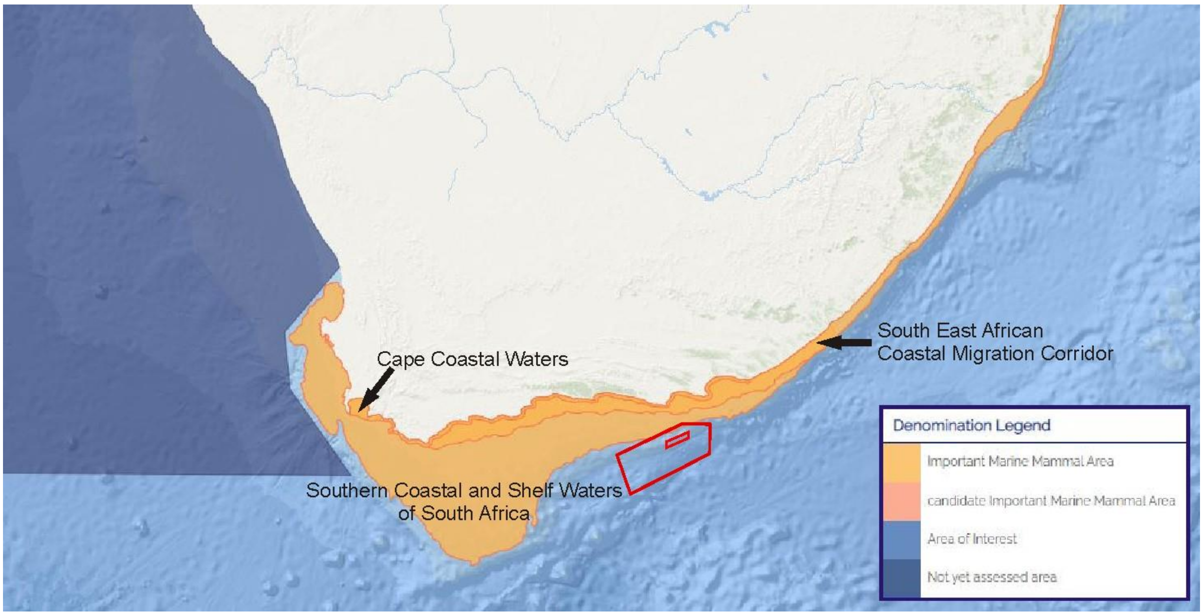


Figure 7-50: The Reconnaissance Permit area (red polygon) in relation to coastal and marine IMMAs (Source: www.marinemammalhabitat.org/imma-eatlas/).

7.6 SOCIO-ECONOMIC ENVIRONMENT

This section provides an overview of the regional context of the project area covering the administrative boundaries; settlements and population demography; education, employment, health and poverty; economic and industrial profile; tourism and recreation and artisanal fishing along the Southeast Coast. The fishing sectors are discussed under Section 7.7.

7.6.1 Regional Context

7.6.1.1 Administrative Areas

The study area along the southeast coast of South Africa is located off the Sarah Baartman District Municipality (DM) and Nelson Mandela Bay Metropolitan Municipality (MM) in the Eastern Cape Province.

The Nelson Mandela Bay MM is a single unified metropolitan area that includes Port Elizabeth (now Gqeberha) and surrounding suburbs. The Sarah Baartman DM is further divided into seven local municipalities, four of which are located along the coast, namely: the Kou-Kamma, Kouga, Sundays River Valley and Ndlamba Local Municipalities. The distribution of the various administrative districts is shown in Figure 7-51.

7.6.1.2 Settlements and Population Demographics

Gqeberha is a major metropolitan area in South Africa, which supports a projected population of around 1.2 million (Statistics South Africa, 2020). Key towns/cities along the South Coast in proximity to the area of interest are Cape St. Francis, Jeffrey's Bay and Gqeberha (see Figure 7-51).

The population of the Sarah Baartman DM is estimated at 527 062, while the population of the Nelson Mandela Bay MM is estimated at 1.26 million people. The Nelson Mandela Bay MM has an estimated 646 people/km^2.

7.6.1.3 Education, Employment, Health and Poverty

Education, employment, health and poverty indicators are inextricably linked and summarised below.

<u>Education</u>

The more densely populated urban centre of Nelson Mandela Bay has a higher proportion of people who have completed secondary schooling or have a tertiary education than the population of the more rural Sarah Baartman DM. Only 25% of the population of the latter has completed secondary school compared to 35-36% in the more urbanised district.

<u>Employment</u>

Unemployment and underemployment are chronic issues in South Africa; the national unemployment rate in late 2016 was estimated at 27.1% which rises to 36.3% when discouraged work seekers are included.

Unemployment in the Eastern Cape is 28.1%, increasing to 41.3% when discouraged work seekers are included. The 13% gap between the official and expanded unemployment rates is higher than the other provinces in South Africa. Unemployment is over 50% in the Eastern Cape for people aged 15-24 years. The overall unemployment rate in 2019 for the Nelson Mandela Bay MM is estimated at 28,9% and for the Sarah Baartman DM it is estimated at 23%.

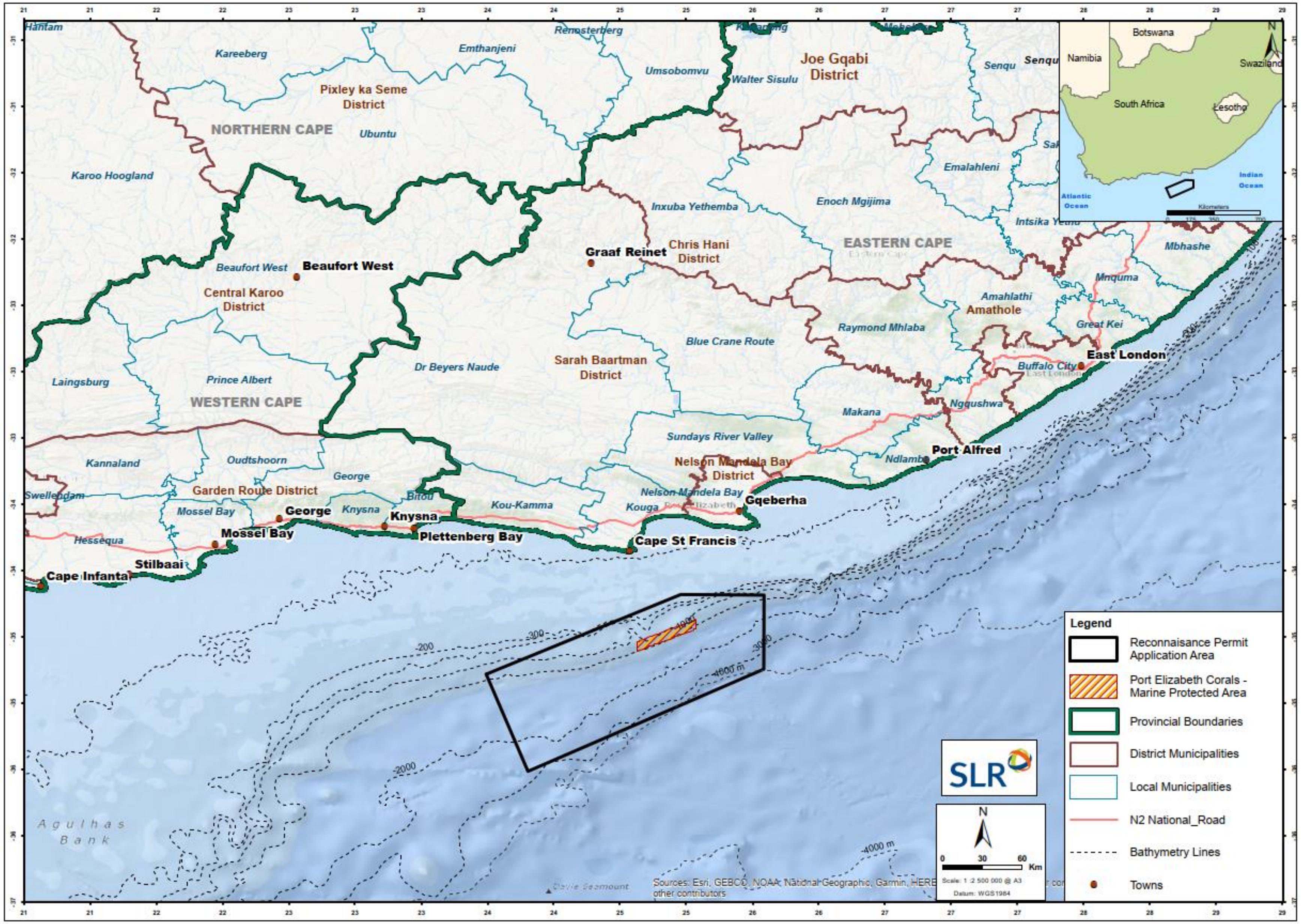


Figure 7-51: Provincial and district administrative structures off the South Coast of South Africa

Employment statistics in South Africa is tracked by sector and fisheries falls into a broader sector of Agriculture, Fisheries and Forestry; thus, it is not possible to provide details into the ratio of people dependent on fisheries and other marine activities.

Health

Similar to educational profiles, people living in the larger urban centre of Nelson Mandela Bay have greater access to health care, reflected by the higher immunisation rate, lower incidence of neonatal deaths and a lower malnutrition rate.

Poverty

In general, poverty levels in South Africa are increasing, as reflected by deteriorating financial health of households and individuals under the weight of economic pressures (Statistics South Africa (SSA) 2017). The Poverty Trends report (SSA 2017) cites rising unemployment levels, low commodity prices, higher consumer prices, lower investment levels, household dependency on credit, and policy uncertainty as the key contributors to the economic decline in recent times. It is measured against the poverty line set at R 1 227 per person per month (SSA 2019). In 2016, the Nelson Mandela Bay MM and Sarah Baartman DM had 50% and 52% of its people living in poverty, respectively, higher than the national average of 49.2%. Income inequality (measured by the Gini coefficient) is also increasing in the coastal districts and is a focus of the National Development Plan which has set a target of reducing income inequality in South Africa by 2030.

7.6.1.4 Economic and Industrial Profile

In the Eastern Cape Province, of the total GDP of R338 billion, the Nelson Mandela Bay MM contributed 51% of total GDP (i.e. R 120 billion) in 2016. The largest contributing sector was community services (largely government services) which contributed 24% of the GDP followed by finance (23%), manufacturing (with the automotive industry a key component) at 19%, and retail and wholesale trade making up 17%. The Sarah Baartman DM contributed R21.6 billion in 2016.

7.6.1.5 Tourism and Recreation

The project area falls mainly in the Jeffreys Bay to Port Elizabeth tourism region of the Eastern Cape.

Domestic and international tourism is a central economic activity for towns along the South Coast, including coastal towns in the Eastern Cape such as Jeffrey's Bay (known as a surfing mecca) and Port Elizabeth. Much of this is based on the scenic beauty of the coastline and a variety of outdoor coastal and marine activities on offer.

The Eastern Cape Province had a total tourism spend of R 12 billion in 2016 and an average annual growth rate of 2.6% over the period compared to South Africa as a whole which increased from R 127 billion in 2006 to R267 billion in 2016 at an average annual rate of 7.7%.

In both districts of the Eastern Cape, tourism has declined between 2008 and 2016 although the number of international visitors showed a slight increase in the order of 1.75% (pre-Covid 19). Total tourism spend over the ten year period from 2006 to 2016 increased more in Sarah Baartman DM than the Nelson Mandela Bay MM with an annual average increase of 4.1% (from 1.69 billion to 2.52 billion) versus 1.7% (from R2.7 billion to R3.2 billion), respectively, compared to the national increase of 7.7%.

Tourists to the Sarah Baartman DM and Nelson Mandela Bay MM (ECSECC 2017a, b) comprise a significantly larger proportion of domestic visitors (83-84%) relative to 16-17% international visitors. Tourism in the Eastern Cape is primarily undertaken during peak school holiday periods (June/July; December/January).

Across the coastline of the Eastern Cape Districts the top tourism and recreational activities include scenic drives, visits to national parks, culture and heritage, and beach and nearshore marine activities. Coastal tourism and recreational activities and services are extensive along most of the South Coast extending to Gqeberha, largely driven by international and domestic tourism demand. The coastal towns and surrounding areas have a good network of roads and are in general well equipped with infrastructure and services to support tourism with a range of accommodation facilities, restaurants, bars, banking, supermarkets, tour operators etc.

The South Coast is well known for its swimming and recreational beaches that are found along the entire coastline. The most populated beaches are linked to local town centres, although the entire coastline is accessible and extensively used by local residents and tourists for sunbathing, walking, swimming, diving, surfing and onshore fishing. Jeffrey's Bay and Cape St Francis are notorious as a popular domestic and international surfing destination (see Figure 7-51 for locations).

In addition, boat cruises, whale watching and offshore recreational fishing, as noted earlier, are important activities along the South Coast and are undertaken as both personal recreation as well as commercial operators. Private recreational fishers can access the coastline from multiple registered boat-launch sites located along the Southern coast, predominantly from slipways in the various towns.

7.6.1.6 Recreational Fishing

Recreational fishing occurs around the whole South African coastline. It takes many forms from use of ski boats, diving for lobsters, rod and line from beaches, picking mussels, limpets, bait and oysters. The limits by species and areas are clearly legislated and recreational fishers need permits. Recreational fishers are not allowed to sell their catch. Historically recreational line fish was split between "A" and "B" permits where A permits had a different catch limit and could sell their catch – this was done away with and there are only recreational or commercial line fish permits. The number of boats permitted to fish were reduced from thousands to only 450 commercial rights. This was done to "save" the line fish species and help rebuild stocks – the Minister implemented these measures by declaring a "crisis" and effectively largely closing down the exploitation of most line fish species. Within the project's area of influence many small recreational or pleasure vessels are launched from a variety of small harbours and slipways located at Gqeberha, Jeffery's Bay and St Francis. Beach launches may be used at various other locations. Recreational fishers must comply with maritime legislation as prescribed by the South African Maritime Safety Association (SAMSA, which is part for the Department of Transport).

7.6.1.7 Artisanal and Subsistence Fishing

Much of the nearshore and offshore marine environment along the South African coast supports well established commercial fishery. This includes subsistence / artisanal components which are mostly found in KZN and southwards towards Transkei and Ciskei – these are technically non-commercial and meant to sustain livelihoods. Historically along the cape South Coast there have been small pockets of communities who have fished for a living and may be defined as artisanal or subsistence fishers. With declining stocks and increasing commercialised fishing and increased populations on the coast, there has been increased pressure on fish and other marine resources leading to conflict and a trend towards selling catch for a living. With the introduction of the Small Scale Fisheries Policy – the government (through DFFE) is implementing the SSF policy through identifying fishers along the coast with historical interests in fishing in order to allocate them into logical co-operative groups. The intent is that these co-ops would have a “legal right” to access baskets of species and that they will fall within the broader fisheries management system in South Africa that aims to manage stocks sustainably. Further information on Small-Scale Fisheries is presented in Section 7.7.10.

7.6.1.8 Supply Port - Port of Gqeberha

CGG is proposing to utilise the Port of Gqeberha for supplies, refuelling and crew changes during the proposed 3D survey. The Port of Gqeberha provides multi-functional uses which include the handling of containerised goods, bulk manganese, break liquid bulk as well as automotive goods. The port also supports commercial fisheries including commercial operators in the demersal trawl, mid-water trawl, demersal long-line, large pelagic long-line, lobster and squid fishing sectors (CapMarine, 2021). Berthing for both commercial as well as a recreational (small-craft) fisheries is provided at the Port. The Port itself plays a limited role in terms of tourism and recreation outside of the small-craft harbour and associated facilities (boat charters, clubs and restaurants). However, there are numerous retail stores, restaurants, recreational activities surrounding the Port

7.7 FISHING SECTOR ACTIVITIES

The South African fishing industry consists of at least 20 commercial sectors operating within the country’s 200 nm EEZ. Fisheries active off the Southeast Coast include:

- Demersal trawl;
- Mid-water trawl
- Small pelagic purse-seine (inshore);
- Demersal long-line (hake- and shark-directed);
- Pelagic long-line (tuna- and shark-directed);
- Traditional line fish (inshore);
- South Coast rock lobster;
- Squid jig; and
- Small-scale fisheries.

Each of these are described in more detail below.

The description of the commercial fisheries is based on a review and collation of existing information. Catch and effort data were sourced from the Fisheries Branch of DFFE based on records for the years 2000 to 2021. All data were referenced to a latitude and longitude position and were redisplayed on a 10x10 or 5x5 minute grid. Additional information was obtained from the Marine Administration System from DFFE and from the South Africa, Namibia and Mozambique Fishing Industry Handbook 2019 (47th Edition).

7.7.1 Demersal Trawl

Demersal trawl is South Africa's most valuable fishery accounting for approximately half of the income generated from commercial fisheries. The fishery is separated into an offshore sector targeting deep-water hake (*Merluccius paradoxus)* and an inshore sector targeting shallow-water hake (*M. capensis*). Secondary species include a large assemblage of demersal fish of which monkfish (*Lophius vomerinus*), kingklip (*Genypterus capensis*) and snoek (*Thyrsites atun*) are the most commercially important. The wholesale value of catch landed by the inshore and offshore demersal trawl sectors, combined, during 2017 was R3.982 billion, or 40.5% of the total value of all fisheries combined. The latest value estimates show a steady increase to R550 million and R6 billion for the inshore and offshore trawl fishery, respectively. The 2022 Total Allowable Catch (TAC) for hake was set at 8 131 tons and 110 449 tons for the inshore and offshore trawl fisheries, respectively. Fishing grounds extend in an almost continuous band along the shelf edge from the Namibian maritime border in the north to Gqeberha in the East. The fishery is restricted by permit condition to operating within the confines of an area of approximately 57 300 km^2 and 17 000 km^2 for the offshore and inshore fleets, respectively.

The offshore fishery is comprised of approximately 45 vessels operating from most major harbours on both the West and South Coasts where the fishing grounds extend in a continuous band along the shelf edge between the 200 m and 1 000 m bathymetric contours. Most effort occurs in water of depth between 300 m and 600 m. Monk-directed trawlers tend to fish shallower waters than hake-directed vessels on mostly muddy substrates. Trawl nets are generally towed along depth contours (thereby maintaining a relatively constant depth) running parallel to the depth contours in a north-westerly or south-easterly direction. Trawlers also target fish aggregations around bathymetric features, in particular seamounts and canyons, where there is an increase in seafloor slope and in these cases the direction of trawls follow the depth contours. The deep-sea trawlers may not fish in waters shallower than 110 m or within five nautical miles of the coastline.

The inshore fishery consists of approximately 31 vessels, which operate on the South and East Coasts mainly from the harbours of Mossel Bay and Gqeberha. Inshore grounds are located on the Agulhas Bank and extend towards the Great Kei River in the east. **The area of interest does not overlap with the inshore trawl grounds off the South Coast.**

Otter trawling is the main trawling method used in the South African hake fishery. This method of trawling makes use of trawl doors (also known as otter boards) that are dragged along the seafloor ahead of the net, maintaining the horizontal net opening (see Figure 7-52:). The configuration of trawling gear is similar for both offshore and inshore vessels however inshore vessels are smaller and less powerful than those operating within the offshore sector. The offshore fleet is segregated into wetfish and freezer vessels which differ in terms of the capacity for the processing of fish at sea and in terms of vessel size and capacity. While freezer vessels may work in an area for up to a month at a time, wetfish vessels may only remain in an area for about a week before returning to port.

The fishery operates continuously throughout the year. **Trawling activity coincides with the area of interest between the 200 m and 1 000 m bathymetric contours** (see Figure 7-53). Over the period 2017 to 2021 an annual average of 2 631 trawls were undertaken within the area of interest, yielding 4 125 tons of hake which is equivalent to 6.8% and 6.4% of the overall effort and catch recorded by the sector, respectively. The area of interest coincides with 2 653 km^2 of trawling ground, which amounts to 4.6% of the total extent of the offshore demersal trawling footprint within the South African EEZ. **Fishing activity can thus be expected along the northern inshore boundary of the area of interest.**

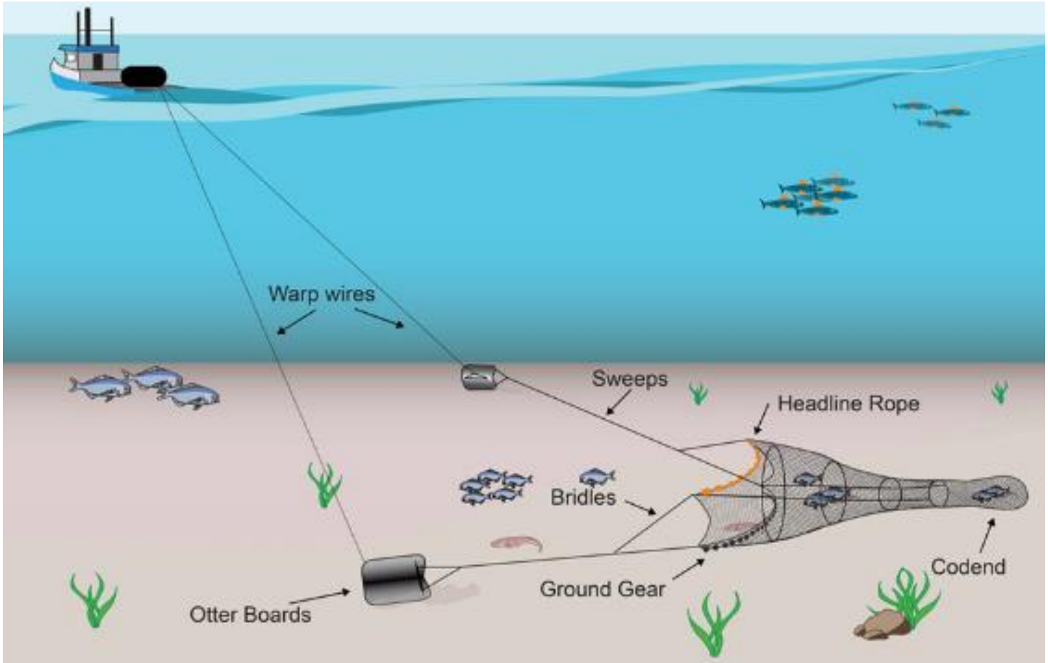


Figure 7-52: Trawl gear typically used by demersal trawlers targeting hake

Source: http://www.afma.gov.au/portfolio-item/trawling

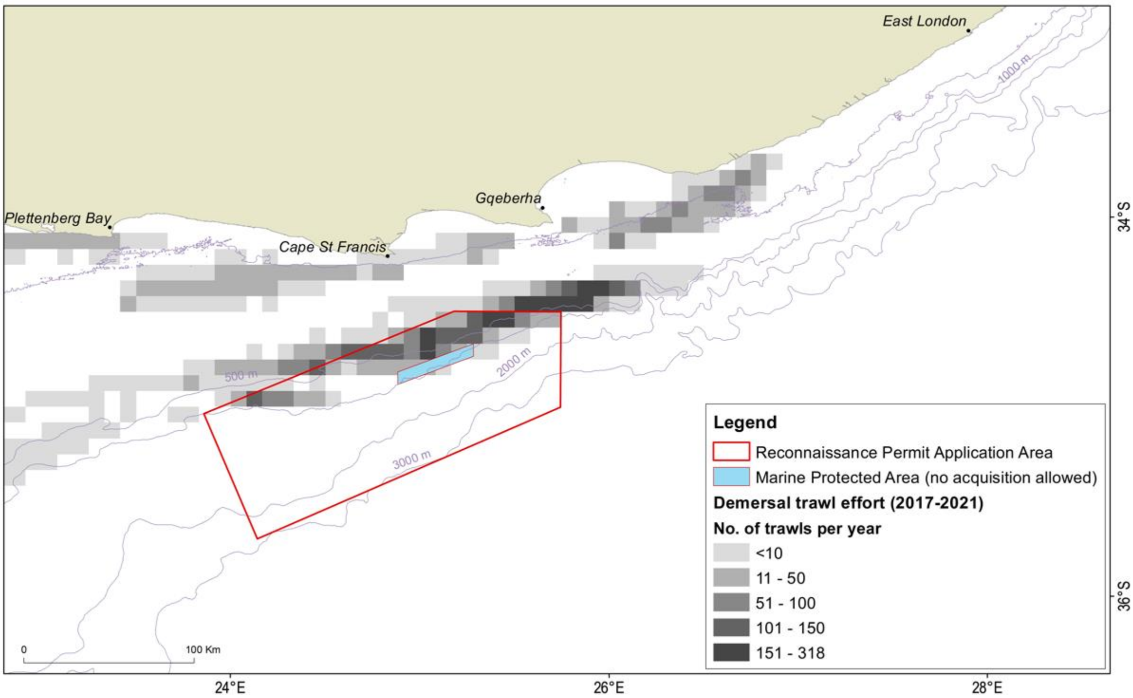


Figure 7-53: Distribution of fishing effort of the offshore demersal trawl sector (2017-2021)

Note: effort is shown as the number of fishing hours at a gridded resolution of 2x2 minutes (each grid block covers an area of approximately 14 km^2).

7.7.2 Mid-Water Trawl

The mid-water trawl fishery targets adult horse mackerel (*Trachurus capensis*), which aggregate in highest concentration on the Agulhas Bank. Shoals of commercial abundance are found in limited areas and the spatial extent of mid-water trawl activity is relatively limited when compared to that of demersal trawling.

Fishing grounds are located in three main areas on the shelf edge of the South and East coasts:

1. Between 22°E and 23°E at a distance of approximately 70 nm offshore from Mossel Bay;
2. Between 24°E to 27°E at a distance of approximately 30 nm offshore; and
3. South of the Agulhas Bank between 21°E and 22°E.

These grounds range in depth from 100 m to 400 m. However, isolated trawls are occasionally made further offshore in deeper water (up to 650 m). The sector comprises six vessels and 34 rights holders which landed a total catch of 19 555 in 2019.

Mid-water trawling gear configuration is similar to that of demersal trawlers, except that the net is manoeuvred vertically through the water column. The towed gear may extend up to 1 km astern of the vessel and comprises trawl warps, net and codend (see Figure 7-54).

Once the gear is deployed, the net is towed for several hours at a speed of 4.8 to 6.8 knots predominantly parallel with the shelf break. Mid-water trawling can occur at any depth between the seabed and the surface of the sea without continuously touching the bottom. However, in practice, mid-water trawl gear does occasionally come into contact with the seafloor.

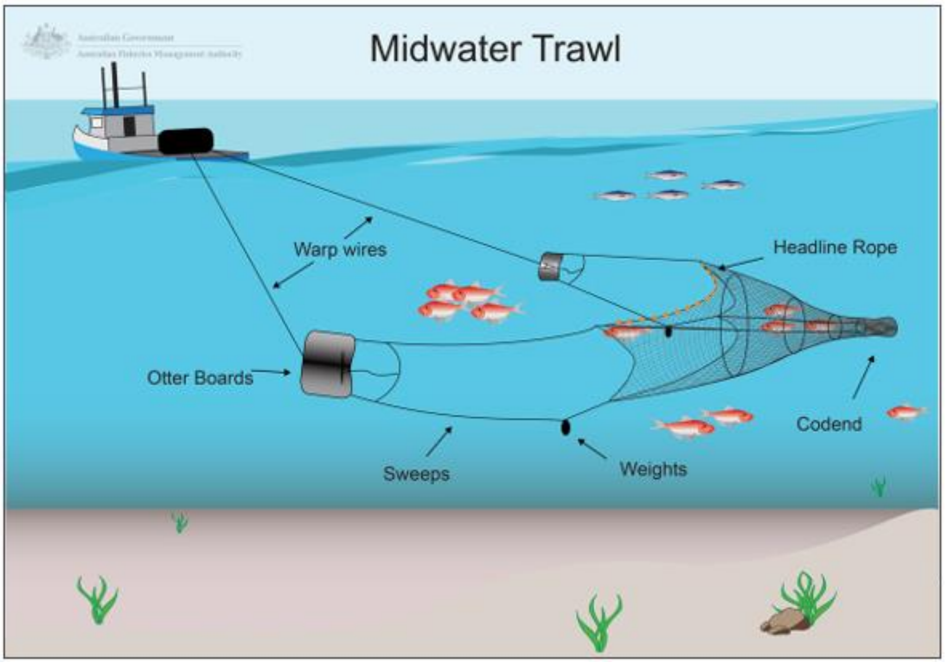


Figure 7-54: Typical configuration of mid-water trawl gear
Source: www.afma.gov.au/fisheries-management/methods-and-gear/trawling

Figure 7-55 shows the spatial extent of grounds fished by mid-water trawlers off the southeast coast in relation to the proposed survey area of interest. **Midwater trawling takes place across the inshore extent of the area of interest between Cape St Francis and Gqeberha, inshore of the 1 000 m bathymetric contour**.

Between 2017 and 2021, an average of 92 trawls per year took place within the proposed survey area of interest, yielding 2 884 tons of horse mackerel. This is equivalent to 18.2% and 16.2% of the overall effort and catch recorded annually by the sector, respectively. The fishery operates continuously throughout the year, with the lowest catches in the project area recorded during June and July.

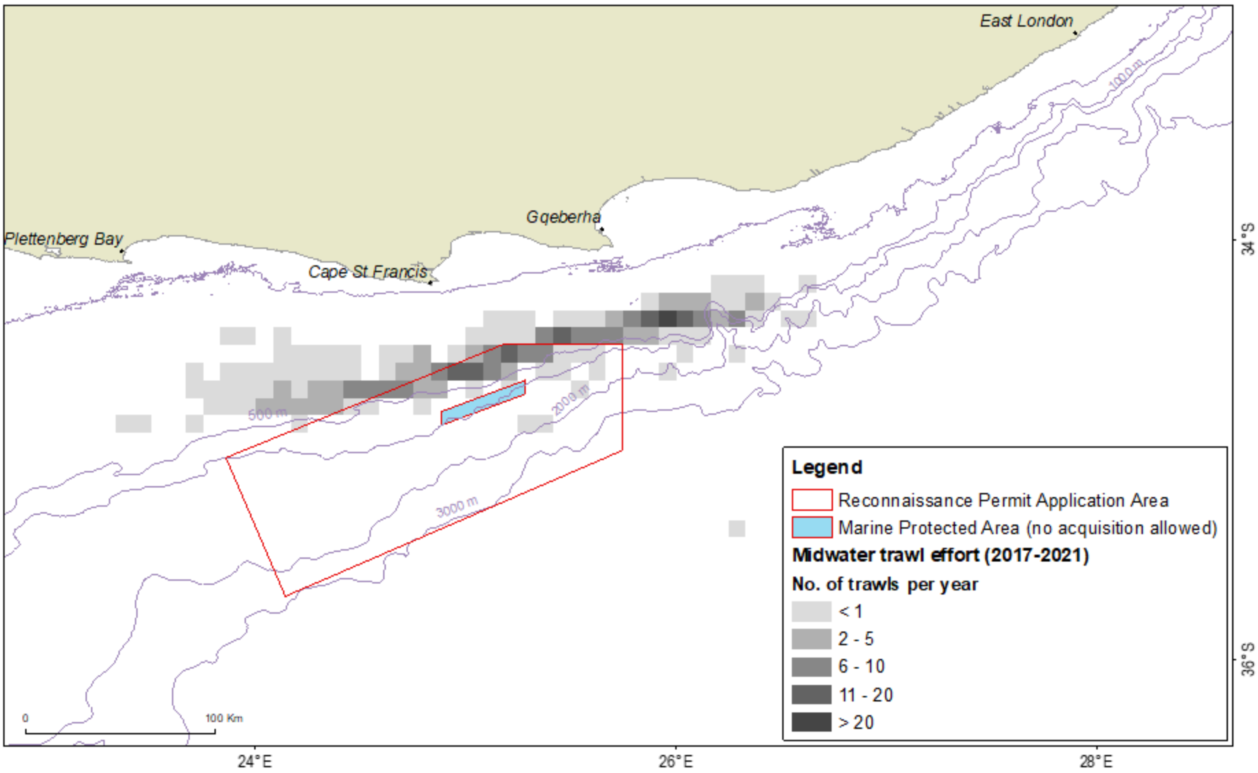


Figure 7-55: Distribution of fishing effort of the mid-water trawl sector (2017-2021)

7.7.3 Demersal Longline – Hake-directed

The demersal longline fishing technique is used to target bottom-dwelling species of fish. Like the demersal trawl fishery the target species of this fishery are the Cape hakes, with a small non-targeted commercial by-catch that includes kingklip. In 2017, 8 113 tons of catch was landed with a wholesale value of R319.2 million, or 3.2% of the total value of all fisheries combined. Landings of 8 230 tons were reported in 2018. Fishing takes place along the West and Southeast coasts in areas similar to those targeted by the demersal trawl fleet.

Currently 64 hake-directed vessels are active within the fishery, most of which operate from Cape Town and Hout Bay. Secondary points of deployment include St Helena Bay, Saldanha Bay, Hermanus, Gansbaai, Plettenberg Bay and Cape St Francis. Vessels based in Cape Town and Hout Bay operate almost exclusively on the West Coast (west of 20° E). The hake longline footprint extends down the west coast from approximately 150 km offshore of Port Nolloth (15°E, 29°S). It lies inshore to the south of St Helena Bay moving offshore once again as it skirts the Agulhas Bank to the south of the country (21°E, 37°S). Along the South Coast the footprint moves inshore again towards Mossel Bay. The eastern extent of the footprint lies at approximately (26°E, 34.5°S). Lines are set parallel to bathymetric contours, along the shelf edge up to the 1 000 m depth contour in places.

The fishery is directed in both inshore and offshore areas. Inshore long-line operations are restricted by the number of hooks that may be set per line while offshore operations may only take place in waters deeper than 110 m and is restricted to the use of no more than 20 000 hooks per line. Lines are typically between 10 km and 20 km in length, carrying between 6 900 and 15 600 hooks each. Baited hooks are attached to the bottom line at regular intervals (1 to 1.5 m) (see Figure 7-56). Gear is usually set at night at a speed of between five and nine knots. Once deployed the line is left to soak for up to eight hours before it is retrieved. A line hauler is used to retrieve gear (at a speed of approximately one knot) and can take six to ten hours to complete.

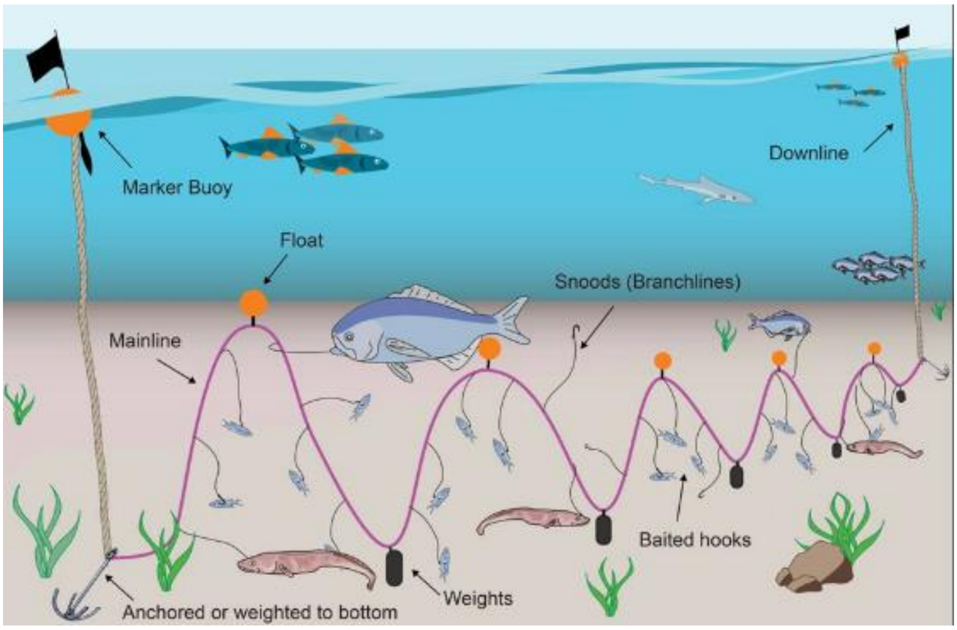


Figure 7-56: Typical configuration of demersal (bottom-set) hake longline gear

Source: http://www.afma.gov.au/portfolio-item/longlining

The spatial distribution of demersal longline fishing areas in relation to the proposed survey area of interest is shown in Figure 7-57. Over the period 2000 to 2019, an average of 2.1 million hooks (166 lines) per year were set within the area of interest, yielding 549 tons of hake which is equivalent to 6.2% and 6.7% of the overall effort and catch recorded annually by the sector, respectively. **Most activity occurs across the inshore portion of the proposed survey area of interest and is concentrated shoreward of the 2 000 m bathymetric contour.** The sector operates year-round, but shows a clear increase in effort within the proposed survey area of interest between September and December.

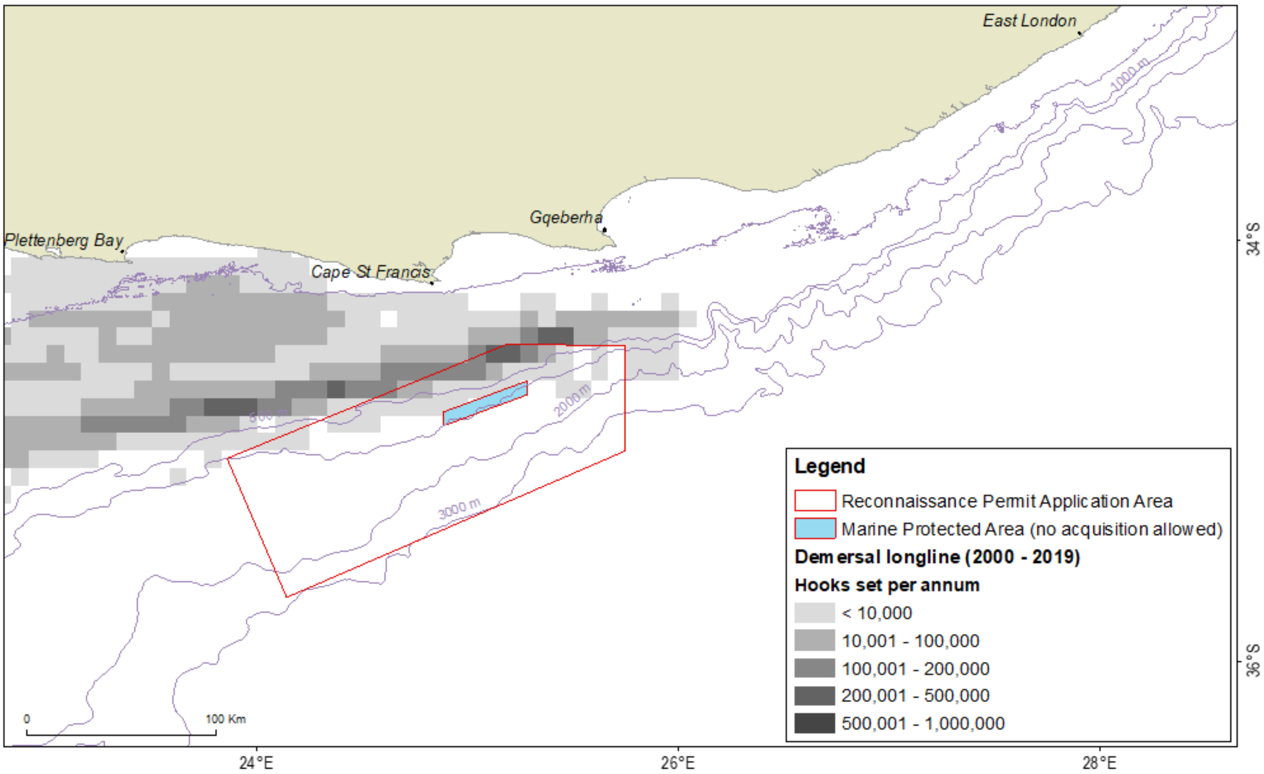


Figure 7-57: Spatial distribution of fishing effort expended by the demersal longline sector (2000-2019)

7.7.4 Demersal Longline – Shark-directed

The shark longline sector formally commenced in 1991 when 30 permits were issued initially to target both demersal and pelagic sharks (pelagic sharks are those living in the water column, often occurring further offshore). In 2005 the dual targeting of demersal and pelagic sharks under the same permit was discontinued and the sector became an exclusive demersal shark longline fishery reduced to eleven Right Holders in 2004 and just six in 2006. The demersal shark longline fishery is permitted to operate in coastal waters from the Orange River on the West Coast to the Kei River on the East Coast, but fishing rarely takes place north of Table Bay. Vessels are typically <30 m in length and use nylon monofilament Lindgren Pitman spool systems to set weighted longlines baited with up to 2 000 hooks (average = 917 hooks). The fishery operates in waters generally shallower than 100 m, and uses bottom-set gear to target predominantly soupfin sharks and smoothhound sharks. The Reconnaissance Permit area overlaps the outer range of the shark directed fishing sector in the vicinity of Gqeberha, with 0.5% (693 kg) of the total catch and effort being recorded within the permit area. **The proposed survey area of interest does not overlap with the shark-directed fishing grounds** (see Figure 7-58).

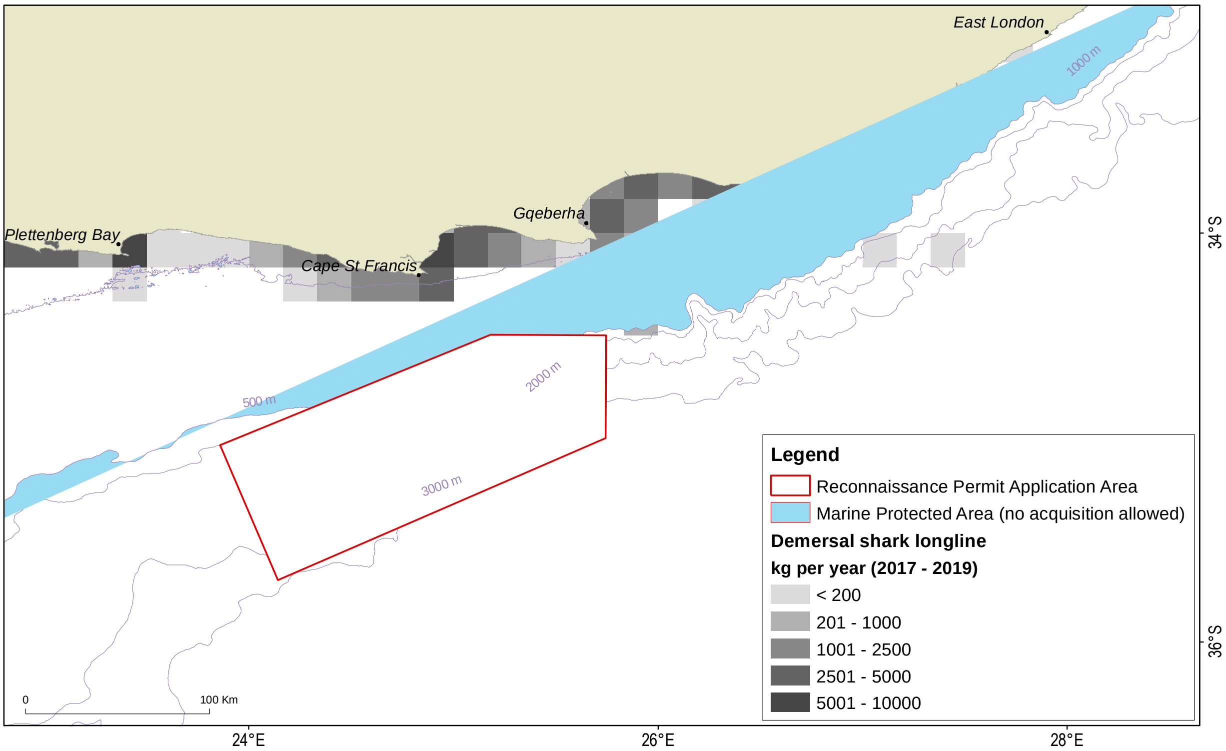


Figure 7-58: Spatial distribution of catch taken by the demersal shark longline sector (2017-2019)

7.7.5 Small Pelagic Purse-Seine

The pelagic-directed purse-seine fishery targeting pilchard (*Sardinops sagax*), anchovy (*Engraulis encrasicolus*) and red-eye round herring (*Etrumeus whitheadii*) is the largest South African fishery by volume (tons landed) and the second most important in terms of economic value. The wholesale value of catch landed by the sector during 2017 was R2.164 billion, or 22% of the total value of all fisheries combined. The total combined catch of anchovy, sardine and round herring landed by the pelagic fishery has decreased by 45% from 395 000 tons in 2016 to just 219 000 tons in 2019, due mainly to a substantial decrease in the catch of anchovy from 262 000 tons in 2016 to only 166 000 tons in 2019. Despite this decline, the average combined catch over the last five years of 322 000 t is only slightly lower than the long-term (1949–2019) average annual catch of 334 000 tons. The industry precautionary upper catch limits (PUCLs) are currently set at 60 000 t for round herring (Red Eye) and 25 000 t for Lantern and Lightfish (combined). The TACs and PUCLs have been repeatedly reduced to allow for stock stabilisation. Anchovy and Sardine directed fishing have been further decreased by 10% for 2023.

The fleet consists of approximately 100 wooden, glass-reinforced plastic and steel-hulled vessels ranging in length from 11m to 48 m. The targeted species are surface-shoaling and once a shoal has been located the vessel will steam around it and encircle it with a large net, extending to a depth of 60 m to 90 m (see Figure 7-59). Netting walls surround aggregated fish, preventing them from diving downwards. These are surface nets framed by lines: a float line on top and lead line at the bottom. Once the shoal has been encircled the net is pursed, hauled in and the fish pumped on board into the hold of the vessel. It is important to note that after the net is deployed the vessel has no ability to manoeuvre until the net has been fully recovered on board and this may take up to 1.5 hours. Vessels usually operate overnight and return to offload their catch the following day.

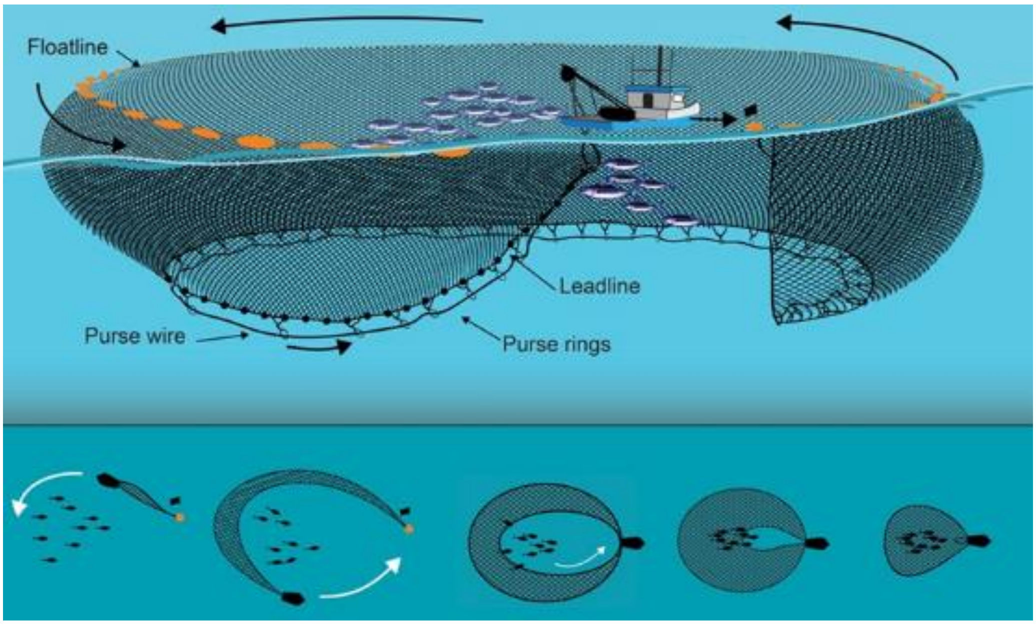


Figure 7-59: Typical configuration and deployment of small pelagic purse-seine for targeting anchovy and sardine as used in South African waters

Source: http://www.afma.gov.au/portfolio-item/purse-seine

Fish are targeted in inshore waters, primarily along the West and South Coasts of the Western Cape and the Eastern Cape Coast, up to a maximum offshore distance of about 100 km. Along the West Coast, the majority of the fleet operate from St Helena Bay, Laaiplek, Saldanha Bay and Hout Bay. The sardine-directed fleet concentrates effort in a broad area extending from Lambert's Bay, southwards past Saldanha and Cape Town towards Cape Point and then eastwards along the coast to Mossel Bay and Gqeberha. Figure 7-60 shows the spatial extent of fishing grounds in relation to the proposed survey area of interest. The fishery is unlikely to operate deeper than the 200 m isobath, with the closest fishing ground located 17 km inshore of the area of interest. **No fishing activity has been reported within the area of interest** (see Figure 7-60).

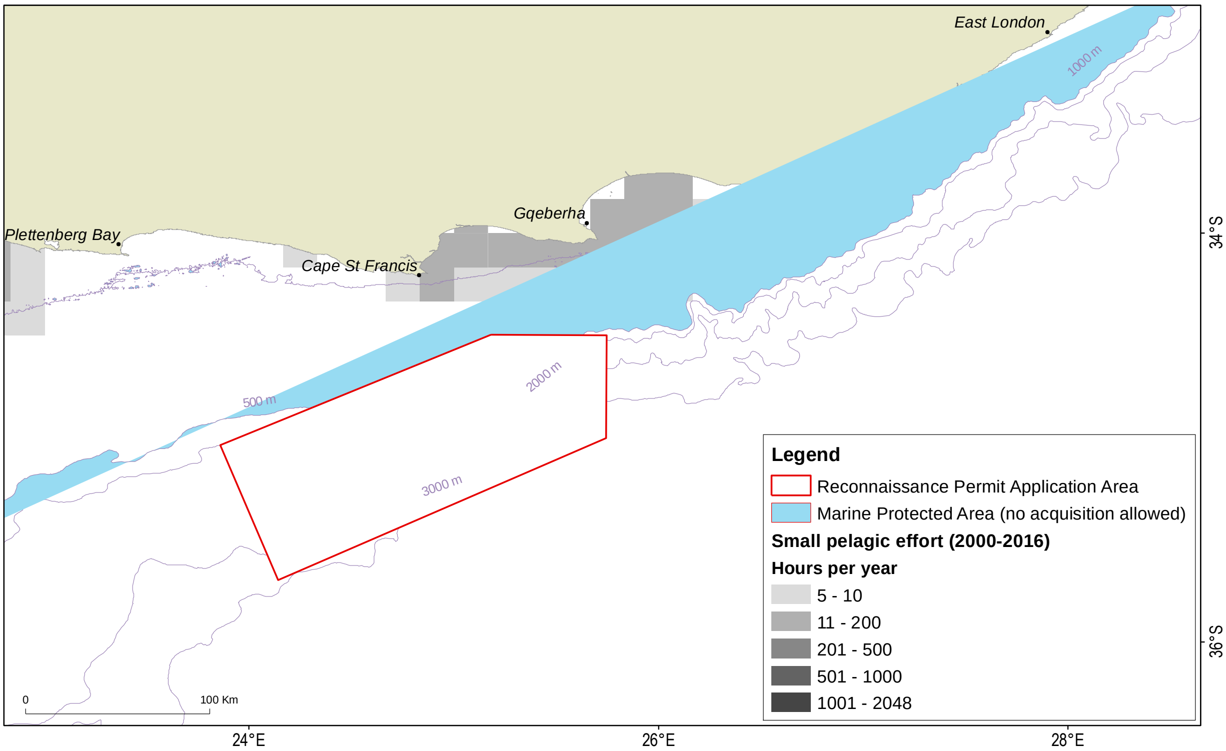


Figure 7-60: Distribution of fishing effort of the purse-seine sector in relation to the proposed survey area of interest (2000-2016)

7.7.6 Pelagic Longline

The target species within the South African pelagic long-line sector are yellowfin tuna, bigeye tuna, swordfish and shark species (primarily mako shark). Due to the highly migratory nature of these species, stocks straddle the EEZ of a number of countries and international waters. As such they are managed as a "shared resource" amongst various countries under the jurisdiction of the International Commission for the Conservation of Atlantic Tunas (ICCAT) and the Indian Ocean Tuna Commission (IOTC). Since the 1990s foreign vessels were banned from South African waters and fishing rights were allocated to South Africans sometimes working in joint ventures with Japanese. In 2017, 60 fishing rights were allocated for a period of 15 years, and there were 22 active long-line vessels within South African waters (DAFF, 2018). Eighteen vessels operated in the Atlantic (west of 20°E) during 2017. These were exclusively domestic vessels, with three Japanese vessels fishing exclusively in the Indian Ocean (east of 20°E) during 2017 (DAFF, 2018). The wholesale value of catch landed by the sector during 2017 was R154.2 Million, or 1.6% of the total value of all fisheries combined, with landings of 2 541 tons in 2017 and 2 815 tons in 2018.

The fishery operates year-round with a relative increase in effort during winter and spring (see Figure 7-61). Variations in catch per unit effort (CPUE) are driven both by the spatial and temporal distribution of the target species and by fishing gear specifications. Variability in environmental factors such as oceanic thermal structure and dissolved oxygen can lead to behavioural changes in the target species, which may in turn influence CPUE (Punsly and Nakano, 1992).

During the period 2000 to 2016, the sector landed an average catch of 4 527 tons and set 3.55 million hooks per year. Catch by species and number of active vessels for each year from 2005 to 2018 are given in Table

7-10. Total catch and effort figures reported by the fishery for the years 2000 to 2018 are shown in Figure 7-62.

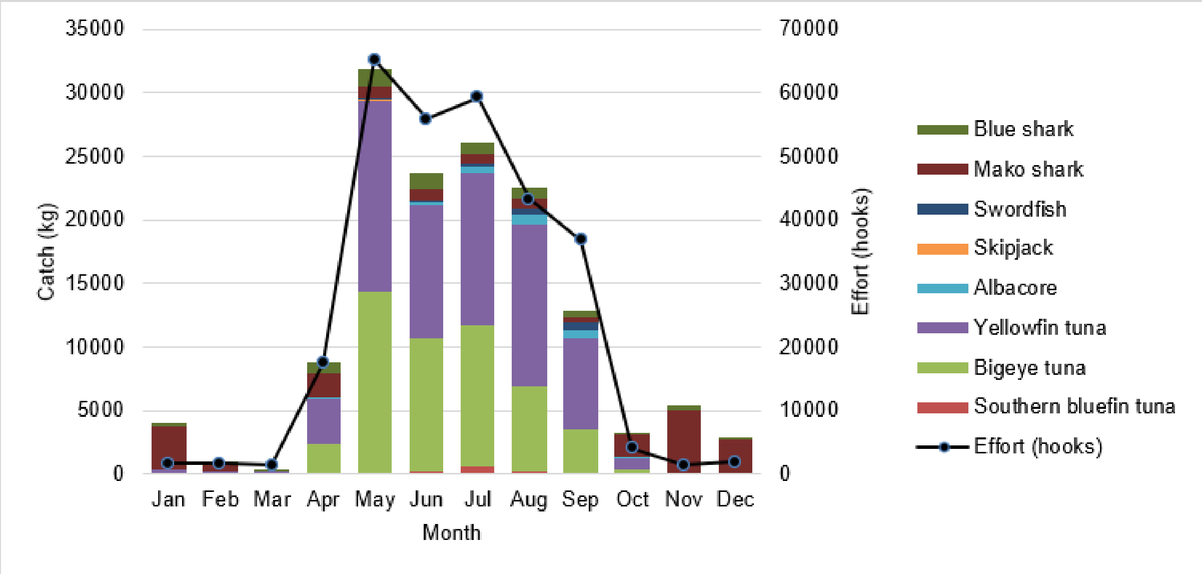


Figure 7-61: Monthly variation of catch and effort recorded by the large pelagic longline sector (average figures for the period 2006 – 2016) within the Reconnaissance Permit area.

Table 7-10: Total catch (t) and number of active domestic and foreign-flagged vessels targeting large pelagic species for the period 2008 to 2018 (Source: DEFF, 2019).

Year	Bigeye tuna	Yellowfin tuna	Albacore	Southern bluefin tuna	Swordfish	Shortfin mako shark	Blue shark	Number of active vessels	
								Domestic	Foreign-flagged
2008	640	630	340	43	398	471	283	15	13
2009	765	1096	309	30	378	511	286	19	9
2010	940	1262	165	34	528	591	312	19	9
2011	907	1182	339	49	584	645	542	16	15
2012	822	607	245	79	445	314	333	16	11
2013	882	1091	291	51	471	482	349	15	9
2014	544	486	114	31	223	610	573	16	4
2015	399	564	151	11	341	778	531	Fleets merged under SA flag with only a few foreign boats: up to 30 boats operating	
2016	315	439	85	18	275	883	528		
2017	497	400	172	47	246	726	523		
2018	478	478	238	208	313	613	592		

Although most vessels operate from the Cape Town harbour, the areas of operation are extensive in the South African EEZ, along the continental shelf break and further offshore, with **overlap of fishing operations with the area of interest.** Pelagic longline effort for tuna extends along and offshore of the 500 m isobath, whilst pelagic shark species are targeted primarily along the 200 m isobath.

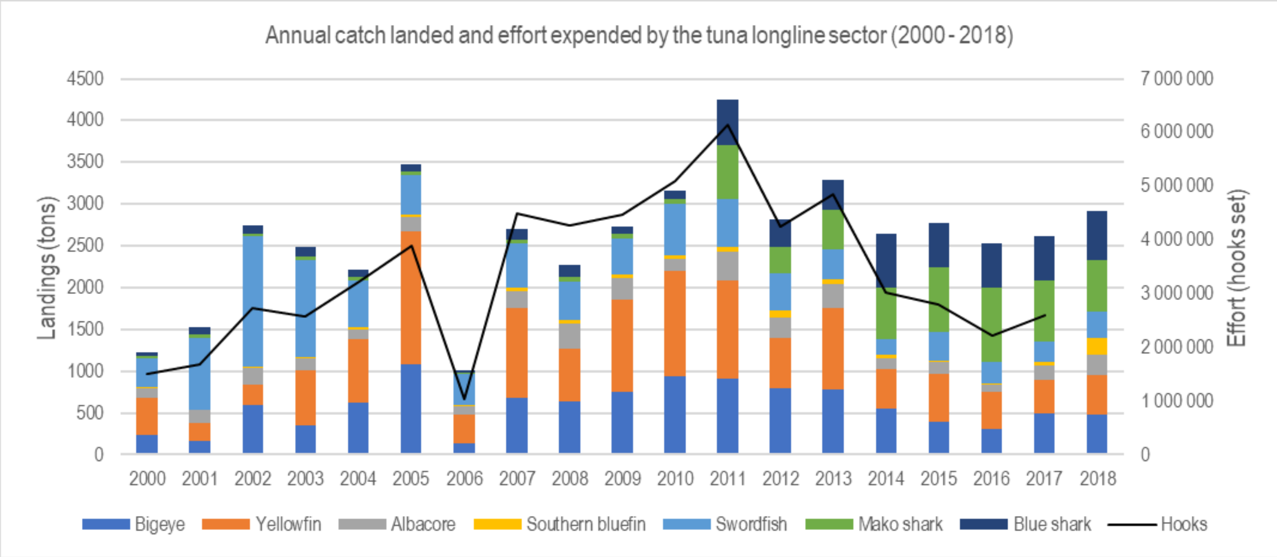


Figure 7-62: Inter-annual variation of catch landed and effort expended by the large pelagic longline sector in South African waters as reported to the two regional management organisations, ICCAT and IOTC (2000 - 2018).

Fishing effort for the period 2017 to 2019 in relation to the proposed survey area of interest is shown in Figure 7-63. Fishing takes place across the entire extent of the area of interest, with effort concentrated along the shallower areas. Over the period 2017 to 2019 an average of 141 lines per year were recorded within the proposed survey area of interest, yielding 233 tons of catch. This is equivalent to 3.4% of the total national effort and 3.3% of the total catch reported annually. **Fishing activity can be expected across the entire area of interest with peak fishing taking place from May to August** (see Figure 7-61).

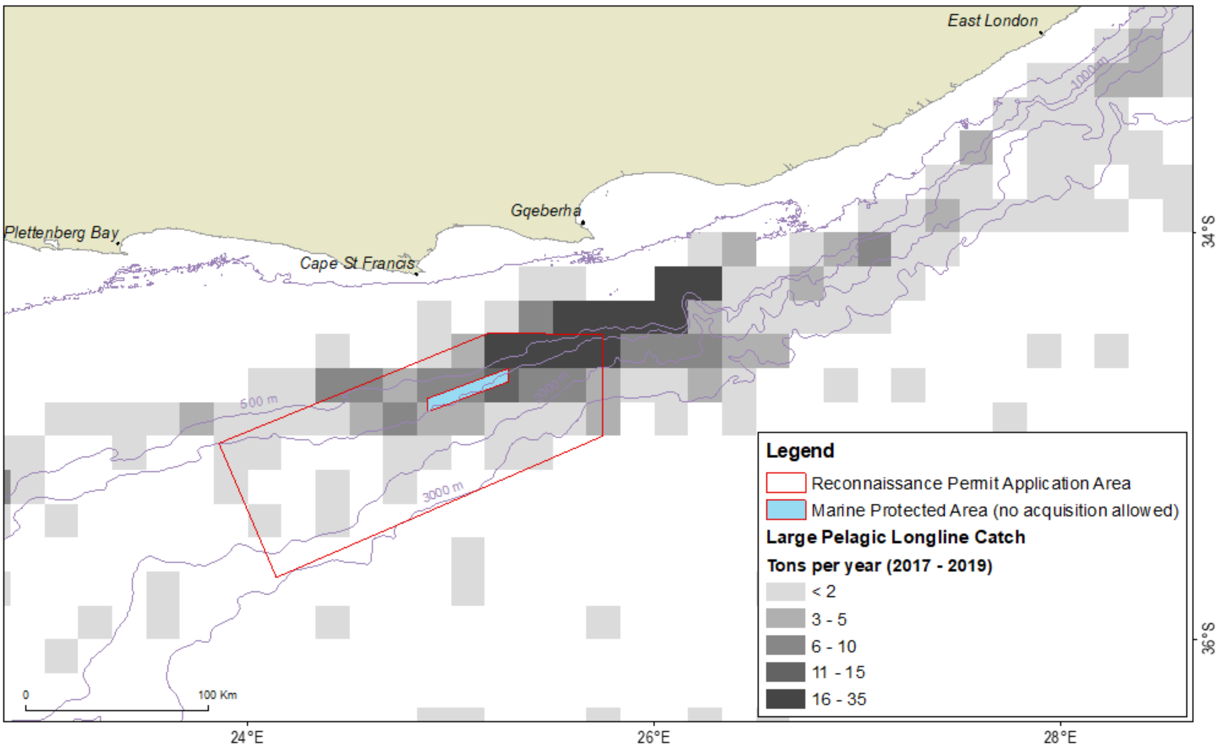


Figure 7-63: Distribution of longline fishing effort targeting large pelagic species in relation to the proposed survey area of interest (2017-2019)

Pelagic long-line vessels set a drifting mainline, which are up to 100 km in length. The mainline is kept near the surface or at a certain depth (20 m below) by means of buoys connected via "buoy-lines", which are spaced approximately 500 m apart along the length of the mainline (see Figure 7-64). Hooks are attached to the mainline via 20 m long trace lines, which are clipped to the mainline at intervals of approximately 50 m. There can be up to 3 500 hooks per line. A single main line consists of twisted rope (6 to 8 mm diameter) or a thick nylon monofilament (5 to 7.5 mm diameter). Various types of buoys are used in combinations to keep the mainline near the surface and locate it should the line be cut or break for any reason. Each end of the line is marked by a Dahn Buoy and Radar reflector, which marks its position for later retrieval by the fishing vessel. A line may be left drifting for up to 18 hours before retrieval by means of a powered hauler at a speed of approximately 1 knot. During hauling a vessel's manoeuvrability is severely restricted and, in the event of an emergency, the line may be dropped to be hauled in at a later stage.

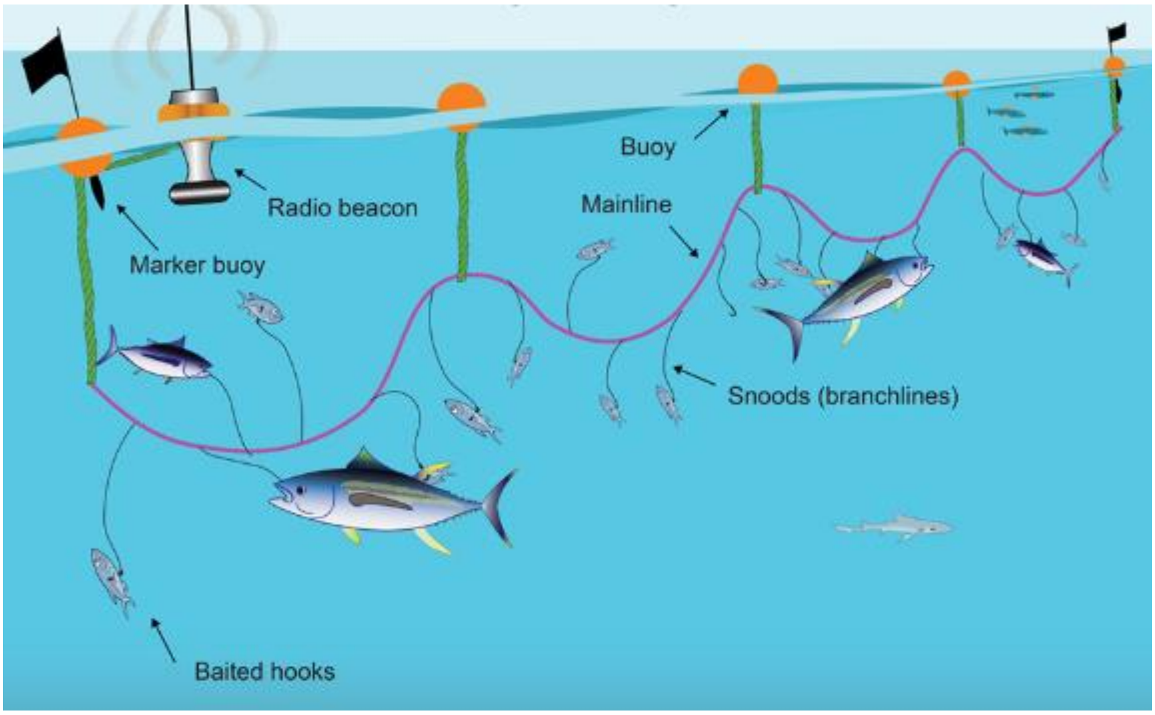


Figure 7-64: Typical pelagic longline gear source
Source: http://www.afma.gov.au/portfolio-item/longlining)

7.7.7 Traditional Line Fish

The traditional line fishery includes commercial, subsistence and recreational sectors and is South Africa's third most important fishery in terms of total tons landed and economic value. It is a long-standing, **nearshore fishery** based on a large assemblage of different marine species of which 50 species are economically important (with species caught dependent on region). Within the Western Cape the predominant catch species is snoek while other species such as Cape bream (hottentot), geelbek, kob and yellowtail are also important. Towards the East Coast the number of catch species increases and includes resident reef fish (Sparidae and Serranidae), pelagic migrants (Carangidae and Scombridae) and demersal migrants (Sciaenidae and Sparidae). In 2017, the wholesale value of catch was reported as R122.1 million.

The commercial line fishery operates between Port Nolloth on the West Coast to Cape Vidal on the East Coast from the coast out to approximately the 100 m depth contour. Fishing gear consists of hand line or rod-and-reel. Recreational permit-holders fish via ski boat or from the shore (anglers) whereas the commercial sector is purely boat-based. Subsistence permit-holders are shore-based and estuarine (purely based on the East Coast). Line fishers are restricted to a maximum of ten hooks per line but a single fisherman may operate several lines at a time. Due to the large number of users, launch sites, species targeted, and the wide operational range, the line fishery is managed on an effort basis, rather than on a catch basis.

Since December 2000, the fishery has consisted of 3 450 crew operating from 455 commercial vessels. The number of rights holders is 425 (rights are valid until 31 December 2020). For the 2019/2020 fishing season, 395 vessels and 3007 crew were apportioned to commercial fishing, whilst 60 vessels and 443 crew were apportioned to small-scale fishing (refer to Section 7.7.9). DFFE has proposed an increase in the apportionment of TAE to small-scale fishing from 13% to 50% commencing in 2021 in order to boost economic possibilities for coastal communities.

In addition to the vessels that operate within the commercial sector, many more ski boats are used in the recreational sector which may be launched from a number of slipways and harbours. Vessels range in length between 4.5 m and 11 m and the offshore operational range is restricted by vessel category to 75 km from shore, but is generally within 15 km of launch site and shallower than the 200 m depth contour (see Figure 7-65). In relation to the proposed survey area of interest, the closest fishing activity would be situated inshore off Cape Recife, Gqeberha, approximately 25 km inshore of the survey area of interest. The fishing activity within this area takes place year-round. **No line fish activity has been recorded within the area of interest between 2017 and 2019.**

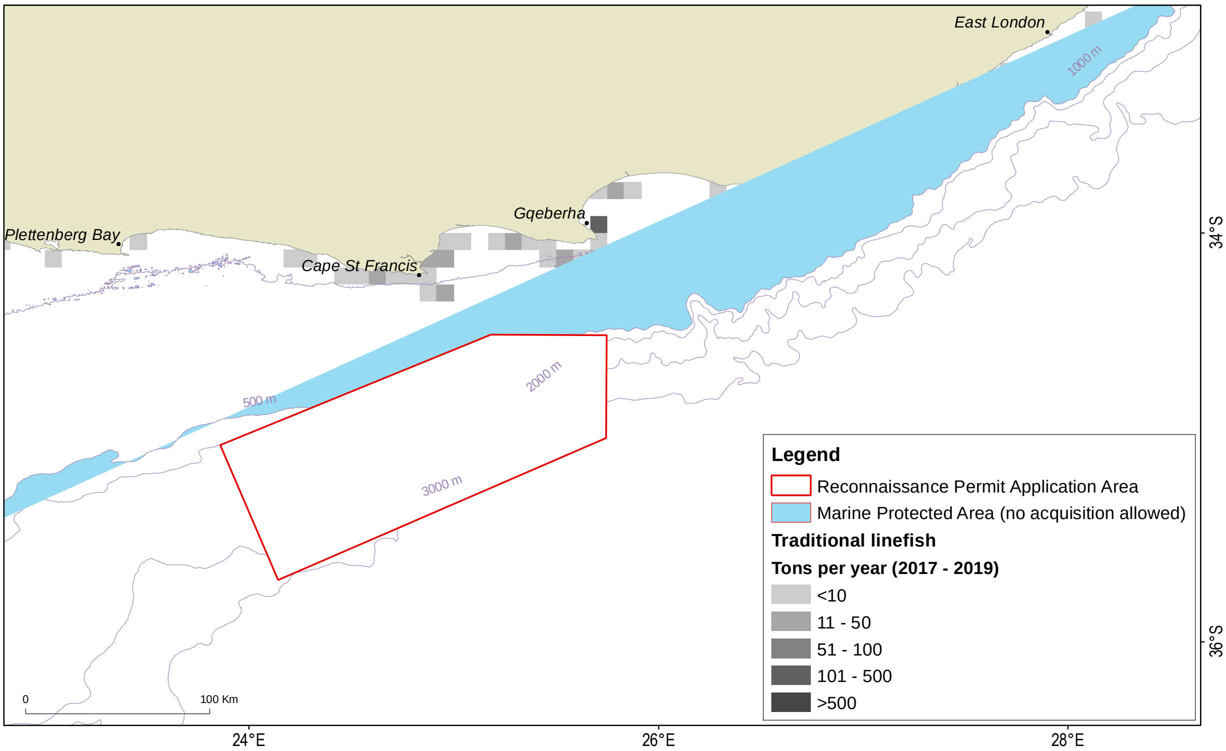


Figure 7-65: The spatial distribution of the traditional line fishery sector in relation to the proposed survey area of interest (2017-2019)

7.7.8 South Coast Rock Lobster

The South Coast rock lobster (*Palinurus gilchristi*) is endemic to the southern coast of South Africa, where they occur on the continental shelf at a depth range of 50 m to 200 m. Two areas are commercially viable to fish on the South Coast, the first is approximately 200 km offshore on the Agulhas Bank and the second is within 50 km of the shoreline between Mossel Bay and East London.

The South Coast rock lobster fishery is a deep-water long-line trap fishery which entails the deployment of traps on the seafloor which are difficult to remove at short notice. 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, which may be up to 2 km in length. Each line is weighted to lie along the seafloor and is connected at each end to a marker buoy at the sea surface. Vessels are large, ranging from 30 m to 60 m in length. Those with on-board freezing capacity will remain at sea for up to 40 days per trip, while those retaining live catch remain at sea between seven and 10 days before discharging at port.

The fishery operates year-round within the proposed survey area of interest with a slight increase in effort during November and December (see Figure 7-66). During the 2018/2019 season eight vessels were active in the fishery, landing a total lobster tail weight of 340 tons. **The Reconnaissance Permit area overlaps with 6 fishing blocks with fishing activity in the area ranging between the 65 m and 130 m depth contours.** Between 2006 and 2020, approximately 38 000 traps were set within the proposed survey area of interest, yielding 6.2 tons of rock lobster (tail weight), which is equivalent to 1.7% and 1.9% of the overall effort and catch recorded annually by the sector (see Figure 7-67). **Fishing gear could be expected within the inshore areas of the area of interest.**

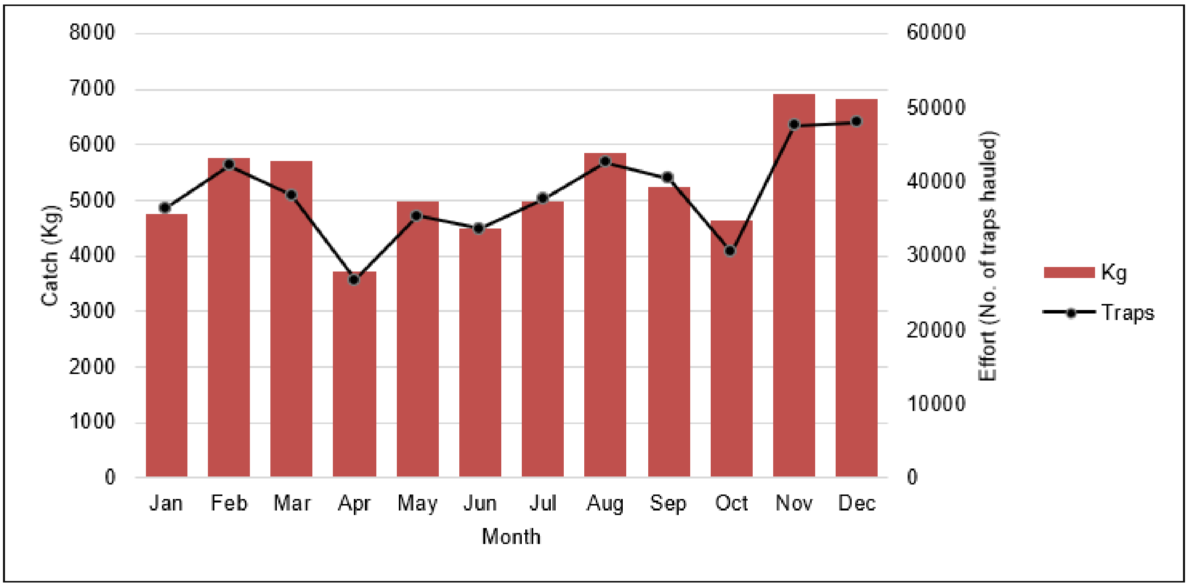


Figure 7-66: South Coast rock lobster catch and effort by month within the proposed survey area of interest (2006-2016)

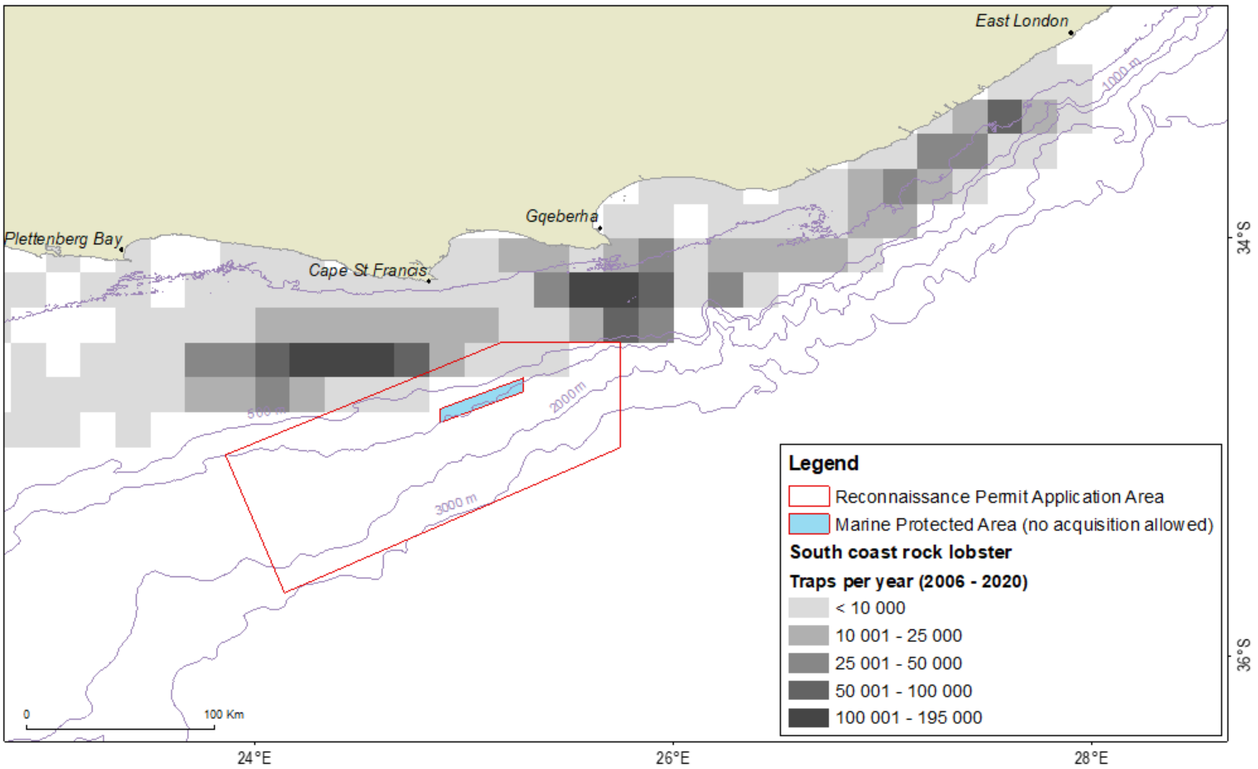


Figure 7-67: An overview of the spatial distribution of South Coast rock lobster fishing effort off the Southeast Coast zones (2006-2020)

7.7.9 Squid Jig

Chokka squid (*Loligo vulgaris reynaudii*) is distributed from the border of Namibia to the Wild Coast. Along the South Coast adult squid is targeted in spawning aggregations on fishing grounds extending from Plettenberg Bay to Port Alfred between 20 m and 120 m depths (see Figure 7-68). Spawning aggregations are a seasonal occurrence, reaching a peak between September and December (Augustyn *et al*. 1992).

Fishing 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. **The fishery is seasonal, with effort largely situated inshore of the area of interest and 99% of the catch taken in water depths of less than 60 m and at least 30 km inshore of the survey area of interest** (see Figure 7-68). Fishing operations could range up to the 200 m depth contour, but activity at this depth is considered sporadic. **Between 2016 and 2020 no fishing activity was reported by the sector within the survey area of interest.**

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

The squid fishery is managed in terms of the Total Allowable Effort (TAE) allowed within the fishery, which in 2020/2021 permitted 2 443 crew and 295 000 man days of fishing during the season. There are two closed seasons totalling slightly more than four months: i) a permanent closed period of five weeks between October and November to allow for summer spawning; and ii) an additional three months in winter to prevent the man-days from exceeding the maximum. During the enforced annual five-week closure between October and November, DFFE undertakes a survey on spawning aggregations in the bay areas.

Typically, annual catches range from 4 000 – 12 000 tonnes with landings in 2018 amounting to 13 237 tonnes. All of the catch is exported to Europe at a value of approximately R80/kg and depending on the season, and the industry is valued anywhere between R320 and R1.1 billion.

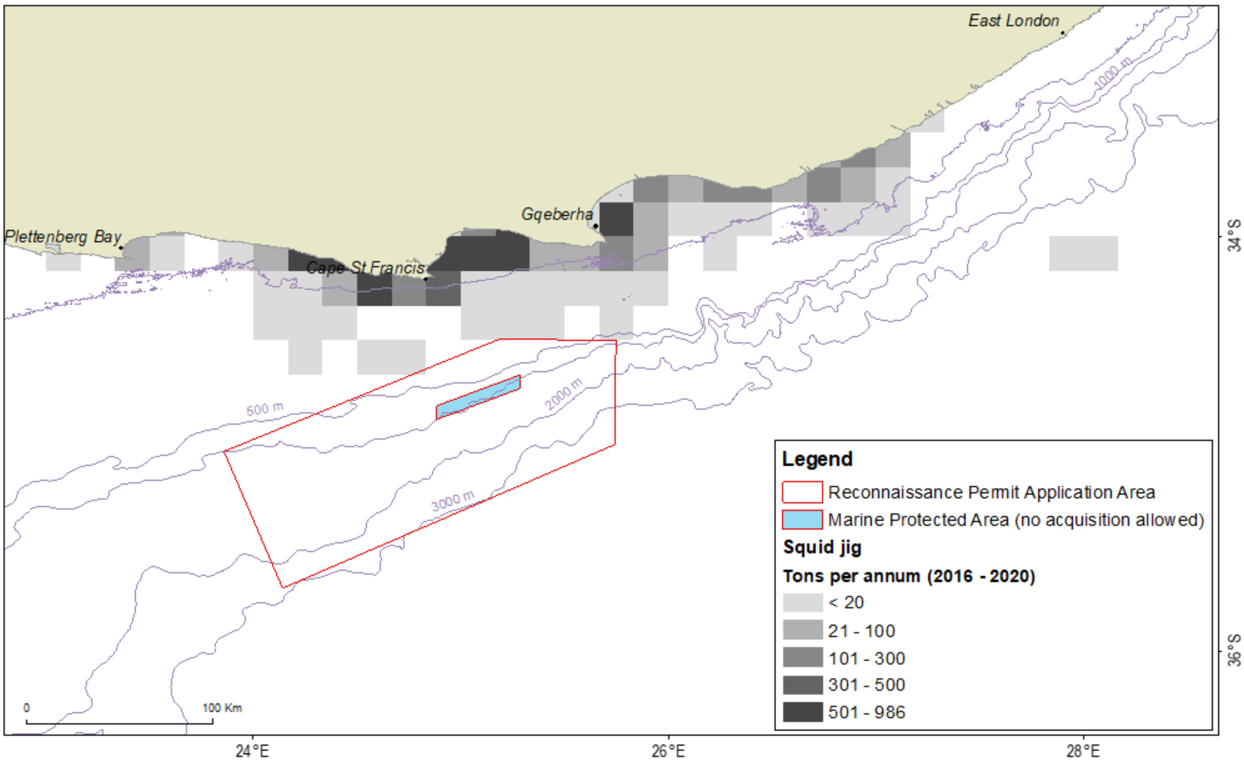


Figure 7-68: Spatial distribution of catch taken by the squid jig fishery in relation to the proposed survey area of interest (2016-2020)

7.7.10 Small-Scale Fishing

South Africa is implementing a small-scale fisheries policy (SSF) to manage fish stocks sustainably by regulating access to baskets of species through the allocation of rights co-operative groups. This is in process and was gazetted in May 2019 under the Marine Living Resources Act, 1998 (Act No. 18 of 1998).

Small-scale fishers fish to meet food and basic livelihood needs, and may be directly involved in harvesting, processing and distribution of fish for commercial purposes. These fishers traditionally operate on nearshore fishing grounds, using traditional low technology or passive fishing gear to harvest marine living resources on a full-time, part-time or seasonal basis. Fishing trips are usually a single day in duration and fishing/harvesting techniques are labour intensive. The equipment used by small-scale fishers includes rowing boats in some areas, motorized boats on the South and West Coast and simple fishing gear including hands, feet, screw drivers, hand lines, prawn pumps, rods with reels, gaffs, hoop nets, gill nets, seine/trek nets and semi-permanently fixed kraal traps. **Distances fished from the shore are constrained by boat size and maritime safety requirements and as a general rule are not expected to be more than 3 nm from the coastline.** Small-scale fishers are an integral part of the rural and coastal communities in which they reside and this is reflected in the socio-economic profile of such communities.

A small-scale fishing right is the right to catch different species of fish in the near shore. These rights are allocated to communities and not to individuals in terms of the SSF. Applicants for small-scale fishing rights must have a historical involvement in traditional fishing operations, including the catching, processing or marketing of fish for a cumulative period of at least 10 years. They also need to show a historical dependence on deriving the major part of their livelihood from traditional fishing operations. More than 270 communities have registered an Expressions of Interest (EOI) with the Department.

The policy also requires a multi-species approach to allocating rights, which will entail allocation of rights for a basket of species that may be harvested or caught within particular designated areas. DEFF recommends five basket areas:

- Basket Area A – The Namibian border to Cape of Good Hope – 57 different resources
- Basket Area B – Cape of Good Hope to Cape Infanta – 109 different resources
- Basket Area C – Cape Infanta to Tsitsikamma – 107 different resources
- Basket Area D – Tsitsikamma to the Pondoland MPA – 138 different resources
- Basket Area E – Pondoland MPA to the Mozambican border – 127 different resources.

While most of the basket species are nearshore (within 3 nm of the coast), the fisheries that operate further offshore may include hake handline and squid which, will be subjected to the ongoing Fishery Rights Allocation Process (referred to as “FRAP”). While the small-scale fisheries are defined as a fishery, specific operations and dynamics are not yet fully defined as they are subject to an ongoing process by DFFE. DFFE has split SSF by communities into district and local municipalities. In the Eastern Cape, the communities are broadly split up as 1) Nelson Mandela Bay, 2) Sarah Baartman, 3) Buffalo City, 4) Amathole, 5) O.R. Tambo and 6) Alfred Nzo. **There are 5 154 fishers registered in the Eastern Cape province.**

Those SSF communities that are in process of, or have formed, cooperatives along the Southeast Coast are indicated in Figure 7-69. The small-scale fishery rights cover the nearshore area (defined in section 19 of the MLRA as being within close proximity of shoreline). Small-scale fishermen along the Southeast Coast are typically involved in traditional line, squid jig and oyster harvesting. The oyster fishery operates within the sub-tidal zone and therefore does not overlap with the proposed survey area of interest. **It is unlikely that the squid jig fishery would operate within the survey area of interest with activity concentrated closer inshore in the vicinity of Gqeberha, and line fish vessels could be expected within 25 km of the area of interest.** There are currently 222 fishers registered within the Nelson Mandela Bay MM and a further 348 fishers registered within the Sarah Baartman DM adjacent to the area of interest.

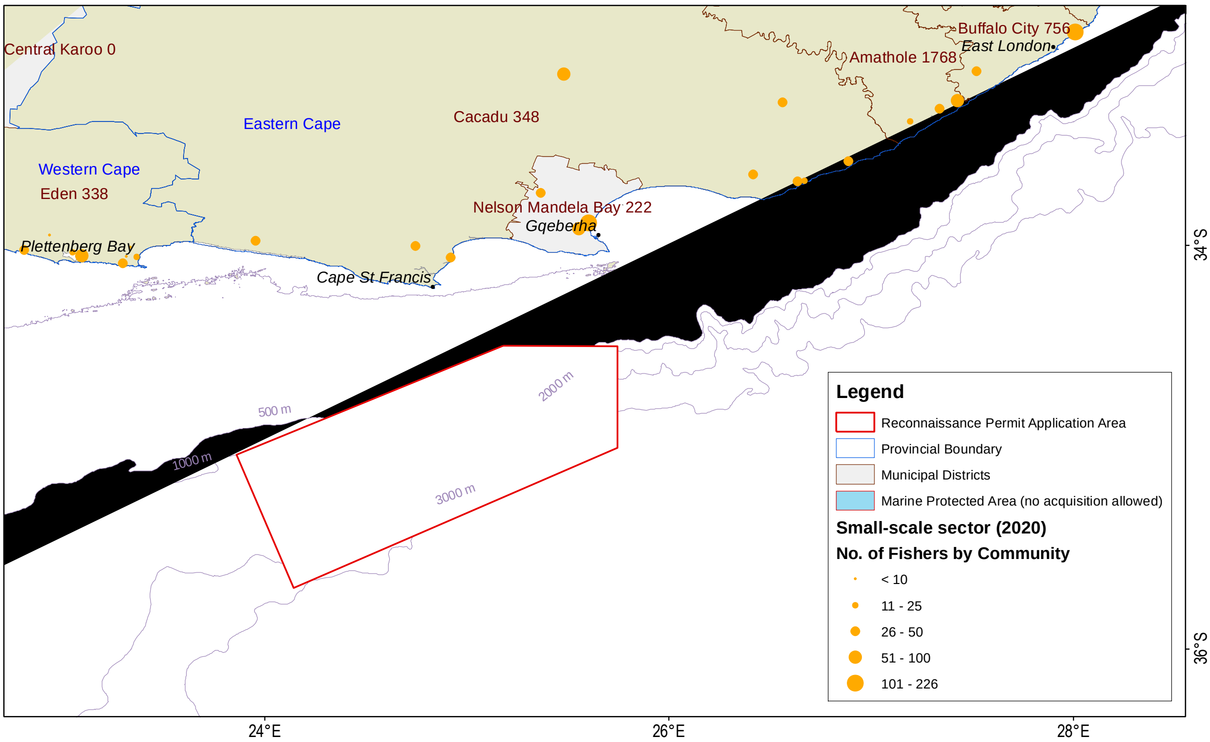


Figure 7-69: Location of small-scale fishing communities along the Southeast Coast and number of participants per community in the vicinity of the proposed survey area of interest

7.7.11 Fisheries Research

Swept-area trawl surveys of demersal fish resources are carried out twice a year by DFFE in order to assess stock abundance. Results from these surveys are used to set the annual TACs for demersal fisheries. Surveys of demersal fish resources are carried out in January/February (West Coast survey) and April/May (South Coast survey) each year by DFFE. Stratified, bottom trawls are conducted to assess the biomass, abundance and distribution of hake, horse mackerel, squid and other demersal trawl species on the shelf and upper slope of the South African coast. The gear configuration is similar to that of commercial demersal trawlers, however, nets are towed for a shorter duration of generally 30 minutes per tow. Trawl positions are randomly selected to cover specific depth strata that range from the coast to the 1 000 m bathymetric contour. Approximately 120 trawls are conducted during each survey over a period of approximately one month. Figure 7-70 shows the distribution of research trawls undertaken off the Southeast Coast in relation to the proposed survey area of interest. Over the period 2013 to 2021, between 5 and 10 trawls per survey have been conducted within the area at a depth range of up to 945 m. **It is possible that demersal research trawls could coincide with the proposed survey at a depth range of 100 m to 500 m during April/May**.

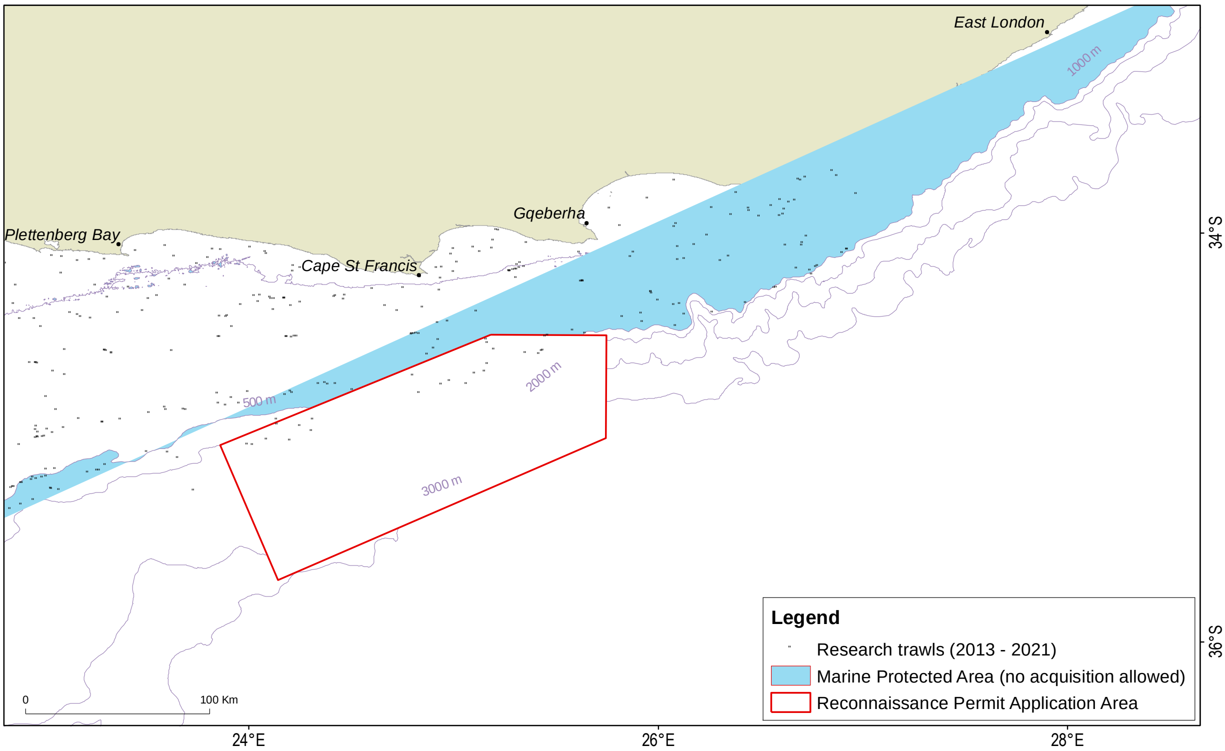


Figure 7-70: Spatial distribution of research survey trawling effort by DFFE off the Southeast Coast.

The biomass of small pelagic species is also assessed bi-annually by an acoustic survey. The first of these surveys is timed to commence mid-May and runs until mid-June while the second starts in mid-October and runs until mid-December. The timing of the demersal and acoustic surveys is not flexible, due to restrictions with availability of the research vessel as well as scientific requirements. During these surveys the survey vessel travels pre-determined transects (perpendicular to bathymetric contours) running offshore from the coastline to approximately the 200 m bathymetric contour. Figure 7-71 shows the distribution of survey transects and sampling stations during the November 2020 and May 2021 research surveys in relation to the proposed survey area of interest. **It is possible that acoustic research surveys could coincide with the proposed survey inshore of the 200m bathymetric contour during May.**

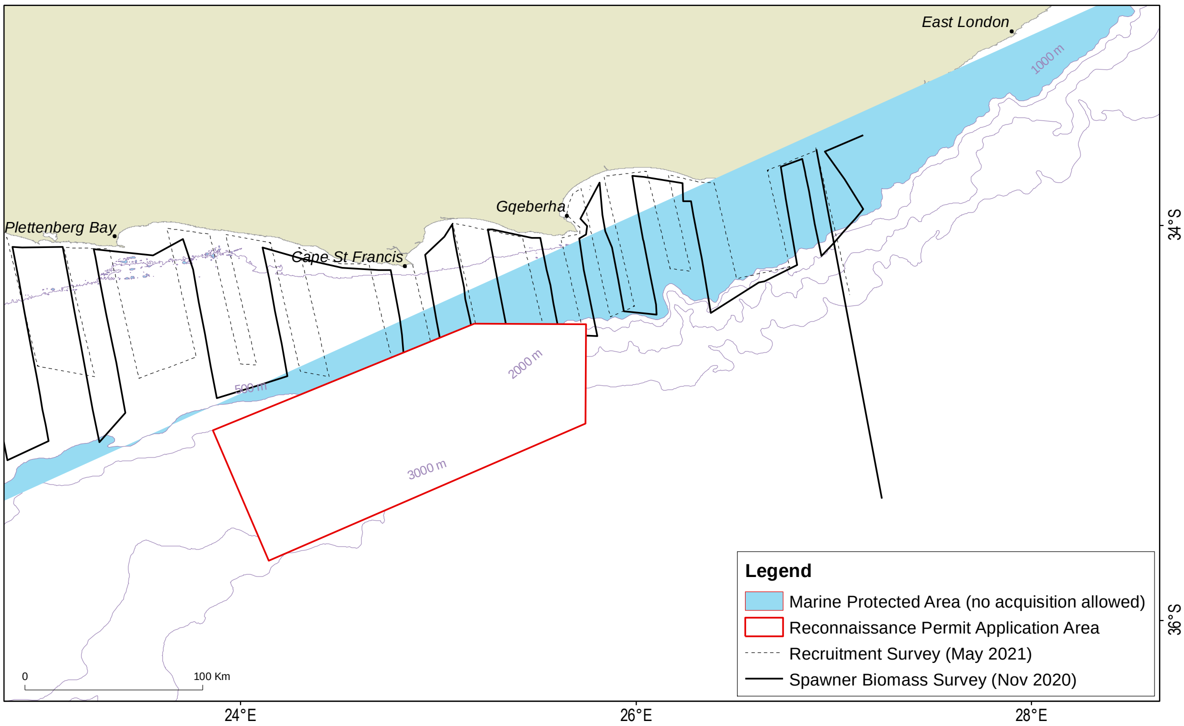


Figure 7-71: Spatial distribution of sampling stations for acoustic surveys off the Southeast Coast (2020-2021).

7.7.12 Summary of Fishing Activities in Project Area

Table 7-11 provides a list of fisheries sectors that operate off the Southeast Coast, the seasonality of fishing effort within the proposed survey area and the likelihood of their presence within the proposed survey area.

Table 7-11: Summary table of seasonal variation in fisheries active in the proposed survey area of interest

Sector	Likelihood of presence in reconnaissance permit area	Fishing Intensity by Month in the vicinity of the reconnaissance permit area H = High; M = Low to Moderate; N = None											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Demersal Trawl	Highly likely	H	H	H	H	M	M	M	M	M	H	H	H
Midwater Trawl	Highly likely	H	H	H	H	H	M	M	H	H	H	H	H
Hake Demersal Longline	Highly likely	M	M	M	M	M	M	M	M	H	H	H	H
Shark Demersal Longline	Unlikely	M	M	M	M	M	M	M	M	M	M	M	M
Small Pelagic Purse-Seine	Unlikely	M	H	H	H	H	H	H	H	H	H	H	M
Large Pelagic Longline	Highly likely	M	M	M	M	H	H	H	H	H	M	M	M
Traditional Line Fish	Unlikely	M	M	M	M	M	M	M	M	M	M	M	M
South Coast Rock Lobster	Possible	M	M	M	M	M	M	M	M	M	M	M	M
Squid Jig	Unlikely	H	M	M	N	N	N	M	M	M	M	M	H
Small-scale	Unlikely	M	M	M	M	M	M	M	M	M	M	M	M
Demersal Research Survey (trawl)	Possible	N	N	N	M	M	M	N	N	N	N	N	N

Sector	Likelihood of presence in reconnaissance permit area	Fishing Intensity by Month in the vicinity of the reconnaissance permit area H = High; M = Low to Moderate; N = None											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pelagic Research Survey (acoustic)	Possible	N	N	N	N	M	M	N	N	N	M	M	M

7.8 OFFSHORE MARINE AND COASTAL INFRASTRUCTURE AND ACTIVITIES

7.8.1 Marine Traffic and Transport

A large number of vessels navigate along the South Coast on their way around the southern African subcontinent (see Figure 7-72). While ship traffic around South Africa is not high in global terms compared to say the Panama or Suez Canal, ship traffic is considerable (Gründlingh *et al.* 2006). Approximately 120 million tonnes of oil and substantial volumes of bunker fuel are estimated to pass through South African waters every year which indicates that South Africa has one of the highest concentrations of oil tankers and cargo ships in the world (IMO, 2005). Although the majority of vessel traffic, including commercial and fishing vessels, remains relatively close inshore **a significant amount of ship traffic can be anticipated to pass through the area of interest** (see Figure 7-72).

North- and south-bound cargo vessels usually remain over the mid-shelf (100 m isobath), while tankers and bulk carriers usually remain further offshore. The latter do, however, move closer inshore to escape extremely rough conditions that develop within the Agulhas Current.

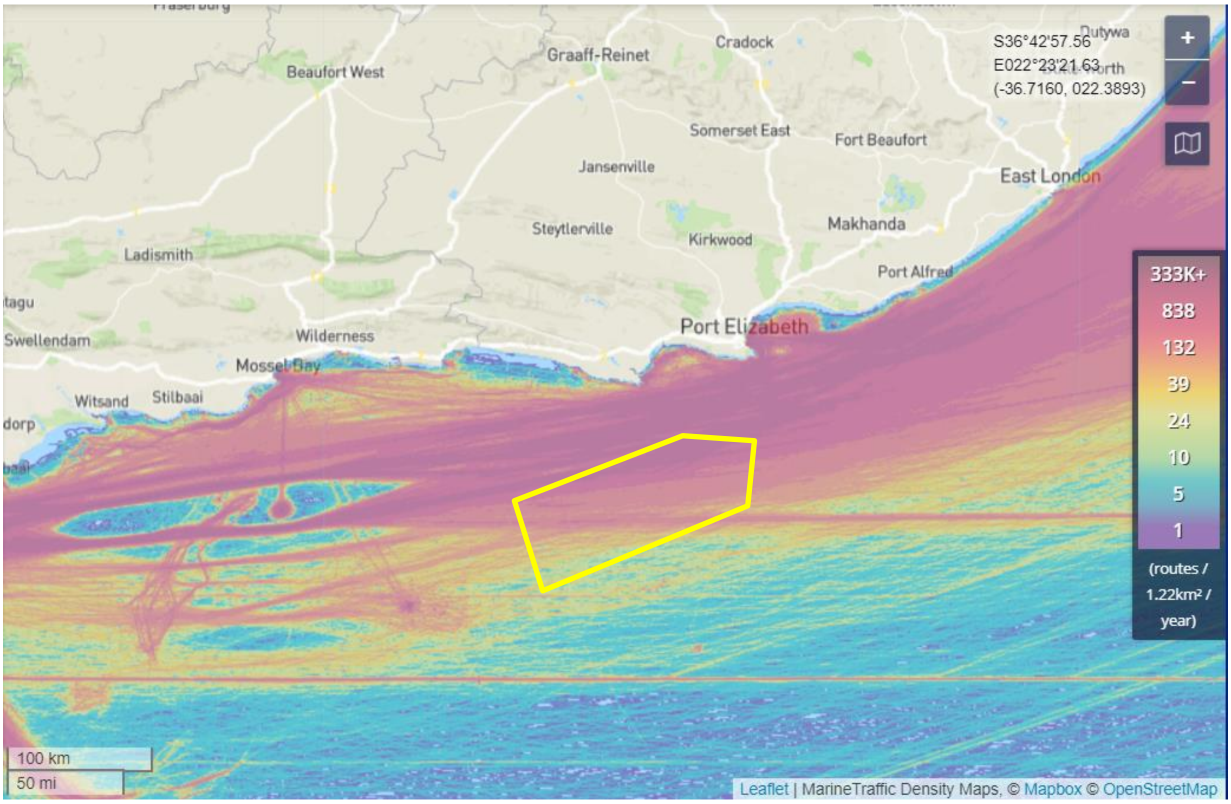


Figure 7-72: The major shipping routes off the Southeast Coast of South Africa in relation to the proposed survey area of interest (yellow polygon)

Source: http://www.marinetraffic.com/

7.8.2 Exploration, Production and Mining

7.8.2.1 Oil and gas exploration and production

Oil and gas exploration and production is currently undertaken in a number of licence blocks off the West, South and East coasts of South Africa. Some 200 wells have been drilled on the Agulhas Bank to date.

Exploration: Licence block rights holders and applicants surrounding the Reconnaissance Permit area are presented in Table 6-1 and Figure 7-73. Existing hydrocarbon wellheads are also shown in Figure 7-74.

Existing Production: PetroSA operates the F-A production platform, which was brought into production in 1992. The F-A platform is located 85 kilometres south of Mossel Bay in a water depth of 100 m. Gas and associated condensate from the associated gas fields are processed through the platform. The produced gas and condensate are exported through two separate 93 km pipelines to the PetroSA GTL plant located just outside the town of Mossel Bay. **There are currently no production activities in the vicinity of the area of interest.** TotalEnergies are, however, in the process of applying for a Production Right in Block 11B/12B.

7.8.2.2 Prospecting and mining of other minerals

Glauconite and phosphorite: Glauconite pellets (an iron and magnesium rich clay mineral) and bedded and pelletal phosphorite occur on the seafloor over large areas of the continental shelf on the West and South Coasts. Permits for the prospecting of glauconite and phosphorite have previously been issued for two areas off the South Coast, namely SOM 3 and Agrimin 3. However, the validity of these permits could not be confirmed with a great deal of certainty, but the Department of Mineral Resources (DMR) indicated that they may no longer be valid. These concentrations represent potentially commercial sources of agricultural phosphate and potassium (Dingle *et al.* 1987; Rogers and Bremner 1991).

Although not mined at present, an application to prospect for marine phosphate in the Outeniqua West Licence Area, offshore Mossel Bay, was submitted to the DMR by Diamond Fields International Ltd in June 2013 (Morant 2013). However, following the moratorium on marine phosphate mining in Namibia and the conclusion that marine mining of phosphate resources in South Africa was unwarranted (Vidima & von Blottnitz 2016; see also Biccard *et al.* 2018), there has been no further development in this regard.

Manganese nodules in ultra-deep water: Rogers and Bremner (1991) report that manganese nodules enriched in valuable metals occur in deep-water areas (>3 000 m) on the South and East. However, the nickel, copper and cobalt contents of the nodules fall below the current mining economic cut-off grade of 2%. **There is no mining of manganese or phosphate resources offshore of the Southeast Coast region**.

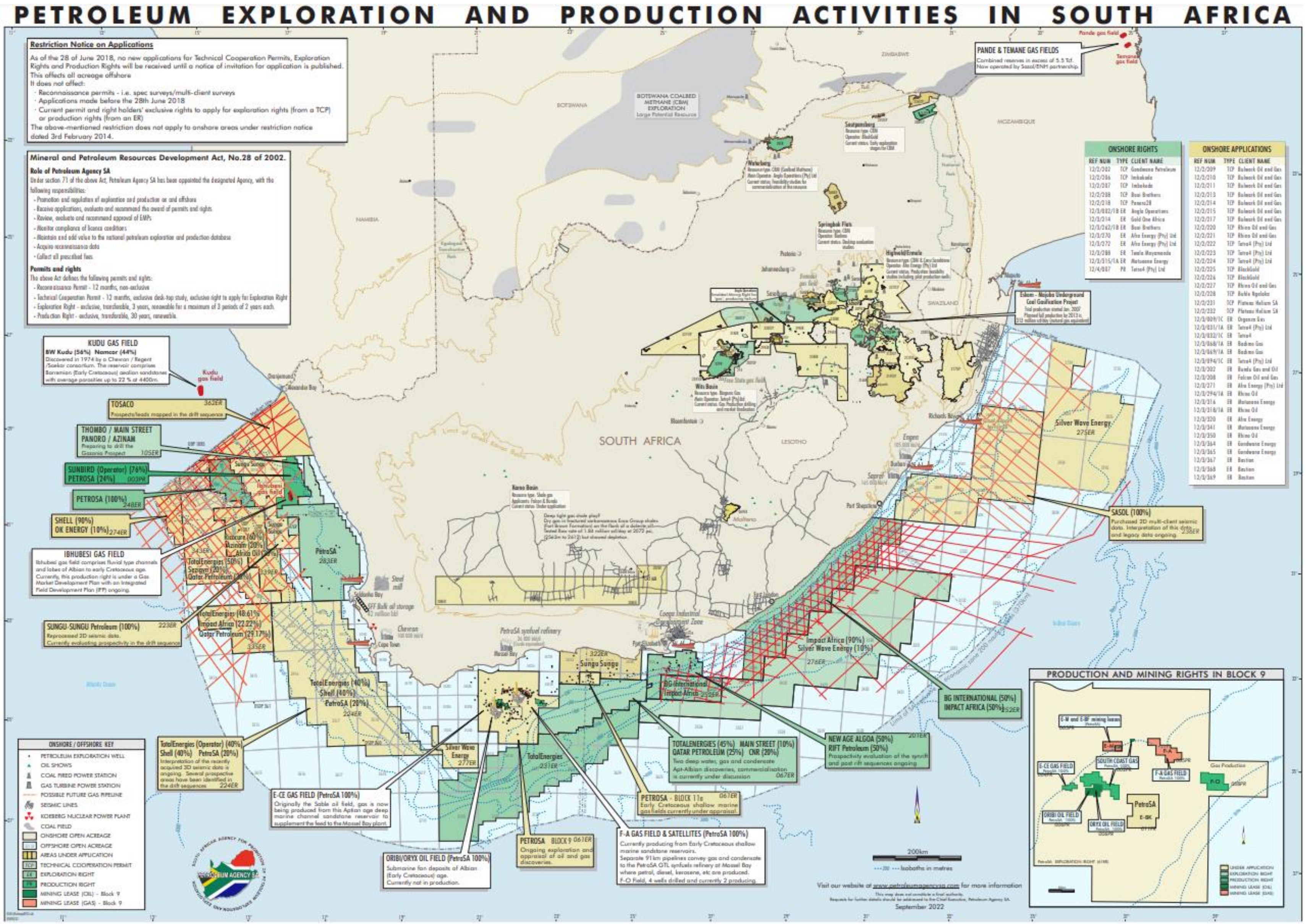


Figure 7-73: Petroleum Licence Blocks off the West, South and East Coasts of South Africa (PASA, September 2022)

7.8.3 Anthropogenic Marine Hazards

Hazards on the seafloor are identified in the Annual Summary of South African Notices to Mariners No. 5 or are marked on charts from the South African Navy or Hydrographic. These include ammunition dump sites, undersea cables and recorded wellhead locations (see Figure 7-74).

7.8.3.1 Ammunition dump sites

From the 1970s to 1995, expired or unusable munitions such as naval shells and other explosive and non-explosive ammunition were dumped in designated marine ammunition dumps. Apart from the potential hazard associated with disturbing unexploded munitions, corrosion may have led to leaching of lead, copper and other pollutants to the marine environment and inadvertent detonation may be physically destructive and may lead to smothering of benthic sea life (Harris *et al.* 2019).

The lack of information on the type, tonnage and condition of the dumped ammunition requires that future exploration and planned infrastructure (e.g. underwater cables, renewable energy infrastructure, etc.) be cognisant of these sites and avoid unnecessary disturbance. **No ammunition dumps occur within the area of interest. The closest known ammunition dumping sites lie approximately 20 km and 45 km southeast and south of the area of interest, respectively.** Locations of the dumps are marked on all relevant SAN navigational charts (see Figure 7-74).

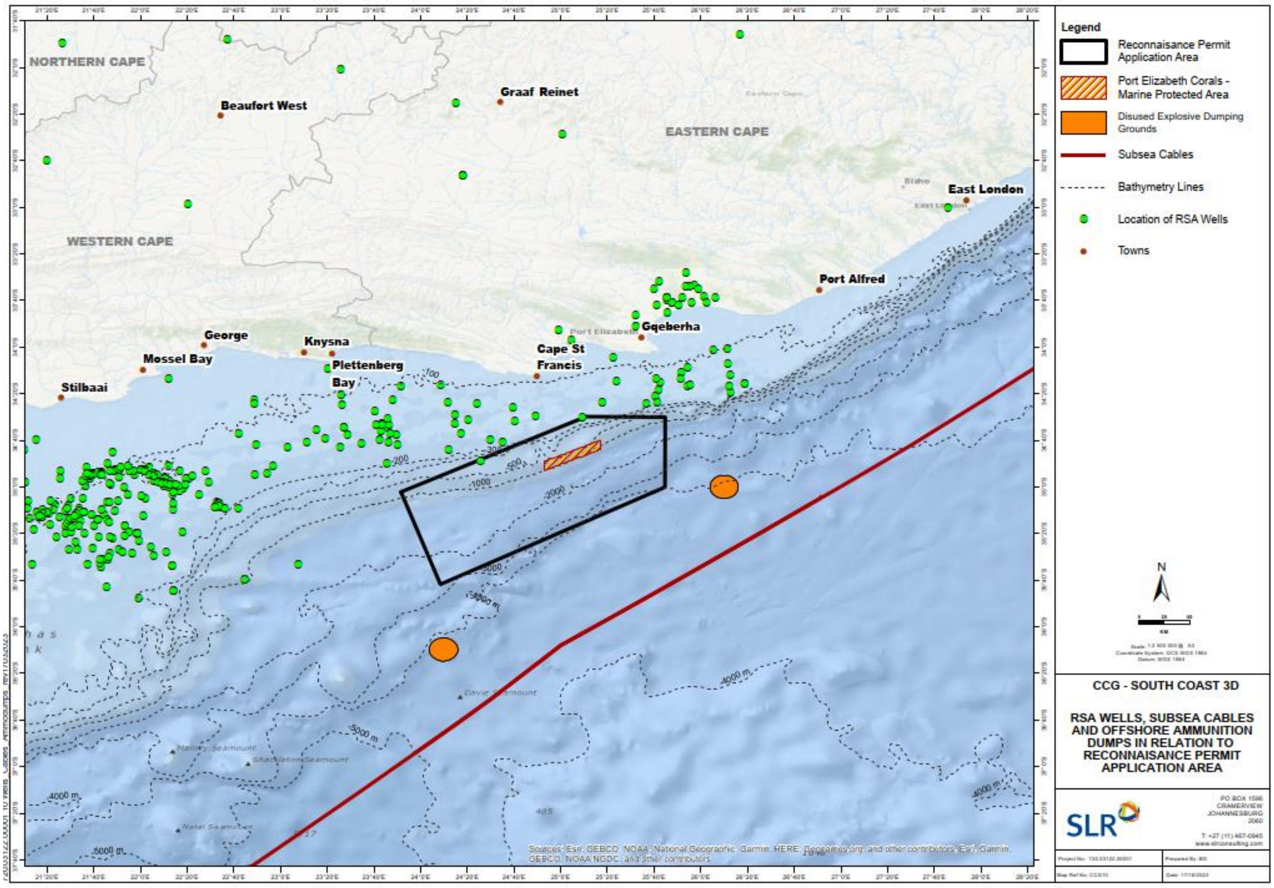


Figure 7-74: Distribution of anthropogenic marine hazards on the seafloor in relation to the proposed survey area of interest (black polygon)

Source: Hydrographic office data

7.8.3.2 Undersea cables

A submarine telecommunications cable system lies across the Atlantic and the Indian Ocean (see Figure 7-74). The section that extends along the South Coast is called "SAT3/SAFE" (South Atlantic Telecommunications cable no.3 / South Africa Far East). The SAT3 cable connects Portugal (Sesimbra) with South Africa (at Melkbosstrand) with intermediate landing points along the north African West Coast. From Melkbosstrand the cable system extends via the SAFE sub-system to Malaysia (Penang) and has intermediate landing points at Mtunzini South Africa, Saint Paul Reunion, Bale Jacot Mauritius and Cochin India (www.safe-sat3.co.za). A safety zone of one nautical mile extends on both sides of the telecommunication cables in which no anchoring is permitted.

A new submarine cable (referred to as 2Africa) is planned for construction and expected to go live in 2023/4 and which is expected to follow a similar route as SAT3/SAFE. The 37 000 km-long 2Africa cable will have around 21 landing points in 16 African countries and will carry three times the total network capacity of all the submarine cables currently serving the continent.

There are no existing or planned cables that are likely to overlap with the area of interest.

7.8.3.3 Offshore renewable projects

No offshore renewable energy projects are active in South Africa currently. However, a study on offshore wind energy potential for the entire African continent indicated very good technical offshore wind energy potential for South Africa with most of the offshore wind resources concentrated in coastal zones (Elsner, 2019, cited in BSL, 2020).

7.8.3.4 Wellheads

In the order of 330 exploration wells have been drilled in the South African offshore. Many of these are associated with exploration and production activities undertaken in Block 9 by PetroSA. A number of historic wells are located in the inshore area of the proposed survey area of interest (see Figure 7-74). Two exploration wells, Brulpadda and Luiperd, have also recently been drilled in Block 11B/12B, approximately 70 km west of the area of interest. These two wellheads remain on the seafloor with over trawlable caps placed over them.

7.9 CULTURAL HERITAGE AND SITESARCHAEOLOGICAL AND CULTURAL SITES

South Africa is a multicultural country of approximately 60 million people. Its citizens speak more than 11 languages and hold a diversity of religious beliefs. These draw on the world's four major religions, as well as indigenous belief systems that contribute to the country's rich cultural heritage. Cultural heritage is globally defined as the cultural legacy passed from one generation to the next. It informs morality, sociality and biocultural relations. In heritage scholarship and conservation practice, a distinction is made between cultural and natural heritage. Heritage is also classified as either tangible or intangible. Tangible heritage includes sites, monuments, artifacts, and objects of cultural value. Intangible heritage consists of folklore, beliefs, values, rituals, symbolism and practices related to culture. Tangible and intangible heritage are not always divisible and, natural and cultural heritage may overlap.

7.9.1 Shipwrecks

At least 2 400 vessels are known to have sunk, grounded, or been wrecked, abandoned or scuttled in South African waters since the early 1500s (Gribble 2018). More than 1 900 of these wrecks are more than 60 years old and are thus protected by the National Heritage Resources Act (NHRA) as archaeological resources. The majority of known wrecks lost along the South Coast are located in relatively shallow water close inshore (Turner 1988). One desktop study (Gribble 2019) focussed on Algoa Bay (where Gqeberha is located) recorded a possible 310 shipwrecks, some of which could have been lost in deeper waters. **No such wrecks in deeper waters in the vicinity of the area of interest are, however, known.** It is still possible that further seismic surveys or other oil and gas exploration in this area could detect a wreck or shipping remains, thereby contributing to archaeological knowledge. Survey data and/or resulting information or analyses that could aid in the discovery of offshore heritage resources, such as shipwrecks, must thus be shared with SAHRA.

7.9.2 Intangible Cultural Heritage

South Africans have a very long relationship with the sea. Archaeological evidence in the form of shell middens which point to the exploitation by humans of marine resources around the South African coast, dates back into the Middle Stone Age, at least 30 000 years before the present and continues through the Later Stone Age and Iron Age (on the east coast) right up until, and beyond the arrival of Europeans on South African shores after the late 15th century. The available evidence suggests that the pre-colonial exploitation of marine resources and people’s interaction with the sea was limited to the littoral and the intertidal zone. There is currently no archaeological evidence for the movement of pre-colonial people in South Africa in the marine environment, or the construction or use, prior to the arrival of Europeans, of watercraft in that environment (Tim Hart and John Gribble pers. com. 2022).

Since the beginning of the colonial presence in South Africa, there has been a tradition of boat-based fishing and marine resource exploitation and many of the small coastal communities have histories linked to this practice which date back many years.

In terms of the current project, Intangible Cultural Heritage consists of the folklore, ritual practice, beliefs, symbolism, social attachment, as well as associated human sensory engagement with the coast and sea. Intangible Cultural Heritage is also related to the tangible heritage, for example it can be associated with maritime artefacts that remain on the seafloor (e.g., shipwreck and associated loss of life) and shell middens (seashell sites) and caves with ancient rock art (produced by the First Peoples) along the South Coast of South Africa (see Figure 7-75). Inshore archaeologically significant sites are also connected to coastal cultural heritages, since some rock art in these sites express the coastal activity of aquatic hunter gatherers, showing that historically, Khoisan peoples moved between inland sites and coastal sites.

With regard to the proposed survey in the Algoa/Outeniqua Bain, there is need to consider terraqueous (territorial and watery) territories which refer to and includes inshore archaeological sites and sites of spiritual significance. These waterways are described as ‘living’ waters and are believed to play a critical role in spiritual and health management in indigenous groups specifically (First Peoples[5] and Nguni), but also the descendant groups of Europeans in the country and immigrant (specifically southern African and Central African) beliefs and ritual practices at the coast.

[5] Khoisan collective, which includes the Nama, Griqua / Guriqua and Korana peoples.

The specific beliefs concerning these ‘living’ waters can be summarised as follows:

- The waters contain the ancestral spirits of the cultural communities.
- The waters offer a spiritual domain to which people in the present realm can travel to (intentionally or otherwise) and from which they can return if the correct ritual activities are performed.
- The ocean itself contains the ancestral spirits of the African continent and arguably the ancestral spirits of all humanity. The ancestral spirits in the ocean reside on the seabed / seafloor.
- Indigenous peoples (both First Peoples and Nguni descendants) that engage in cultural rituals at the coast should always approach the sea and coast with reverence and sometimes fear.
- Belief in the ancestral world and the place of ancestors in waterways and other ecologically sacred places does not require a relinquishing of belief in an omnipresent God. The ancestors form part of a complex genealogy of which God is the head.
- Regular, consistent and frequent interaction take place with the coast and sea in order to secure the guidance and benevolence of ancestors, as well as spirits that reside in such 'living' waters.

The coastline inshore of the survey area of interest has rich coastal intangible cultural heritage as well as archaeological (tangible) heritage. First Peoples or Khoisan and SSF display a high regard for the sea, as well as their spiritual and cultural connection with the ocean and the reliance on these coastlines for subsistence. For these communities, the whole ocean forms part of a cultural complex in which ancestral permission / blessing must be obtained for any development to take place. In this regard, people consider the whole ocean to be highly sensitive regardless of industrial or other activities happening inshore.

Khoisan and Nguni peoples regularly and consistently engage with the ocean and nature, drawing on fynbos and coastal plants for healing and using the sea to commune with the ancestral world. For the Xhosa in particular, the ocean seabed is the final resting place of ancient ancestors and there is belief (even among Zimbabwean immigrants) that the sea is living water and has the possibility of healing many physical and spiritual ailments.

The primary data collection as part of this ESIA found that present day Khoisan descendants are recently and currently re-membering and re-establishing connection with this history and are reviving pilgrimages to the sea to reconnect with histories suppressed under colonial and apartheid rule.

It was found that European descendants in the area of influence also had cultivated a cultural relationship with ocean and coast based on coastal sporting / leisure activities. The research also revealed the role of the sea and associated leisure as an important deterrent against substance abuse and crime.

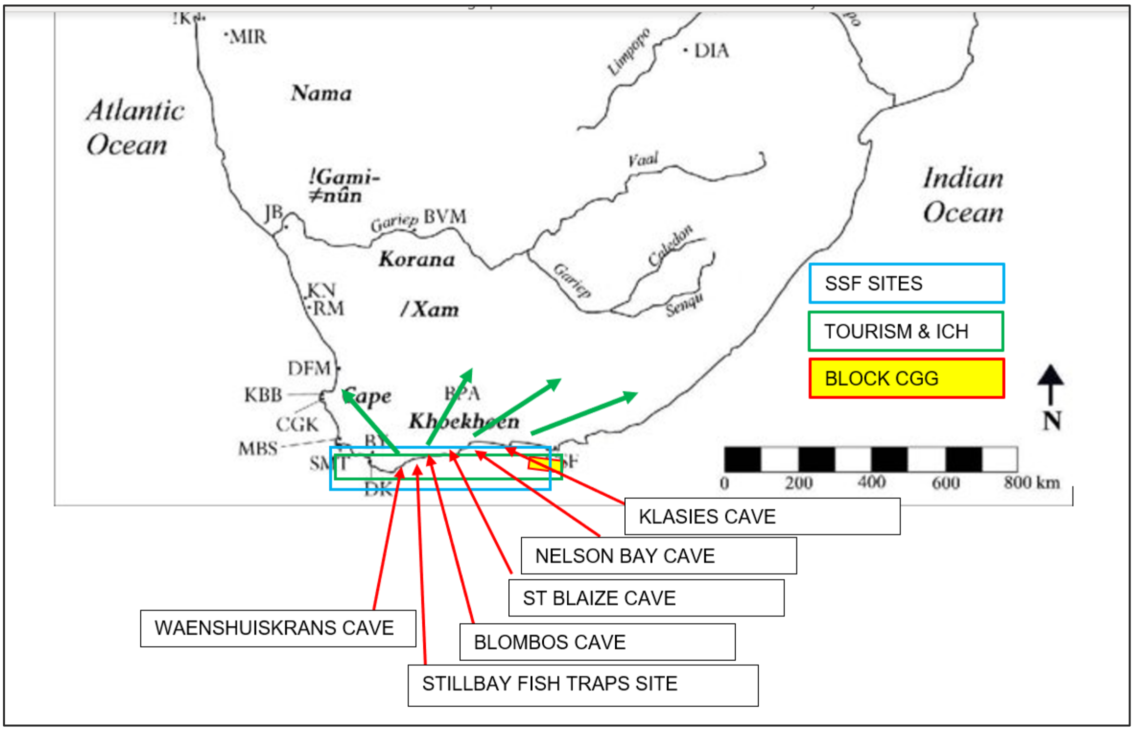


Figure 7-75: Map indicating sites of archaeological importance, coastal caves and mega-midden sites of cultural value along the South Coast. The survey area of interest is shown in yellow.

Source: Boswell 2022