# PROPOSED 2D SEISMIC SURVEY, SONAR BATHYMETRY AND DROP CORE SAMPLING IN THE OUTENIQUA SOUTH AREA OFF THE SOUTH COAST OF SOUTH AFRICA

# ENVIRONMENTAL MANAGEMENT PLAN

Prepared for:
**Petroleum Agency South Africa**

On behalf of:
**Total E and P South Africa (Pty) Ltd**

Prepared by:
**CCA Environmental (Pty) Ltd**

TOT01OBE/EMP

OCTOBER 2012

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Prepared for:
**Petroleum Agency South Africa**
**Tygerpoort Building, 7 Mispel Street**
**BELLVILLE, 7779**

On behalf of:
**Total E and P South Africa (Pty) Ltd**
**JHI House, 11 Cradock Avenue**
**ROSEBANK, 2196**

Prepared by:
**CCA Environmental (Pty) Ltd**
**Contact person: Eloise Costandius**
**Unit 35 Roeland Square, Drury Lane**
**CAPE TOWN, 8001**
**Tel: (021) 461 1118 / 9 Fax (021) 461 1120**
**E-mail: eloise@ccaenvironmental.co.za**

# PROJECT INFORMATION

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|---|---|
| TITLE | Environmental Management Plan for a proposed 2D seismic survey, sonar bathymetry and drop core sampling in the Outeniqua South Area off the South Coast of South Africa |
| APPLICANT | Total E and P South Africa (Pty) Ltd |
| ENVIRONMENTAL CONSULTANT | CCA Environmental (Pty) Ltd |
| REPORT REFERENCE | TOT01OBE/EMP |
| REPORT DATE | 26 October 2012 |

**REPORT COMPILED BY:** Eloise Costandius

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Eloise Costandius (Pr.Sci.Nat.)
Environmental Consultant

**REPORT REVIEWED BY:** Jonathan Crowther

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Jonathan Crowther (Pr.Sci.Nat.; CEAPSA)
Managing Director

# EXPERTISE OF ENVIRONMENTAL ASSESSMENT PRACTITIONER

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|---|---|
| **NAME** | Jonathan Crowther |
| **RESPONSIBILITY ON PROJECT** | Project leader and quality control. |
| **DEGREE** | B.Sc. Hons (Geol.), M.Sc. (Env. Sci.) |
| **PROFESSIONAL REGISTRATION** | Pr.Sci.Nat., CEAPSA |
| **EXPERIENCE IN YEARS** | 24 |
| **EXPERIENCE** | Jonathan Crowther has been involved in environmental consulting since 1988 and is currently the Managing Director of CCA Environmental (Pty) Ltd. He has expertise in a wide range of environmental disciplines, including Environmental Impact Assessments (EIA), Environmental Management Plans/Programmes, Environmental Planning & Review, Environmental Auditing & Monitoring, Environmental Control Officer services, and Public Consultation & Facilitation. He has project managed a number of offshore oil and gas EIAs for various exploration and production activities in South Africa and Namibia. He also has extensive experience in projects related to roads, property developments and landfill sites. |

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|---|---|
| **NAME** | Eloise Costandius |
| **RESPONSIBILITY ON PROJECT** | Project consultant and report compilation |
| **DEGREE** | B.Sc. Hons (Zoo.), M.Sc. (Ecol. Ass.) |
| **PROFESSIONAL REGISTRATION** | Pr.Sci.Nat. |
| **EXPERIENCE IN YEARS** | 7 |
| **EXPERIENCE** | Eloise Costandius has worked as an environmental assessment practitioner since 2005 and has been involved in a number of projects covering a range of environmental disciplines, including Faunal Specialist Studies, Basic Assessments, Environmental Impact Assessments and Environmental Management Programmes. She has gained experience in a wide range of projects relating to mining (e.g. oil exploration and borrow pits), infrastructure projects (e.g. roads), and housing and industrial developments. |

# EXECUTIVE SUMMARY

## 1. INTRODUCTION

Total E and P South Africa (Pty) Ltd (Total E&P) is proposing to explore for oil and gas reserves in the deep offshore area of the South Coast of South Africa, referred to as the Outeniqua South Area (see Figure 1). Exploration activities would include a 2D seismic survey, a sonar bathymetric survey and drop core sampling. In order to undertake the proposed exploration activities, Total E&P lodged an application for an Exploration Right with the Petroleum Agency of South Africa (PASA) in terms of Section 74 of the Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA). PASA accepted the application on 28 June 2012.

The proposed Exploration Right area is approximately 76 060 km$^2$ in extent. The proposed seismic survey would be approximately 7 000 km in length comprising a number of low density spaced survey lines covering Total E&P's entire licence block area in the Outeniqua South Area between Cape Agulhas (20°E) and Cape St Francis (25°E). Although survey commencement would ultimately depend on a permit award date, it is anticipated that the seismic survey would commence during the last quarter of 2013 and would take in the order of two to three months to complete (between November 2013 and March 2014). Following analysis of the 2D seismic data, a sonar bathymetry survey and drop core sampling would be undertaken. These activities are proposed to take place from November 2014, with an estimated duration of 30 to 45 days.

In terms of the MPRDA an Exploration Right must be issued prior to the commencement of the proposed exploration activities. A requirement of obtaining an Exploration Right is that an Environmental Management Plan (EMP) has to be compiled in term of Section 39 of the MPRDA and submitted to PASA for consideration and for approval by the Minister of Mineral Resources. Furthermore, Interested and/or Affected Parties (I&APs) must be notified and consulted in this regard.

Total E&P appointed CCA Environmental (Pty) Ltd (CCA) to compile an EMP to meet the relevant requirements of the MPRDA and the Regulations thereto.

## 2. EMP APPROACH AND METHODOLOGY

### 2.1 OBJECTIVES

The objectives for the EMP process are:

- To provide a reasonable opportunity for I&APs to be consulted on the proposed project;
- To ensure that all potential key environmental issues and impacts that could result from the proposed project are identified;
- To identify feasible alternatives to the implementation of the proposed project;
- To assess potential impacts related to the proposed project;
- To present appropriate mitigation or optimisation measures to minimise potential impacts or enhance potential benefits; and
- Through the above, to ensure informed, transparent and accountable decision-making by the relevant authorities.

### 2.2 PUBLIC PARTICIPATION PROCESS

The Public Participation Process has involved an open, participatory approach and involvement of I&APs to ensure that all potential impacts are identified and that planning and decision-making takes place in an informed, transparent and accountable manner.

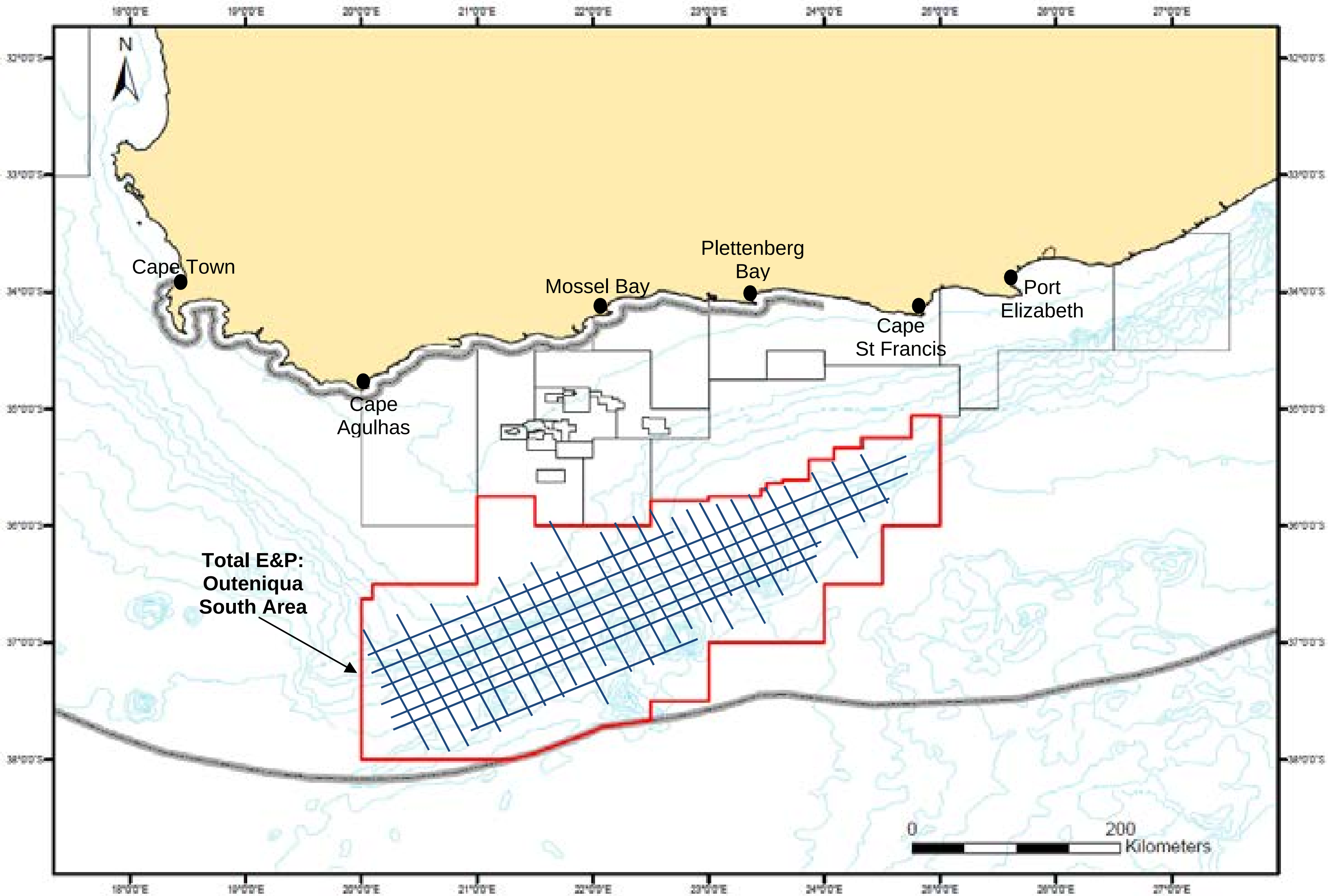


**Figure 1:** **Location of Total E&P's 2D seismic survey off the South Coast of South Africa, with approximate survey lines indicated.**

As part of compiling the EMP, a Background Information Document (BID) and Response Form were distributed for a 21-day comment period (02 October 2012 to 23 October 2012). Advertisements announcing the proposed project and the availability of the BID were placed in four regional newspapers on 02 October 2012, i.e. Cape Times (Western Cape), Die Burger (Western Cape), Die Burger (Eastern Cape) and The Herald (Eastern Cape).

Comments received have been collated and responded to in an Issues and Responses Trail, which is appended to the EMP.

### 2.3 SPECIALIST STUDIES AND REPORT COMPILATION

Two specialist studies were undertaken to address the key issues that required further investigation, namely the impact on fishing and marine fauna. The specialist studies involved the gathering of data relevant to identifying and assessing environmental impacts that may occur as a result of the proposed project. These impacts were then assessed according to pre-defined rating scales.

The specialist information and other relevant information were then integrated into this EMP. The EMP aims to present all information in a clear and understandable format and suitable for easy interpretation by authorities.

The EMP will be distributed for a 30-day review and comment and any comments received will be forwarded directly to PASA for consideration.

## 3. PROJECT DESCRIPTION

### 3.1 GENERAL INFORMATION

#### 3.1.1 Exploration Right Applicant

Total E&P as the applicant for the Exploration Right will also be the operator for the proposed project.

Address: Total E and P South Africa (Pty) Ltd
11 Cradock Avenue
JHI House
Rosebank
2196

Project Manager: Renaud Lions
Telephone: +33 (0)1 47 445006
Facsimile: +33 (0)1 47 447805
Cell: +33 (0)6 09 625106
E-mail: renaud.lions@total.com

#### 3.1.2 Exploration block area

The Outeniqua South Area is situated in the deep offshore area of the South Coast of South Africa roughly between Cape Agulhas and Cape St. Francis (see Figure 1). It covers an area of approximately 76 060 km$^2$ with water depths ranging from 200 m to over 4 000 m. The block is roughly located between 20° and 25° east and 35° and 38° south. The proposed exploration activities would be undertaken over most of the defined block area.

### 3.1.3 Financial Provision

In terms of Section 41 of the MPRDA and Sections 52 and 53 of the MPRDA Regulations, Total E&P would provide for rehabilitation, management and remediation of negative environmental impacts associated with the exploration work programme. This would be provided by means of an insurance policy to the value of USD 10 000 000.

## 3.2 SEISMIC SURVEY

Seismic surveys are carried out during marine oil and gas exploration in order to investigate subsea geological formations. During seismic surveys high-level, low frequency sounds are directed towards the seabed from near-surface sound sources towed by a seismic vessel. Signals reflected from geological interfaces below the seafloor are recorded by multiple receivers (or hydrophones) towed in a number of streamers. Analyses of the returned signals allow for interpretation of subsea geological formations.

For this investigation Total E&P is proposing to undertake a 2D seismic survey. The proposed seismic survey would be approximately 7 000 km in length comprising a number of low density spaced survey lines covering a large area off the South and East coasts (refer to Figure 1). Although survey commencement would ultimately depend on a permit award date, it is anticipated that the survey would be undertaken during the summer of 2013/2014 and would take in the order of three months to complete.

At this stage no vessel has been contracted for the proposed seismic survey programme. Thus specific detail will only be available when Total E&P has appointed a seismic contractor and contracted a vessel. The specific details of the survey programme will be compiled into an Environmental Notification that will be submitted to PASA for information purposes.

The seismic vessel would travel along transects of a prescribed grid that is carefully chosen to cross any known or suspected geological structure in the area. During surveying vessels travel at a speed of four to six knots.

The anticipated airgun and hydrophone array would consist of one airgun array with operating pressures of 4 000 to 5 000 cubic inches. The airgun sound source would be situated between 80 m and 150 m behind the vessel at approximately six metres below the surface. The single hydrophone steamer would be approximately 12 000 m long. The streamer would be towed at a depth of between six and 20 m and would not be visible, except for the tail-buoy at the far end of the cable.

Under the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972, Part A, Rule 10), a seismic survey vessel that is engaged in surveying is defined as a “vessel restricted in its ability to manoeuvre” which requires that power-driven and sailing vessels give way to a vessel restricted in her ability to manoeuvre. Vessels engaged in fishing shall, so far as possible, keep out of the way of the seismic survey operation.

Furthermore, under the Marine Traffic Act, 1981 (No. 2 of 1981), a seismic survey vessel and its array of airguns and hydrophones fall under the definition of an “offshore installation” and as such it is protected by a 500 m safety zone. It is an offence for an unauthorised vessel to enter the safety zone. In addition to the statutory 500 m safety zone, a seismic contractor would request a safe operational limit that it would like other vessels to stay beyond (i.e. 8 km fore and aft of the vessel and 6 km abeam during daylight, and 12 km fore and aft and 9 km abeam during the night).

A support vessel would be commissioned as a "chase" boat. This vessel would be equipped with appropriate radar and communications to patrol the area during the seismic survey to ensure that other vessels adhere to the safe operational limits. The chase boat would assist in alerting other vessels (e.g. fishing, transport, etc.) about the proposed survey and the lack of manoeuvrability of the survey vessel. The chase boat would also be required to perform logistics support to the survey vessel. Helicopters may be utilised for crew / supply transfers between the seismic and support vessels and the mainland.

### 3.3 SONAR SURVEY AND DROP CORE SAMPLING

Based on the results of the 2D seismic survey, a sonar bathymetry survey and drop core sampling is planned to take place from November 2014, with an estimated duration of 30 to 45 days.

The sonar survey would be undertaken in order to further investigate the structure of the ocean bed sediment layers. The sonar surveying tools currently considered for use include depth sounders, fish finders, bottom profilers, side scan sonar and multibeam depth sounders.

Total E&P further proposes to use a piston coring system to undertake sediment core sampling of the seabed surface. The core barrels would be taken in lengths of 6 to 9 m with a diameter of 10 cm. The system is mounted over the deck of the survey vessel and utilises the “free fall” of the coring rig to create the initial impact force on the seabed and a sliding piston inside the core barrel to reduce the inside wall friction with sediment.

Total E&P would collect approximately 150 to 200 core samples across the 2D seismic survey area. This number and the exact location of the core samples would be confirmed following the analysis of the 2D seismic survey and sonar bathymetric survey results.

## 4. DESCRIPTION OF THE AFFECTED ENVIRONMENT

### 4.1 PHYSICAL OCEANOGRAPHY

The oceanography off the South Coast is almost totally dominated by the warm Agulhas Current. 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 to 75 cm/sec midshelf and 10 to 40 cm/sec nearshore. Eastward flow may occur close inshore, being particularly strong off Port Elizabeth. Bottom water shows a persistent westward movement, although short-term current reversals may occur. The surface waters of the Agulhas Current may be over 25º C in summer and 21º C in winter and have lower salinities than the Equatorial Indian Ocean and South Indian Ocean Central water masses found below.

On the South Coast, the majority of waves arrive from the south-west quadrant, dominating wave patterns during winter and spring. During summer, easterly wind-generated ‘seas’ occur. Tides are typically semi-diurnal along the South Coast with an average tidal range of between 0.5 m during neap tides and 1.5 to 2.0 m during springs. Wind-driven upwelling occurs in the nearshore along the South Coast, especially when easterly winds blow during summer. Such upwelling usually begins at the prominent capes and progresses westwards.

### 4.2 BIOLOGICAL OCEANOGRAPHY

South Africa is divided into nine bioregions, four of which occur in the proposed survey area (namely Atlantic Offshore, South-western Cape, Agulhas and Indo-Pacific Offshore). The South African National Biodiversity Institute (SANBI) has initiated a process to identify potential benthic priority areas for spatial management in the offshore environment that require protection. The proposed survey area includes areas that are considered to be Vulnerable and Critically Endangered. The Southwest Indian Seamounts and Browns Bank which are located within the proposed survey area have been identified as priority areas for seabed protection.

The nutrient-poor characteristics of the Agulhas Current water are reflected in comparatively low primary productivity in the proposed survey area. The Agulhas Bank (particularly the western portion) is an important spawning area for a variety of pelagic species, including anchovy, pilchard and horse mackerel.

Squid and the South Coast rock lobster are two commercially important invertebrate species. Squid forms dense spawning aggregations (at depths ranging from 20 to 130 m) in sheltered bays along the eastern half of the South Coast, especially between Plettenberg Bay and Algoa Bay. These aggregations of adults reach a peak in November and December. The South Coast rock lobster occurs on rocky substrate in depths of 90 to 170 m.

The ichthyofauna on the South Coast is diverse, comprising a mixture of temperate and tropical species. As a transition zone between the Agulhas and Benguela current systems, the South Coast ichthyofauna includes many species occurring also along the West and/or East coasts. The seabed of the Agulhas Bank substrate is also diverse comprising areas of sand, mud and coral thereby contributing to increased benthic fauna and fish species. Small pelagic shoaling species occurring along the South Coast include anchovy, pilchard, round herring, chub mackerel and horse. Large migratory pelagic species that occur in offshore waters and beyond the shelf break include dorado, sailfish and black, blue and striped marlin, frigate tuna, skipjack, longfin tuna/albacore, bigeye tuna, yellowfin tuna, southern bluefin tuna and bluefin tuna. There is a high diversity of teleosts (bony fish) and chondrichthyans (cartilaginous fish) associated with the inshore and shelf waters of the South Coast, many of which are endemic to the Southern African coastline and form an important component of the demersal trawl and long-line fisheries. The Cape hake is distributed widely on the Agulhas Bank, while the deep-water hake is found further offshore in deeper water. Apart from the hakes, numerous other by-catch species are landed by the South Coast demersal trawling fishery including panga, kob, gurnard, monkfish, John Dory and angel fish.

Three species of turtle occur along the South Coast, namely the leatherback (Critically Endangered), and occasionally the loggerhead (Endangered) and the green (Endangered) turtle. Both the leatherback and the loggerhead turtle nest on the beaches of the northern KwaZulu-Natal coastline between October and February, extending into March. The southern extremity of the nesting area is thus located over 1 000 km to the north of the proposed seismic area. Hatchlings are born from late January through to March when the Agulhas Current is warmest. Once hatchlings enter the sea, they move southward in the Agulhas Current and are thought to remain in the southern Indian Ocean gyre for the first five years of their lives.

Overall, 60 species of seabirds are known, or thought likely to occur, along the South Coast. Thirteen species breed within the South Coast region. These include Cape gannets (Algoa Bay islands), African penguins (Algoa Bay islands), Cape cormorants (a small population at Algoa Bay islands and mainland sites), white-breasted cormorant, Roseate tern (Bird and St Croix Islands), Damara tern (inshore between Cape Agulhas and Cape Infanta), Swift tern (Stag Island) and kelp gulls. African penguin colonies along the South Coast occur at Dyer Island, Cape Recife and on the Algoa Bay islands (St Croix Island, Jaheel Island, Bird Island, Seal Island, Stag Island and Brenton Rocks).

The cetacean fauna of the South Coast comprises between 35 and 38 species of whales and dolphins known (historic sightings or strandings) or likely (habitat projections based on known species parameters) to occur here. The distribution of whales and dolphins on the South Coast can largely be split into those associated with the continental shelf and those that occur in deep, oceanic waters. Species from both environments may, however, be found associated with the shelf (200 - 1 000 m), making this 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 1 000's of kilometres. The most common species within the proposed survey area (in terms of likely encounter rate not total population sizes) are likely to be the common bottlenose dolphin, long finned pilot whale, southern right whale and humpback whale. Southern right whales migrate to the southern Africa subcontinent to breed and calve, where they tend to have an extremely coastal distribution mainly in sheltered bays (90% <2 km from shore). Winter concentrations have been recorded all along the South and East coasts of South Africa as far north as Maputo Bay, with the most significant concentration currently on the South Coast between Cape Town and Port Elizabeth. They typically arrive in coastal waters off the South Coast between June and November each year, although animals may be sighted as early as April and as late as January. The majority of humpback whales on the South and East coasts of South Africa are migrating past the southern African continent. The main winter concentration areas for humpback whales on the East Coast include Mozambique, Madagascar, Kenya and Tanzania. Humpbacks have a bimodal distribution off the East Coast, most reaching southern African waters around April, continuing through to September/October when the southern migration begins and continues through to December. The calving season for humpback whales extends from July to October, peaking in early August. Off Cape Vidal whale abundances peak around June/July on their northward migration, although some have been observed still moving north as late as October. Southward moving animals on their return migration were first seen in July, peaking in August and continuing to late October.

The Cape fur seal is the only seal species that has breeding colonies along the South Coast, namely at Seal Island in Mossel Bay, on the northern shore of the Robberg Peninsula in Plettenberg Bay and at Black Rocks (Bird Island group) in Algoa Bay.

### 4.3 HUMAN UTILISATION

There are five commercial fisheries active in the vicinity of the proposed survey area, including demersal trawl, demersal long-line (hake- and shark-directed), pelagic long-line (tuna- and shark-directed), south coast rock lobster and mid-water trawl

A large number of vessels navigate along the South Coast on their way around the southern African subcontinent. The majority of this vessel traffic, including commercial and fishing vessels, remains relatively close inshore and is, therefore, expected to pass inshore of the proposed survey area.

There are currently no oil and gas exploration or production activities taking place within the proposed seismic survey area.

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, both of which are located well inshore of the proposed survey area. The proposed survey area does, however, overlap with manganese nodules enriched in valuable metals.

There are a number of promulgated marine protected areas (MPAs) situated along the South Coast, although none fall within the proposed survey area. A number of priority conservation focus areas have been identified by the South African National Biodiversity Institute and the proposed survey area overlaps with two of these.

## 5. IMPACT ASSESSMENT CONCLUSIONS

A summary of the assessment of potential environmental impacts associated with the proposed seismic survey is provided in Table 1.

In summary, the majority of the impacts associated with seismic surveys would be of short-term duration and limited to the immediate survey area. As a result, the majority of the impacts associated with seismic surveys are considered to be of **INSIGNIFICANT** to **LOW** significance after mitigation.

The two key issues identified in this study relate to:

- The potential impact on marine mammals (physiological injury and behavioural avoidance) as a result of seismic noise; and

- The potential impact on the fishing industry (vessel interaction, disruption to fishing operations and reduced catch) due to the presence of the survey vessel with its associated safety zone, potential fish avoidance of the survey area and changes in feeding behaviour.

Although most of the impacts on cetaceans are assessed to have **VERY LOW to LOW** significance with mitigation, the impact could be of much higher significance due to the limited understanding of how short-term effects of seismic surveys relate to longer term impacts. For example, if a sound source displaces a species from an important breeding area for a prolonged period, impacts at the population level could be more significant. In order to mitigate the potential impact on cetaceans it is recommended that the proposed seismic survey programme be planned, as far as possible, to avoid cetacean migration and breeding periods from June to November (inclusive). In addition, surveying should ideally avoid December when humpback whales may still be moving through the area on their return migrations. Should surveying in the sensitive cetacean periods be unavoidable, Passive Acoustic Monitoring (PAM) technology, which detects animals through their vocalisations, must be implemented 24 hours a day. Various other measures are recommended to further mitigate the potential impact on cetaceans, e.g. “soft-starts”, temporary termination of survey, etc. It should, however, be noted that if the seismic survey is undertaken when more whales are likely to be present in the area, there could be increased downtime due to the temporary termination of the seismic survey.

The potential impact on the fishing industry ranges from **VERY LOW** (demersal trawl, hake demersal long-line, mid-water trawl and South Coast rock lobster) to **MEDIUM** (pelagic long-line) significance with and without mitigation. However, if fish avoid the survey area and / or change their feeding behaviour it could have a more significant impact on the fishing industry. Research has, however, shown that behavioural effects are generally short-term with duration of the effect being less than or equal to the duration of exposure, although these vary between species and individuals, and are dependent on the properties of the received sound. Similarly, if there was any interaction between the seismic survey vessel and a fishery the significance of the impact could be higher. Thus it is important that Total E&P engage timeously with the fishing industry prior to and during the survey. Regular communication with fishing vessels in the vicinity during surveying would minimise the potential disruption to fishing operations and risk of gear entanglements.

As the proposed survey area is located beyond the 200 m depth contour, it would not coincide with the small pelagic purse-seine, shark-directed demersal long-line, traditional line or squid jig fishing grounds. No impact on these fishing sectors are thus expected.

**Table 6.1: Summary of the significance of potential impacts of the proposed exploration activities in the Outeniqua South Area of the South Coast of South Africa.**

| Potential impact | Significance | |
|---|---|---|
| | Without mitigation | With mitigation |
| ***Normal seismic / support vessels and helicopter operation:*** | | |
| Emissions to the atmosphere | VL | **VL** |
| Deck drainage into the sea | VL | **VL** |
| Machinery space drainage into the sea | VL | **VL** |
| Sewage effluent into the sea | VL | **VL** |
| Galley waste disposal into the sea | VL | **VL** |
| Solid waste disposal into the sea | Insignificant | **INSIGNIFICANT** |
| Noise from seismic and support vessel operation | VL | **VL** |
| Noise from helicopter operation | L-M | **VL** |
| ***Impact of seismic noise on marine fauna:*** | | |
| Plankton | VL | **VL** |

| **Potential impact** | | **Significance** | |
|---|---|---|---|
| | | **Without mitigation** | **With mitigation** |
| Invertebrates | Physiological injury | VL | **VL** |
| | Behavioural avoidance | VL | **VL** |
| Fish | Physiological injury | L | **VL** |
| | Behavioural avoidance | L | **VL** |
| | Spawning and reproductive sucess | L | **VL** |
| | Masking sound and communication | VL | **VL** |
| | Indirect impacts | VL | **VL** |
| Non-diving seabirds | Physiological injury | Insignificant | **INSIGNIFICANT** |
| | Behavioural avoidance | Insignificant | **INSIGNIFICANT** |
| Diving seabirds | Physiological injury | L | **VL** |
| | Behavioural avoidance | L | **VL** |
| | Indirect impacts | VL | **VL** |
| Turtles | Physiological injury | L | **VL** |
| | Behavioural avoidance | L | **VL** |
| | Reproductive success | L | **VL** |
| | Masking sound and communication | Insignificant | **INSIGNIFICANT** |
| | Indirect impacts | VL | **VL** |
| Seals | Physiological injury | VL | **VL** |
| | Behavioural avoidance | VL | **VL** |
| | Masking sound and communication | VL | **VL** |
| | Indirect impacts | VL | **VL** |
| Mysticetes Cetaceans | Physiological injury | M | **L** |
| | Behavioural avoidance | L-M | **VL-L** |
| | Masking sound and communication | VL | **VL** |
| | Indirect impacts | VL | **VL** |
| Odontocetes Cetaceans | Physiological injury | M | **L** |
| | Behavioural avoidance | VL-L | **VL** |
| | Masking sound and communication | L | **VL** |
| | Indirect impacts | VL | **VL** |
| ***Impacts from drop core sampling on benthic biota:*** | | | |
| Sediment removal | | Insignificant | **INSIGNIFICANT** |
| Physical crushing of benthic biota | | Insignificant | **INSIGNIFICANT** |
| ***Impact on other users of the sea:*** | | | |
| Fishing industry | Demersal trawl | VL | **VL** |
| | Demersal long-line (hake) | VL | **VL** |
| | Large pelagic long-line (tuna) | M | **M** |
| | South Coast rock lobster | VL | **VL** |
| | Mid-water trawl | VL | **VL** |
| | Fisheries research | L | **L** |
| Marine transport routes | | L | **VL** |
| Marine prospecting, mining, exploration and production | Prospecting and mining | Insignificant | **INSIGNIFICANT** |
| | Exploration and production | VL | **VL** |
| H=High M=Medium L=Low VL=Very low | | | All impacts are negative |

# 6. RECOMMENDATIONS

## 6.1 COMPLIANCE WITH ACTION PLAN, PROCEDURES AND MARPOL STANDARDS

All phases of the proposed project (including pre-establishment phase, establishment phase, operational phase, and decommissioning and closure phase) must comply with the Action Plan and Procedures presented in Chapter 7 of the EMP. In addition, the seismic and support vessels must ensure compliance with the MARPOL 73/78 standards.

## 6.2 SURVEY TIMING AND SCHEDULING

The seismic survey should, as far as possible, be planned to avoid cetacean migration periods from their southern feeding grounds into low latitude waters from June to November (inclusive). In addition, surveying should ideally avoid December when humpback whales may still be moving through the area on their return migrations. Should surveying during November and December be unavoidable all other mitigation measures must be stringently enforced and additional mitigation measures must be implemented (see Section 6.2.3.1 below).

It is further recommended that the survey programme be scheduled, as far as possible, to avoid operating within key spawning areas within the proposed survey area (see Figure 4.8 in the EMP) in November and December.

## 6.3 SEISMIC SURVEY PROCEDURES

### 6.3.1 PAM technology

Should surveying during November and December be unavoidable, PAM technology, which detects animals through their vocalisations, must be implemented 24-hours a day. For all other periods, PAM technology must be used during seismic surveys at night and during daytime adverse weather conditions and thick fog.

If there is a technical problem with PAM during surveying, visual watches must be maintained by the Marine Mammal Observer (MMO) during the day and night-vision/infra-red binoculars must be used at night while PAM is being repaired.

### 6.3.2 "Soft-start" procedures and airgun firing

All initiations of seismic surveys must be carried out as "soft-starts" for a minimum of 20 minutes. This requires that the sound source be ramped from low to full power rather than initiated at full power, thus allowing a flight response by marine fauna to outside the zone of injury or avoidance. Where possible, "soft-starts" should be planned so that they commence within daylight hours.

"Soft-start" procedures must only commence once it has been confirmed (visually during the day[1] and using PAM technology and night-vision/infra-red binoculars at night) that there is no seabird (diving), seal, turtle or cetacean activity within 500 m of the vessel[2]. For cetaceans, the period of confirmation should be for at least 30 minutes prior to the commencement of the "soft-start" procedures, so that deep or long diving species can be detected. However, in the case of seals and small cetaceans (particularly dolphins), which are common in inshore waters and often attracted to survey vessels, the normal "soft-start" procedures should be allowed to commence, if after a period of 30 minutes seals and small cetaceans are still within 500 m of the airguns.

[1] Note: should surveying during November and December be unavoidable, PAM technology must be used, in addition to the visual watches by the MMO, during the day.

[2] Note: once it has been confirmed that there is no seabird (diving), seal, turtle or cetacean activity within 500 m of the vessel and soft-start procedures have commenced, monitoring must continue, but there is no need to monitor using night-vision/infra-red binoculars at night.

“Soft-start” procedures must also be implemented after breaks in airgun firing (for whatever reason) of longer than 20 minutes. Breaks of shorter than 20 minutes should be followed by a “soft-start” of similar duration.

The use of the lowest practicable airgun volume, as defined by the operator, should be defined and enforced.

During surveying, airgun firing should be terminated when:
- obvious negative changes to turtle, seal and cetacean behaviour is observed;
- turtles or cetaceans are observed within 500 m of the operating airgun and appear to be approaching the firing airgun; or
- there is mortality or injuries to seabirds, turtles, seals or cetaceans as a direct result of the survey.

A log of all termination decisions must be kept (for inclusion in both daily and “close-out” reports).

#### 6.3.3 Line changes

During night-time line changes, low level warning airgun discharges should be fired at regular intervals in order to keep animals away from the survey operation while the vessel is repositioned.

#### 6.3.4 Independent Observer or MMO and PAM Operator

An onboard Independent Observer or MMO must be appointed for the duration of the seismic survey to act as a fisheries and marine mammal observer. The Observer or MMO should be familiar with fisheries operational in the area and must have experience in seabird, turtle, seal and other marine mammal identification and observation techniques. The duties of the Observer or MMO would be to:

<u>Marine fauna:</u>
- Observe and record responses of marine fauna to the seismic survey, including seabird, turtle, seal and cetacean incidence and behaviour and any mortality of marine fauna as a result of the surveys. Data captured should include species identification, position (latitude/longitude), distance from the vessel, swimming speed and direction (if applicable) and any obvious changes in behaviour (e.g. startle responses or changes in surfacing/diving frequencies, breathing patterns) as a result of the survey activities;
- Record airgun activities, including sound levels, “soft-start” procedures and pre-firing regimes;
- Request the temporary termination of a seismic survey, as appropriate;

<u>Fishing and other users of the sea:</u>
- Provide back-up onboard facilitation with the fishing industry and other users of the sea. This would include communication with fishing and shipping / sailing vessels in the area in order to reduce the risk of interaction between the proposed surveys and other existing or proposed activities. The Observer would need to identify fishing vessels active in the area and associated fishing gear;
- Daily electronic reporting on vessel activity and recording of any communication and/or interaction should also be undertaken in order to keep key stakeholders informed of survey activity and progress;

<u>Other:</u>
- Record meteorological conditions;
- Monitor compliance with international marine pollution regulations (MARPOL 73/78 standards); and
- Prepare daily reports of all observations. These reports should be forwarded to the key stakeholders.

A PAM operator must be appointed if surveying during the sensitive cetacean periods. For all other periods, a PAM operator would be required during seismic surveys at night and during daytime adverse weather conditions and thick fog. The duties of the PAM Operator would be to:

- Confirm that there is no marine mammal activity within 500 m of the vessel prior to commencing with the “soft-start” procedures;
- Record species identification, position (latitude/longitude) and distance from the vessel, where possible;
- Record airgun activities, including sound levels, “soft-start” procedures and pre-firing regimes; and
- Request the temporary termination of the seismic survey, as appropriate.

All data recorded by MMOs and PAM Operator should form part of the survey “close-out” report.

## 6.4 HELICOPTER OPERATIONS

Mitigation relating to helicopter operations includes:

- Flight paths must be pre-planned to ensure that no flying occurs over bird and seabird colonies, coastal reserves or marine islands. Important areas in the vicinity of the proposed survey area include: Algoa Bay islands (St Croix Island, Jaheel Island, Bird Island, Black Rocks, Seal Island, Stag Island and Brenton Rocks), Dyer Island, Cape Recife, Seal Island (Mossel Bay) and Robberg Peninsula (Plettenberg Bay);
- Extensive coastal flights (parallel to the coast within 1 nautical mile of the shore) should be avoided. There is a restriction of coastal flights (parallel to the coast within 1 nautical mile of the shore) on the South Coast between the months of June and November to avoid Southern Right whale breeding areas;
- Aircraft may not approach to within 300 m of whales in terms of the Marine Living Resources Act, 1998;
- The operator must comply with the Seabirds and Seals Protection Act, 1973, which prohibits the wilful disturbance of seals on the coast or on offshore islands;
- The contractor should comply fully with aviation and authority guidelines and rules; and
- All pilots must be briefed on ecological risks associated with flying at a low level parallel to the coast.

## 6.5 OTHER MITIGATION MEASURES

Other mitigation measures that should also be implemented during the survey in order to ensure that any potential impacts are minimised include the following:

<u>Equipment</u>

- ‘Turtle-friendly’ tail buoys should be used by the survey contractor or existing tail buoys should be fitted with either exclusion or deflector 'turtle guards';

<u>Vessel safety</u>

- The survey vessels must be certified for seaworthiness through an appropriate internationally recognised marine certification programme (e.g. Lloyds Register, Det Norske Veritas). The certification, as well as existing safety standards, requires that safety precautions would be taken to minimise the possibility of an offshore accident;
- Collision prevention equipment should include radar, multi-frequency radio, foghorns, etc. Additional precautions include: the chase boat with staff familiar with the fisheries expected in the area, the existence of an internationally agreed 500 m safety zone around the survey vessel, cautionary notices to mariners, and access to current weather service information;
- The vessels are required to fly standard flags, lights (three all-round lights in a vertical line, with the highest and lowest lights being red and the middle light being white) or shapes (three shapes in a vertical line, with the highest and lowest lights being balls and the middle light being a diamond) to

indicate that they are engaged in towing surveys and are restricted in manoeuvrability, and must be fully illuminated during twilight and night;
- Report any emergency situation to SAMSA;

Vessel lighting
- Lighting on board survey vessels should be reduced to the minimum safety levels to minimise stranding of pelagic seabirds on the survey vessel at night. All stranded seabirds must be retrieved and released according to appropriate guidelines;

Emissions, discharges into the sea and solid waste
- Ensure adequate maintenance of diesel motors and generators to minimise the volume of soot and unburned diesel released to the atmosphere;
- Ensure adequate maintenance of all hydraulic systems and frequent inspection of hydraulic hoses;
- Undertake training and awareness of crew members of the need for thorough cleaning up of any spillages immediately after they occur, as this would minimise the volume of contaminants washing off decks;
- Use of low toxicity, biodegradable detergents during deck cleaning to further minimise the potential impact of deck drainage on the marine environment;
- Collect deck drainage in oily water catchment systems;
- Discharge effluent (e.g. sewage and galley waste as per MARPOL requirements) into the sea as far as possible from the coast;
- Initiate an onboard waste minimisation system;
- Ensure onboard solid waste storage is secure;
- Ensure that contractors co-operate with the relevant local authority to ensure that solid and hazardous waste disposal is carried out in accordance with the appropriate laws and ordinances;

Communication with key stakeholders
- Total E&P should engage timeously with the fishing industry, the Department of Environmental Affairs: Branch Oceans and Coasts, Department of Agriculture, Forestry and Fisheries (DAFF)[3] and other exploration right holders and applicants to discuss the scheduling of the proposed survey in relation to current or planned activities in order to reduce the risk of delay to or interference with the proposed survey. Any dispute arising in this regard should be referred to the Department of Mineral Resources or PASA for resolution;
- Communication channels should be set up with the fishing industry / associations (including South African Deep-sea Trawling Industry Association, South East Coast Inshore Fishery Association, Small Hake Quota Holders Association, South African Tuna Longline Association, Hake Longline Association, South Coast Rock Lobster Association, Blue Continent Products, South African Squid Management Industry Association, South African Marine Linefish Association and the Small Pelagic Sea Management Association) and other key stakeholders (including DAFF, Port Captains, South African Maritime Safety Authority (SAMSA) and South African Navy Hydrographic office). This would involve pre-survey notification of navigational co-ordinates of the survey areas, timing and duration of proposed activities and likely implications for the fishing industry and other vessels;
- Total E&P must request, in writing, the South African Navy Hydrographic office to release Radio Navigation Warnings and Notices to Mariners throughout the seismic survey period. The Notice to Mariners should give notice of (1) the co-ordinates of the proposed survey areas, (2) an indication of the proposed survey timeframes and day-to-day location of the survey vessel, and (3) an indication of the 500 m safety zones and the proposed safe operational limits of the survey vessel. These notices should be distributed timeously to fishing companies and directly onto vessels where possible;

[3] Managers of the DAFF research survey programmes include Deon Durholtz (DeonD@nda.agric.za) and Janet Coetzee (JanetC@nda.agric.za).

- Ensure ongoing notification throughout the duration of the survey with the submission of daily reports (via email) indicating the vessel's location to key stakeholders; and
- Marine mammal incidence data and data arising from the survey should be made available, if requested, to the Marine Mammal Institute, Department of Environmental Affairs: Branch Oceans and Coasts, DAFF and PASA.

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**Acronyms**

| | |
|---|---|
| 2D | Two-dimensional |
| BID | Background Information Document |
| AABW | Antarctic Bottom Water |
| AAIW | Antarctic Intermediate Water |
| BOD | Biological oxygen demand |
| CCA | CCA Environmental (Pty) Ltd |
| CITES | Convention on International Trade in Endangered Species |
| CO | Carbon monoxide |
| $CO_2$ | Carbon dioxide |
| COLREGS | Convention on the International Regulations for Preventing Collisions at Sea |
| CMS | Convention on Migratory Species |
| DAFF | Department of Agriculture, Forestry and Fisheries |
| DEA | Department of Environmental Affairs |
| DEA: BOC | Department of Environmental Affairs: Branch Oceans and Coasts |
| DWA | Department of Water Affairs |
| EASSy | Eastern Africa Submarine Cable System |
| EEZ | Exclusive Economic Zone |
| EIA | Environmental Impact Assessment |
| EMP | Environmental Management Plan |
| GN | Government Notice |
| GRT | Gross Registered Tonnage |
| IAEA | International Atomic Energy Agency |
| IAGC | International Association of Geophysical Contractors |
| I&APs | Interested & Affected Parties |
| ICRC | International Commission on Radiological Protection |
| IMO | International Maritime Organisation |
| ISO | International Standards Organisation |
| IUCN | International Union for Conservation of Nature |
| MARPOL | International Convention for the Prevention of Pollution from Ships, 1973/1978 |
| MMO | Marine Mammal Observer |
| MPA | Marine Protected Area |
| MPRDA | Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002) |
| NADW | North Atlantic Deep Water |
| NBSA | National Biodiversity Spatial Assessment Report |
| NEMA | National Environmental Management Act, 1998 (No. 107 of 1998) |
| NNW | North-north-west |
| $NO_X$ | Nitrogen oxides |
| NW | North-west |
| OPRC | Oil Pollution Preparedness, Response and Co-operation |
| PAM | Passive Acoustic Monitoring |
| PASA | Petroleum Agency South Africa |
| PetroSA | The Petroleum Oil and Gas Corporation of South Africa (Pty) Ltd |
| PIM | Particulate Inorganic Matter |
| POM | Particulate Organic Matter |
| PTS | Permanent Threshold Shifts |
| psi | Per square inch |
| SAFE | South Africa Far East |
| SAHRA | South African Heritage Resources Agency |
| SAMSA | South African Maritime Safety Authority |
| SAN | South African Navy |
| SANBI | South African National Biodiversity Institute |

| | |
|---|---|
| SASAR | South African Search and Rescue |
| SAT3 | South Atlantic Telecommunications cable no.3 |
| SAWS | South African Weather Service |
| $SO_X$ | Sulphur oxides |
| SSW | South-south-west |
| SW | South-west |
| TAC | Total Allowable Catch |
| TAE | Total Applied Effort |
| TSPM | Total Suspended Particulate Matter |
| TTS | Temporary Threshold Shifts |
| UNCLOS | United Nations Convention on Law of the Sea, 1982 |
| VMEs | Vulnerable Marine Ecosystems |
| VOS | Voluntary Observing Ships |
| WACS | West Africa Cable System |
| WASC | West African Submarine Cable |
| WSW | West-south-west |

# 1. INTRODUCTION

This chapter provides background to the proposed project, presents the assumptions and limitations of the study, and describes the structure of the report.

## 1.1 BACKGROUND

Total E and P South Africa (Pty) Ltd (Total E&P) is proposing to explore for oil and gas reserves in the deep offshore area of the South Coast of South Africa, referred to as the Outeniqua South Area (see Figure 1.1). Exploration activities would include a 2D seismic survey, a sonar bathymetry survey and drop core sampling. In order to undertake the proposed exploration activities, Total E&P lodged an application for an Exploration Right with the Petroleum Agency of South Africa (PASA) in terms of Section 74 of the Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA). PASA accepted the application on 28 June 2012.

The proposed Exploration Right area is approximately 76 060 $km^2$ in extent. The initial proposed seismic survey would be approximately 7 000 km in length comprising a number of low density spaced survey lines covering Total E&P's entire licence block area in the Outeniqua South Area between Cape Agulhas (20°E) and Cape St Francis (25°E). Although survey commencement would ultimately depend on a permit award date, it is anticipated that the seismic survey would commence during the last quarter of 2013 and would take in the order of two to three months to complete (between November 2013 and March 2014). Following analysis of the 2D seismic data, a sonar bathymetry survey and drop core sampling would be undertaken. These activities are proposed to take place from November 2014, with an estimated duration of 30 to 45 days.

In terms of the MPRDA an Exploration Right must be issued prior to the commencement of the proposed exploration activities. A requirement of obtaining an Exploration Right is that an Environmental Management Plan (EMP) has to be compiled in term of Section 39 of the MPRDA and submitted to PASA for consideration and for approval by the Minister of Mineral Resources. Furthermore, Interested and/or Affected Parties (I&APs) must be notified and consulted in this regard.

Total E&P appointed CCA Environmental (Pty) Ltd (CCA) to compile an EMP to meet the relevant requirements of the MPRDA and the Regulations thereto.

## 1.2 ASSUMPTIONS AND LIMITATIONS OF THIS EMP

This EMP was prepared with the following assumptions and limitations:

- CCA has been provided with all relevant project description information;
- There will be no significant changes to the project description or surrounding environment between the completion of the report and implementation of the proposed project that could substantially influence findings, recommendations with respect to mitigation and management, etc.;
- The assessment is based, to a large extent, on generic descriptions of 2D seismic surveys, sonar bathymetry surveys and drop core sampling, as the specific details of the proposed exploration activities were not available at the time of writing this report (e.g. survey vessel, exact timing of the survey, airgun and hydrophone array specifications, etc.);
- The study assumes that all mitigation measures incorporated into the project description would be implemented as proposed;
- Specialists were provided with all relevant information required in order to produce accurate and unbiased assessments; and
- Time constraints did not allow for public review of a draft of this report. However, this report will be released for a 30-day review and comment period at the same time it is submitted to PASA for

consideration. Any comments received will be forwarded directly to PASA for consideration.

These assumptions and limitations, however, are not considered to have any negative implications in terms of the credibility of the results of the study or the required management actions included in this EMP.

## 1.3 STRUCTURE OF THIS REPORT

This report consists of eight chapters and seven appendices as shown below.

| Section | Contents |
|---|---|
| Executive Summary | Provides an overview of the main findings of the EMP. |
| Chapter 1 | **Introduction**<br>Provides background to the proposed project, the assumptions and limitations of the study, and describes the structure of the report. |
| Chapter 2 | **Approach and methodology**<br>Covers the legislative requirements of the EMP process and presents the process undertaken. |
| Chapter 3 | **Project description**<br>Provides general information on the proposed project, a description of seismic surveys, sonar bathymetry surveys and drop core sampling and provides details on the proposed activities. |
| Chapter 4 | **The affected environment**<br>Describes the existing biophysical and socio-economic environment that could be affected by the proposed project. |
| Chapter 5 | **Environmental Impact Assessment**<br>Describes and assesses the potential impacts of the proposed project on the affected environment. It also presents mitigation measures that could be used to reduce the significance of any negative impacts or enhance any benefits. |
| Chapter 6 | **Conclusion and recommendations**<br>Provides conclusions to the EMP and summarises the recommendations for the proposed project. |
| Chapter 7 | **Action Plan and Procedures**<br>Provides a detailed Action Plan and Procedures for implementing the EMP. |
| Chapter 8 | **References**<br>Provides a list of the references used in compiling this report. |
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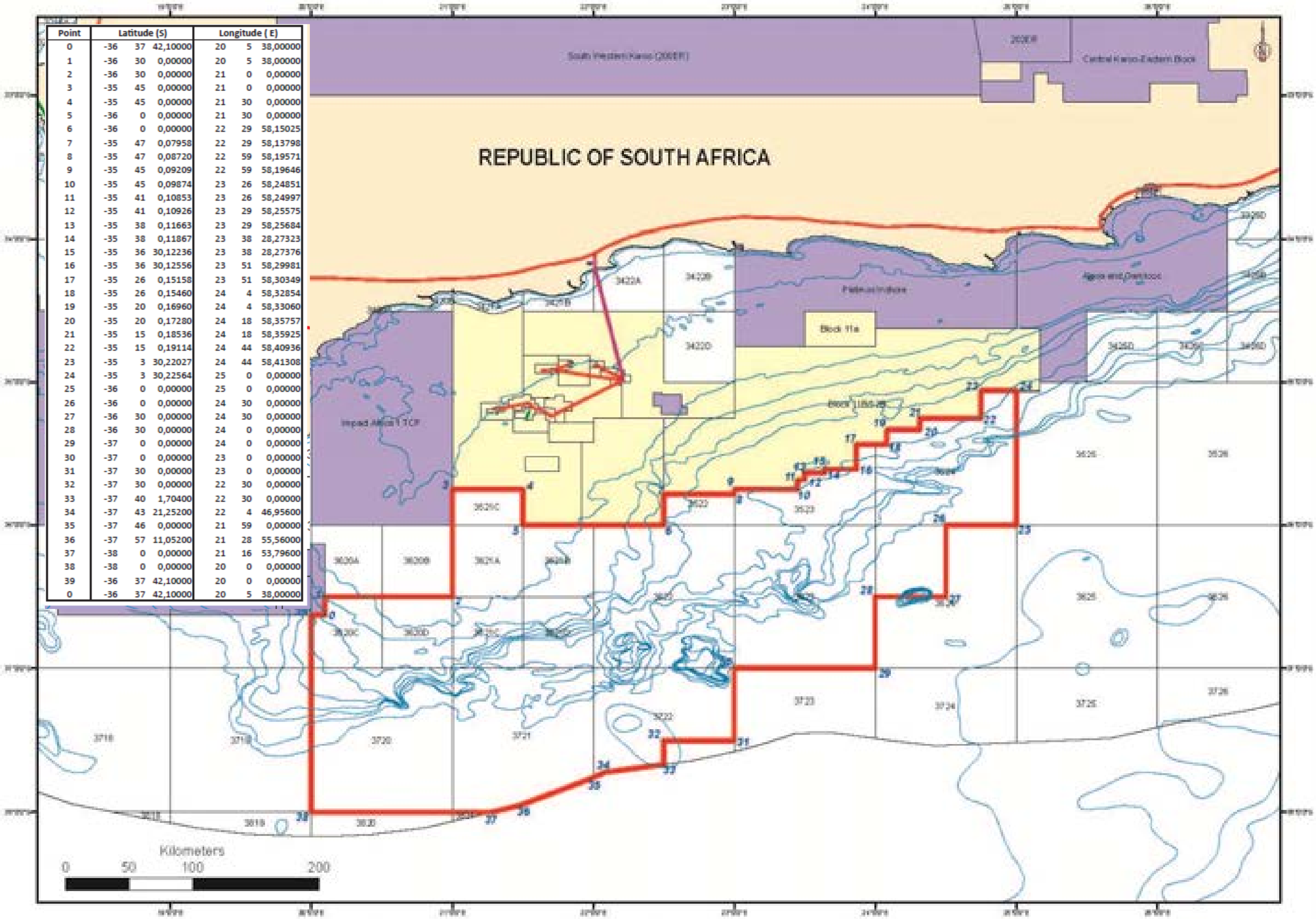


| Point | Latitude (S) | | | Longitude ( E) | | |
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| 4 | -35 | 45 | 0,00000 | 21 | 30 | 0,00000 |
| 5 | -36 | 0 | 0,00000 | 21 | 30 | 0,00000 |
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| 7 | -35 | 47 | 0,07958 | 22 | 29 | 58,13798 |
| 8 | -35 | 47 | 0,08720 | 22 | 59 | 58,19571 |
| 9 | -35 | 45 | 0,09209 | 22 | 59 | 58,19646 |
| 10 | -35 | 45 | 0,09874 | 23 | 26 | 58,24851 |
| 11 | -35 | 41 | 0,10853 | 23 | 26 | 58,24997 |
| 12 | -35 | 41 | 0,10926 | 23 | 29 | 58,25575 |
| 13 | -35 | 38 | 0,11663 | 23 | 29 | 58,25684 |
| 14 | -35 | 38 | 0,11867 | 23 | 38 | 28,27323 |
| 15 | -35 | 36 | 30,12236 | 23 | 38 | 28,27376 |
| 16 | -35 | 36 | 30,12556 | 23 | 51 | 58,29981 |
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| 18 | -35 | 26 | 0,15460 | 24 | 4 | 58,32854 |
| 19 | -35 | 20 | 0,16960 | 24 | 4 | 58,33060 |
| 20 | -35 | 20 | 0,17280 | 24 | 18 | 58,35757 |
| 21 | -35 | 15 | 0,18536 | 24 | 18 | 58,35925 |
| 22 | -35 | 15 | 0,19114 | 24 | 44 | 58,40936 |
| 23 | -35 | 3 | 30,22027 | 24 | 44 | 58,41308 |
| 24 | -35 | 3 | 30,22564 | 25 | 0 | 0,00000 |
| 25 | -36 | 0 | 0,00000 | 25 | 0 | 0,00000 |
| 26 | -36 | 0 | 0,00000 | 24 | 30 | 0,00000 |
| 27 | -36 | 30 | 0,00000 | 24 | 30 | 0,00000 |
| 28 | -36 | 30 | 0,00000 | 24 | 0 | 0,00000 |
| 29 | -37 | 0 | 0,00000 | 24 | 0 | 0,00000 |
| 30 | -37 | 0 | 0,00000 | 23 | 0 | 0,00000 |
| 31 | -37 | 30 | 0,00000 | 23 | 0 | 0,00000 |
| 32 | -37 | 30 | 0,00000 | 22 | 30 | 0,00000 |
| 33 | -37 | 40 | 1,70400 | 22 | 30 | 0,00000 |
| 34 | -37 | 43 | 21,25200 | 22 | 4 | 46,95600 |
| 35 | -37 | 46 | 0,00000 | 21 | 59 | 0,00000 |
| 36 | -37 | 57 | 11,05200 | 21 | 28 | 55,56000 |
| 37 | -38 | 0 | 0,00000 | 21 | 16 | 53,79600 |
| 38 | -38 | 0 | 0,00000 | 20 | 0 | 0,00000 |
| 39 | -36 | 37 | 42,10000 | 20 | 0 | 0,00000 |
| 0 | -36 | 37 | 42,10000 | 20 | 5 | 38,00000 |

**Figure 1.1: Location of Total E&P's licence area off the South Coast of South Africa.**

# 2. APPROACH AND METHODOLOGY

This chapter outlines the key legislative requirements for the proposed project and outlines the methodology and public participation process undertaken in the study.

## 2.1 LEGISLATIVE REQUIREMENTS

### 2.1.1 MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002

As noted earlier, an EMP is a requirement for obtaining an Exploration Right. The EMP must comply with Section 39 and Regulation 52 of the MPRDA.

In terms of Section 39[1] of the MPRDA an EMP must:

3(a) Establish baseline information concerning the affected environment to determine protection, remedial measures and environmental management objectives;

(b) Investigate, assess and evaluate the impact of the proposed project on:
- (i) The environment; and
- (iii) Any national estate referred to in Section 3(2) of the National Heritage Resources Act, 1999 (No. 25 of 1999), with the exception of the national estate contemplated in Section 3(2)(i)(vi) and (vii) of that Act.

(d) Describe the manner in which the Applicant intends to:
- (i) Modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;
- (ii) Contain or remedy the cause of pollution or degradation and migration of pollutants; and
- (iii) Comply with any prescribed waste standard or management or practices.

In terms of Regulation 52 of the MPRDA an EMP must include the following:

2(a) A description of the environment likely to be affected by the proposed exploration;

(b) An assessment of the potential impacts of the proposed exploration on the environment, socio-economic conditions and cultural heritage, if any;

(c) A summary of the assessment of the significance of the potential impacts, and the proposed mitigation and management measures to minimise adverse impacts and benefits;

(d) Financial provision;

(e) Planned monitoring and performance assessment of the EMP;

(f) Closure and environmental objectives;

(g) A record of the public participation process undertaken and the results thereof; and

(h) An undertaking by the Applicant regarding the execution of the EMP.

This EMP has been compiled to meet the legislative requirements indicated above.

### 2.1.2 NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998

The Environmental Impact Assessment (EIA) Regulations 2010 promulgated in terms of Chapter 5 of the National Environmental Management Act, 1998 (No. 107 of 1998) (NEMA), as amended, provide for the control of certain activities that are listed in Government Notices (GN) R544 (Listing Notice 1), R545 (Listing Notice 2) and R546 (Listing Notice 3). Activities listed in these notices must comply with the regulatory

[1] Subsection (7) of Section 39 states that "*The provisions of subsection (3)(b)(ii) and subsection (3)(c) do not apply to the applications for reconnaissance permissions, prospecting rights or mining permits."* In addition, Subsection (2)(b)(vii) of Section 69 states that *"prospecting rights, must be construed as a reference to exploration rights".* Therefore, the provisions of Subsection (7) of Section 39 would also apply to the current application for an Exploration Right.

requirements listed in GN R543, which prohibits such activities until written authorisation is obtained from the competent authority.

There are currently no activities listed in Listing Notice 1, 2 or 3 applicable to the proposed exploration activities. Activity 21 in Listing Notice 2 relating to "*any activity which requires an exploration right*" in terms of the MPRDA is not yet in effect (refer to GN No. R662) and is, therefore, not applicable. No Basic Assessment or Scoping and EIA process is thus required.

### 2.1.3 OTHER RELEVANT LEGISLATION

In addition to the foregoing, Total E&P must also comply with the provisions of other relevant international and national legislation and conventions, which include, but are not limited to, the following:

**International Marine Pollution Conventions**

- International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL);
- Amendment of the International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL) (Bulletin 567 – 2/08);
- International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 (OPRC Convention);
- United Nations Convention on Law of the Sea, 1982 (UNCLOS);
- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (the London Convention) and the 1996 Protocol (the Protocol);
- International Convention relating to Intervention on the High Seas in case of Oil Pollution Casualties (1969) and Protocol on the Intervention on the High Seas in Cases of Marine Pollution by substances other than oil (1973);
- Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal (1989); and
- Convention on Biological Diversity (1992).

**Other International Legislation**

- International Commission on Radiological Protection (ICRC); and
- International Atomic Energy Agency (IAEA) Regulations for the Safe Transport of Radioactive Material, 1984.

**Other South African legislation**

- Carriage of Goods by Sea Act, 1986 (No. 1 of 1986);
- Dumping at Sea Control Act, 1980 (No. 73 of 1980);
- Hazardous Substances Act, 1983 and Regulations (No. 85 of 1983);
- Marine Living Resources Act, 1998 (No. 18 of 1998);
- Marine Traffic Act, 1981 (No. 2 of 1981);
- Marine Pollution (Control and Civil Liability) Act, 1981 (No. 6 of 1981);
- Marine Pollution (Prevention of Pollution from Ships) Act, 1986 (No. 2 of 1986);
- Marine Pollution (Intervention) Act, 1987 (No. 65 of 1987);
- Maritime Safety Authority Act, 1998 (No. 5 of 1998);
- Maritime Safety Authority Levies Act, 1998 (No. 6 of 1998);
- Maritime Zones Act 1994 (No. 15 of 1994);
- Merchant Shipping Act, 1951 (No. 57 of 1951);
- Mine Health and Safety Act, 1996 (No. 29 of 1996);
- National Environmental Management: Air Quality Act, 2004 (No. 39 of 2004);
- National Environmental Management: Biodiversity Act, 2004 (No. 10 of 2004);

- National Environmental Management: Integrated Coastal Management Act, 2008 (No. 24 of 2008);
- National Environmental Management: Waste Act, 2008 (No. 59 of 2008);
- National Heritage Resources Act, 1999 (No. 25 of 1999)
- National Nuclear Energy Regulator Act, 1999 (No. 47 of 1999);
- National Ports Act, 2005 (No. 12 of 2005);
- National Water Act, 1998 (No. 36 of 1998);
- Nuclear Energy Act, 1999 (No. 46 of 1999);
- Occupational Health and Safety Act, 1993 (No. 85 of 1993) and Major Hazard Installation Regulations;
- Sea-Shore Act, 1935 (No. 21 of 1935);
- Sea Birds and Seals Protection Act, 1973 (No. 46 of 1973);
- Ship Registration Act, 1998 (No. 58 of 1998); and
- Wreck and Salvage Act, 1995 (No. 94 of 1995).

## 2.2 EMP PROCESS

### 2.2.1 OBJECTIVES

The objectives of the EMP process are:

- To provide a reasonable opportunity for I&APs to be consulted on the proposed project;
- To ensure that all potential key environmental issues and impacts that could result from the proposed project are identified;
- To identify feasible alternatives to the implementation of the proposed project;
- To assess potential impacts related to the proposed project;
- To present appropriate mitigation or optimisation measures to minimise potential impacts or enhance potential benefits; and
- Through the above, to ensure informed, transparent and accountable decision-making by the relevant authorities.

### 2.2.2 PROCESS UNDERTAKEN

#### 2.2.2.1 Public Participation Process

The Public Participation Process has involved an open, participatory approach and involvement of I&APs to ensure that all potential impacts are identified and that planning and decision-making takes place in an informed, transparent and accountable manner.

Steps undertaken in the Public Participation Process are summarised below and all supporting information is presented in the Public Participation Summary Report (see Appendix 1):

1. A preliminary I&AP database was compiled of authorities (local and regional), Non-Governmental Organisations, Community-based Organisations and other key stakeholders (including the fishing industry, overlapping and neighbouring users with delineated boundaries in the oil/gas and mining industries). This database was compiled using databases of previous studies in the area and responses to the newspaper advertisement;
2. A Background Information Document (BID) was prepared and distributed to all registered I&APs for a 21-day comment period from 01 October 2012 to 23 October 2012. The purpose of the BID was to convey information on the proposed project to I&APs and allowed them the opportunity to comment on the proposed project. To simplify the commenting process, a Response Form was included with the BID; and

3. On 02 October 2012, advertisements announcing the proposed project and the availability of the BID were placed in four regional newspapers, including:
   - Cape Times (Western Cape), Die Burger (Western Cape), Die Burger (Eastern Cape) and The Herald (Eastern Cape).

All written comments received from I&APs are presented in the Public Participation Summary Report (see Appendix 1). These comments have been collated into an Issues and Responses Trail. Where applicable, responses to comments and questions are given or cross-referenced to the relevant section of text in the EMP where this concern has been addressed.

#### 2.2.2.2 Specialist Studies

Two specialist studies were undertaken to address the key issues that required further investigation, namely the impact on fishing and marine fauna. A list of the specialists and their details are provided in Table 2.1.

The specialist studies involved the gathering of data relevant to identifying and assessing environmental impacts that may occur as a result of the proposed project. These impacts were then assessed according to pre-defined rating scales (see Appendix 2). Specialists also recommended appropriate mitigation / control or optimisation measures to minimise potential negative impacts or enhance potential benefits, respectively.

**Table 2.1: List of specialist studies and specialists.**

| No. | Specialist study | Specialist/s | Qualifications | Company | Appendix |
|---|---|---|---|---|---|
| 1 | Fishing | Mr Dave Japp | MSc (Ichthyology and Fisheries Science), Rhodes University | CapFish cc | 3.1 |
| | | Ms Sarah Wilkinson | BSc (Hons) (Botany), University of Cape Town | | |
| 2 | Marine fauna | Dr Andrea Pulfrich | PhD (Fisheries Biology), Christian-Albrechts University, Kiel, Germany | Pisces Environmental Services (Pty) Ltd | 3.2 |

#### 2.2.2.3 EMP Compilation and I&AP Review

The specialist information and other relevant information have been integrated into the EMP. Many of the issues associated with seismic surveys are generic in nature and have been assessed based on previous seismic survey programmes off the coast of South Africa. In addition, information has been incorporated into the EMP in order to ensure compliance with Section 39 and Regulation 52 of the MPRDA.

The EMP aims to present all information in a clear and understandable format and suitable for easy interpretation by authorities.

The EMP will be distributed for a 30-day review and comment and any comments received will be forwarded directly to PASA for consideration.

# 3. PROJECT DESCRIPTION

This chapter provides general information on the proposed project, a brief description of typical seismic surveys and specific details regarding the proposed seismic survey programme, sonar bathymetry survey and drop core sampling in the Outeniqua South Area.

## 3.1 GENERAL INFORMATION

### 3.1.1 EXPLORATION RIGHT APPLICANT

Total E&P as the applicant for the Exploration Right will also be the operator of the proposed project.

Address: Total E and P South Africa (Pty) Ltd
11 Cradock Avenue
JHI House
Rosebank
2196

Project Manager: Renaud Lions
Telephone: +33 (0)1 47 445006
Facsimile: +33 (0)1 47 447805
Cell: +33 (0)6 09 625106
E-mail: renaud.lions@total.com

### 3.1.2 DETAILS OF EXPLORATION AREA

**Location and surface area**
The Outeniqua South Area is situated in the deep offshore area of the South Coast of South Africa roughly between Cape Agulhas and Cape St. Francis (see Figure 1.1). It covers an area of approximately 76 060 km$^2$ with water depths ranging from 200 m to over 4 000 m. The block is roughly located between 20° and 25° east and 35° and 38° south. The full set of co-ordinates for the Outeniqua South Area is provided in Figure 1.1. The proposed exploration activities would be undertaken over most of the defined block area.

**Nearest Infrastructure**
The block is located at a substantial distance offshore. From Cape Agulhas and Cape St. Francis, the block is approximately 180 km and 90 km offshore, respectively. The larger harbours located at Mossel Bay and Port Elizabeth are approximately 150 km north and 130 km north-east of the area, respectively.

Adjacent License Blocks which are all located to the north include Block 11B/12B (CNR International), Block 9 (PetroSA) and Block 7 (Impact Africa).

Oil and gas production projects are currently in operation in Block 9. These include the F-A Platform with its satellite gas fields (including E-M and South Coast Gas) and the Oribi/Oryx oil production facility. Well drilling is being undertaken on an ongoing basis in Block 9 by PetroSA as part of the exploration work for the F-O Gas Field and the refurbishment of various production facilities. CNR International has an Exploration Right for well drilling in Block 11B/12B.

### 3.1.3 FINANCIAL PROVISION

In terms of Section 41 of the MPRDA and Sections 52 and 53 of the MPRDA Regulations, Total E&P would provide for rehabilitation, management and remediation of negative environmental impacts associated with the exploration work programme. This would be provided by means of an insurance policy to the value of USD 10 000 000. The determination of the quantum of the financial provision is set out in Appendix 4.

Proof of Financial Provision would be provided to PASA in the following manner:

- Copies of the insurance cover carried by the Contractors and Total E&P would be provided together with the environmental notification submitted to PASA at least 14 days prior to the commencement of any exploration activity;
- A copy of the insurance certificate for the year would be provided on the renewal date of each year; and
- The annual revision of the closure provision would be submitted together with the annual Performance Assessment reports.

### 3.1.4 ENVIRONMENTAL POLICY

A copy of Total E&P's Health, Safety and Environmental Policy is presented in Appendix 5. This policy sets out their commitment to ensure successful implementation of the proposed project and EMP.

### 3.1.5 MONITORING AND EMP PERFORMANCE ASSESSMENT

Total E&P would undertake appropriate monitoring during the proposed seismic survey as presented in Chapter 7. Total E&P would track performance against objectives and targets specified in this EMP.

Total E&P would appoint an Environmental Officer to undertake monitoring on an ongoing basis to ensure the protection of the environment and the safety of personnel and contractors. The audit would generate a list of recommended corrective actions, which would be used as a tool to document all corrective actions taken and how they were performed. In addition, Total E&P would conduct a performance assessment as determined by PASA.

At the conclusion of each exploration activity a "close-out" report would be prepared, which would include monitoring and performance assessments. This report would outline the implementation of the EMP and highlight any problems and issues that arose during the seismic survey.

### 3.1.6 PLANS AND PROCEDURES FOR ENVIRONMENTAL RELATED EMERGENCIES AND REMEDIATION

An Emergency Response Plan would be prepared for the proposed survey. Total E&P would use as a basis its generic Emergency Response Plan (see extract in Appendix 6). This plan would be updated and modified for the proposed exploration activities in the Outeniqua South Area. The project specific Emergency Response Plan would be submitted to PASA (see Section 3.2.5).

All offshore emergencies (e.g. streamer cable damage, fuel oil release, etc.) would be managed in terms of a bridging document between the Emergency Response Plan prepared for the Outeniqua South Area and the emergency response procedures and plans of the selected Contractor.

### 3.1.7 UNDERTAKING BY THE APPLICANT

Total E&P undertakes to comply with the specifications of the EMP and provisions of the MPRDA and Regulations thereto (see Appendix 7).

## 3.2 TYPICAL SEISMIC SURVEYS

### 3.2.1 INTRODUCTION

Seismic surveys are carried out during marine oil and gas exploration in order to investigate subsea geological formations. During seismic surveys high-level, low frequency sounds are directed towards the seabed from near-surface sound sources towed by a seismic vessel. Signals reflected from geological interfaces below the seafloor are recorded by multiple receivers (or hydrophones) towed in a number of streamers (see Figure 3.1). Analyses of the returned signals allow for interpretation of subsea geological formations.

Seismic surveys are undertaken to collect either 2D or 3D data. 2D surveys are typically applied to obtain regional data from widely spaced survey grids (tens of kilometres) and infill surveys on closer grids (down to a 1 km spacing) are applied to provide more detail over specific areas of interest such as potentially drillable petroleum prospects. A 2D survey provides a vertical slice through the earth's crust along the survey track-line. The vertical scales on displays of such profiles are generally in two-way sonic time, which can be converted to depth displays by using sound velocity data.

As a first step, Total E&P is proposing to undertake a 2D seismic survey across a large portion of the Outeniqua South Area (see Figure 1.1). It is anticipated that the proposed survey would be undertaken over a two to three month period between November 2013 and March 2014.

### 3.2.2 SURVEY METHODOLOGY AND SEISMIC ARRAY

A seismic survey would be conducted using a dedicated vessel. The seismic survey vessel would travel along transects of a prescribed grid within the proposed survey area. A support vessel(s) (often referred to as a chase vessel) would accompany the seismic vessel for the duration of the survey.

During surveying vessels would travel at a speed of between 4 to 6 knots. A 2D survey would typically involve a towed airgun array and a single hydrophone streamer (see Figure 3.1). A surface tail-buoy with radar reflectors is connected to the end of the streamer/s. The entire seismic array from the survey vessel to the end of the streamer/s may be up to 12 000 m in length. A typical 2D seismic survey configuration and safe operational limits are illustrated in Figure 3.2.

Airguns, which are the most common sound source used in modern seismic surveys, would be used for the proposed survey. The airgun is an underwater pneumatic device from which high-pressure air is released suddenly into the surrounding water. On release of pressure the resulting bubble pulsates rapidly producing an acoustic signal that is proportional to the rate of change of the volume of the bubble. The frequency of the signal depends on the energy of the compressed air prior to discharge. Airguns are used on an individual basis (usually for shallow water surveys) or in arrays. Arrays of airguns are made up of towed parallel strings, usually comprised of between 12 and 70 airguns in total. The airguns are commonly towed some 100 m behind the vessel at a depth of 5 to 6 m below the surface. The airgun would be fired at approximately 10-20 second intervals.

Signals (sound waves) reflected from geological discontinuities below the seafloor are recorded by hydrophones mounted inside streamer cables. Hydrophones are typically made from piezoelectric material encased in a rubber plastic hose. The reflected acoustic signals are recorded and transmitted to the seismic vessel for electronic processing. Analyses of the returned signals allow for interpretation of subsea geological formations.

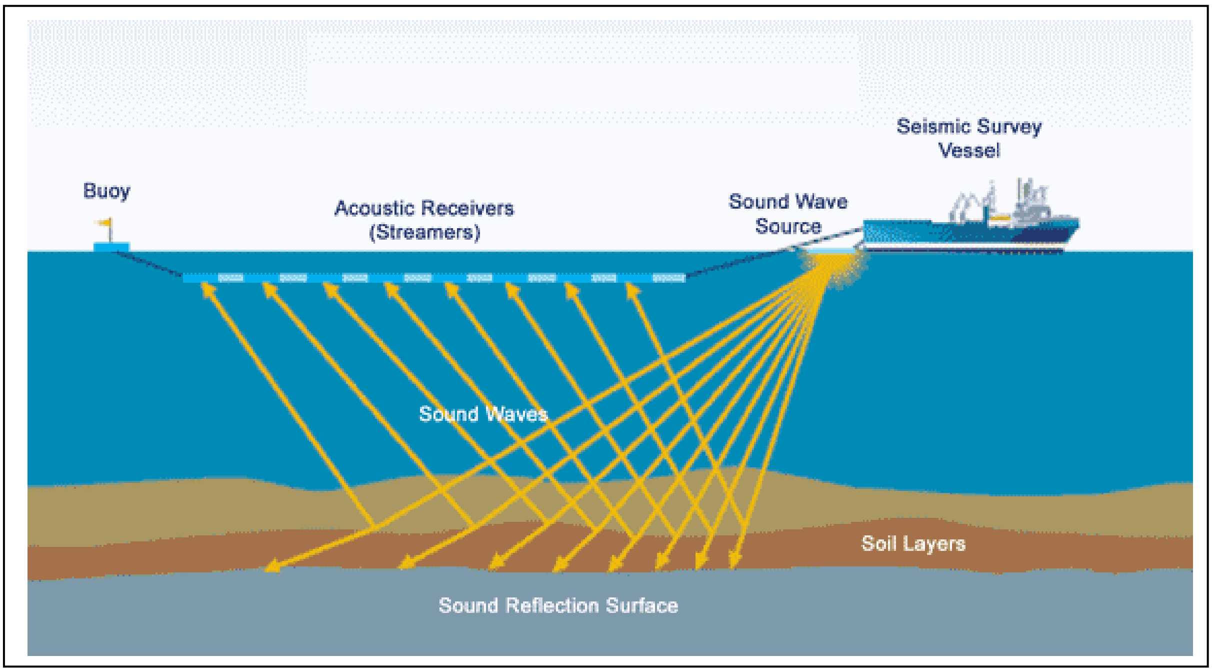


**Figure 3.1: Principles of offshore seismic acquisition surveys (from fishsafe.eu).**

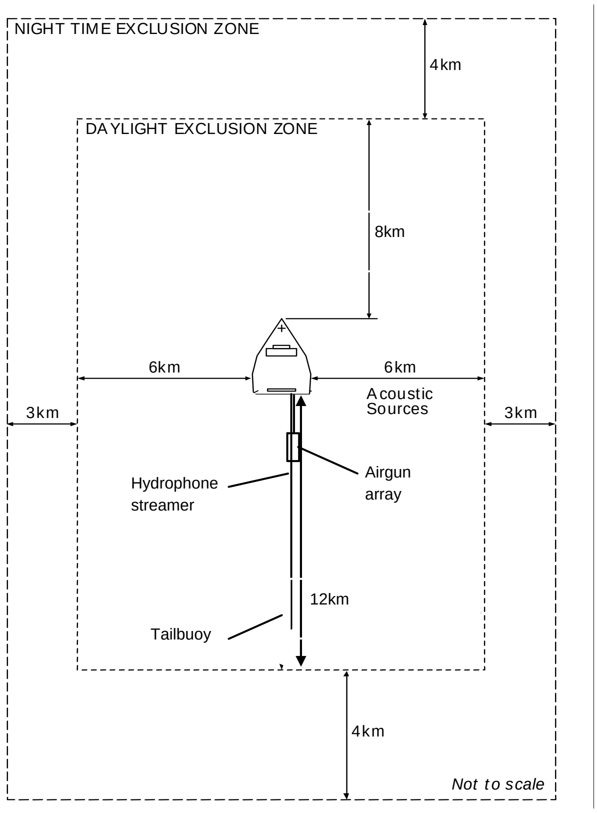


**Figure 3.2: Typical configuration and safe operational limits for 2D seismic survey operations.**

### 3.2.3 SOUND PRESSURE EMISSION LEVELS

A single airgun could typically produce sound levels of the order of 220-230 dB re 1 mPa @ 1m, while arrays produce sounds typically in the region of 250 dB re 1 mPa @ 1m. The majority of energy produced is in the 0 to 120 Hz bandwidth, although energy at much higher frequencies is also recorded. High-resolution surveys and shallow penetration surveys require relatively high frequencies of 100-1000 Hz, while the optimum wavelength for deep seismic work is in the 10-80 Hz range.

One of the required characteristics of a seismic shot is that it is of short duration (the main pulse is usually between 5 and 30 milliseconds). The main pulse is followed by a negative pressure reflection from the sea surface of several lower magnitude bubble pulses (see Figure 3.3). Although the peak levels during the shot may be high, the overall energy is limited by the duration of the shot.

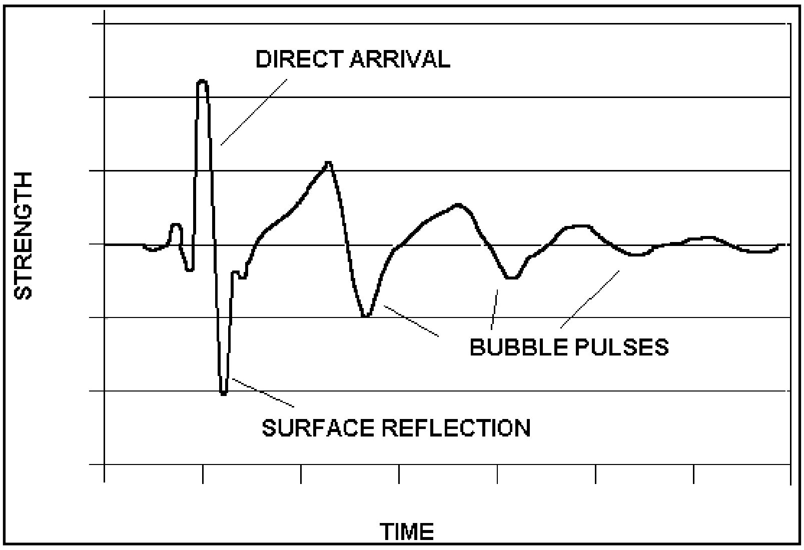


**Figure 3.3: A typical pressure signature produced on firing of an airgun.**

### 3.2.4 EXCLUSION ZONE IMPLICATIONS FOR OTHER VESSELS

The acquisition of high quality seismic data requires that the position of the survey vessel and the array be accurately known. Seismic surveys consequently require accurate navigation of the sound source over pre-determined survey transects (see Figure 3.4). This, and the fact that the array and the hydrophone streamers need to be towed in a set configuration behind the tow-ship, means that the survey operation has little manoeuvrability while operating.

Under the Merchant Shipping Act, 1951 (No. 57 of 1951), a seismic survey vessel that is engaged in surveying is defined as a “vessel restricted in its ability to manoeuvre” which requires that other vessels shall, so far as possible, keep out of the way of a vessel restricted in her ability to manoeuvre. The Convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972, Part A, Rule 10) recognises vessels with “restricted ability to manoeuvre” and assigns responsibility to fishing and other boats to give way to such vessels. Furthermore, under the Marine Traffic Act, 1981 (No. 2 of 1981), a seismic survey vessel and its array of airguns and hydrophones fall under the definition of an “offshore installation” and as such it is protected by a 500 m safety zone. It is an offence for an unauthorised vessel to enter the safety zone. In addition to a statutory 500 m safety zone, a seismic contractor would request a safe operational limit (that is greater than the 500 m safety zone) that it would like other vessels to stay beyond. Typical safe operational limits for a 2D survey are illustrated in Figure 3.2.

At least a 500 m exclusion zone would need to be enforced around the seismic vessel at all times. A chase boat with appropriate radar and communications would be used to warn vessels that are in danger of breaching the exclusion zone.

For semi-industrial, industrial and recreational fishers and other related activities, the seismic survey journey plan and exclusion areas will be communicated to these stakeholders well in advance to ensure that the appropriate planning can be undertaken in accordance with a communications plan. Notices to Mariners will be communicated through the proper channels and harbour / port masters will be informed of exclusion zones.

### 3.2.5 SUPPORT SERVICES AND EMPLOYMENT

The chase boat would also be required to perform logistics support to the survey vessel. Helicopters may be utilised for crew / supply transfers between the seismic and support vessels and the mainland.

Bunkering of the seismic vessel is expected to be undertaken at port of operation or at sea during the survey. Standard operating procedures for refuelling would be adhered to at all times.

Highly skilled and experienced crew and seismic operators are required for the seismic operations and labour for a survey is generally employed through the seismic contractor. The size and nature of the crew would depend on the size of the vessel, and may consist of between 35 and 50 people on-board at any one time. Given the specific technical and experience requirements the crew is likely to consist of international specialists of various nationalities. On-board Marine Mammal Observers (MMOs) may be sourced from South Africa.

## 3.3 DETAILED SEISMIC SURVEY INFORMATION

At this stage no vessel has been contracted for the proposed seismic survey programme. Thus specific detail would only be available when Total E&P has appointed a seismic contractor and contracted a vessel. The specific details of the survey programme would be compiled into an Environmental Notification that would be submitted to PASA for information purposes. The Environmental Notification would provide details on the following:

- Seismic contractor;
- Vessel specifications;
- Survey timing and duration;
- Survey lines; and
- Relevant insurance.

The anticipated survey specifications, on which the EMP and associated impact assessment is based, are presented below.

### 3.3.1 TYPE OF SURVEY AND EXTENT

Total E&P is proposing to initially undertake a 2D seismic survey across the whole of the Outeniqua South Area (see Figure 3.4). The survey would cover approximately 76 060 $km^2$ of the block.

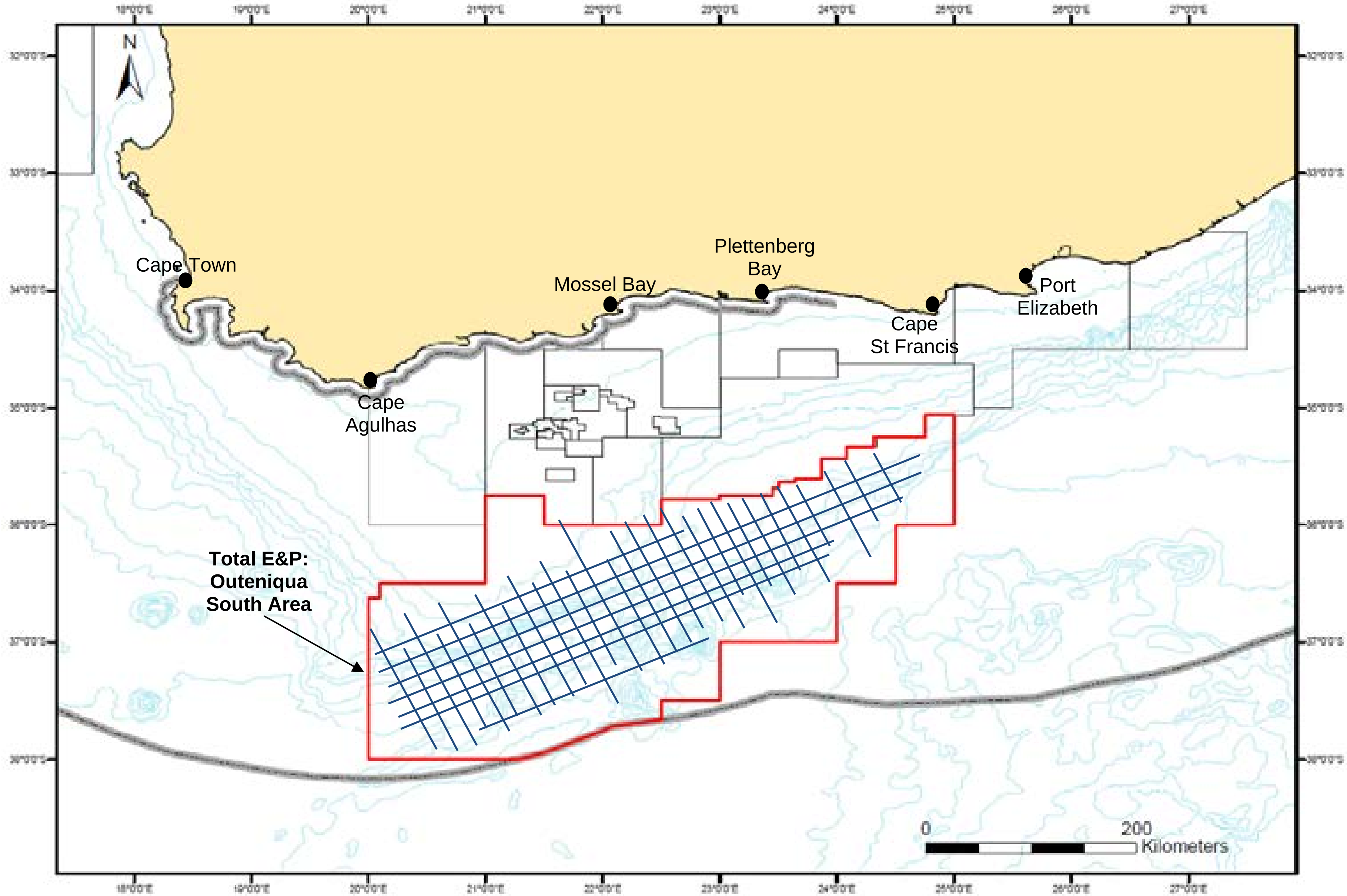


**Figure 3.4 Location of Total E&P's 2D seismic survey off the South Coast of South Africa, with approximate survey lines indicated.**

### 3.3.2 TIMING AND DURATION

Although survey commencement would ultimately depend on the approval of the EMP, the survey is scheduled to commence in the last quarter of 2013 and is anticipated to take in the order of two to three months between November 2013 and March 2014.

### 3.3.3 AIRGUN AND HYDROPHONE ARRAY SPECIFICATIONS

The anticipated airgun and hydrophone array specifications are summarised in Table 3.1.

**Table 3.1: Anticipated airgun and hydrophone array specifications.**

| Specification | 2D |
|---|---|
| **No. of active air guns** | 4 in one array |
| **Nominal source pressure (typical)** | 4 000 to 5 000 psi |
| **Depth of airgun** | 6 – 10 m |
| **Distance of airgun behind vessel** | 80 - 150 m |
| **No. of hydrophone streamers** | 1 |
| **No. of hydrophones per streamer** | 480 - 800 |
| **Streamer depth** | 6 – 20 m |
| **Streamer length** | 12 000 m |

## 3.4 SONAR BATHYMETRY SURVEY AND CORE SAMPLING

### 3.4.1 TIMING AND DURATION

The sonar bathymetry survey and core sampling are planned to take place from November 2014, with an estimated duration of 30 to 45 days.

### 3.4.2 DESCRIPTION OF SONAR SURVEY

In order to further investigate the structure of the ocean bed sediment layers, Total E&P are proposing to undertake a sonar bathymetry survey. The following sonar surveying tools are currently considered for use:

- *Depth Sounders:*
  The majority of hydrographic depth/echo sounders are dual frequency, transmitting a low frequency pulse (typically around 24 kHz) at the same time as a high frequency pulse (typically around 200 kHz). Dual frequency depth/echo sounding has the ability to identify a vegetation layer or a layer of soft mud on top of a layer of rock.
- *Fish Finders*:
  Fish finders are used to determine the depth of water. The depth is calculated using a formula which considers the salinity and temperature of seawater together with the speed of sound through a water column. In operation, an electrical impulse from a transmitter is converted into a sound wave by an underwater hydrophone and sent into the water. When the wave strikes an object, it is reflected back and displays size, composition, and shape of the object. The process can be repeated up to 40 times per second and eventually results in the bottom of the ocean being displayed versus time.

- *Bottom Profilers*:
  Bottom profilers are powerful low frequency echo-sounders that provide profiles of the upper layers of the ocean floor.

- *Side scan sonar*:
  Side scan sonar systems produce acoustic intensity images of the seafloor and are used to map the different sediment textures of the seafloor. Side-scan uses a sonar device, towed from a surface vessel or mounted on the ship's hull, that emits conical or fan-shaped pulses down toward the seafloor across a wide angle perpendicular to the path of the sensor through the water (see Figure 3.5). The intensity of the acoustic reflections from the seafloor of this fan-shaped beam is recorded in a series of cross-track slices. When stitched together along the direction of motion, these slices form an image of the sea bottom within the swath (coverage width) of the beam.

- *Multibeam Depth Sounders:*
  In addition to the single beam depth sounder, multibeam depth sounds are capable of receiving many return "pings". This system produces a digital terrain model of the seafloor (see Figure 3.6).

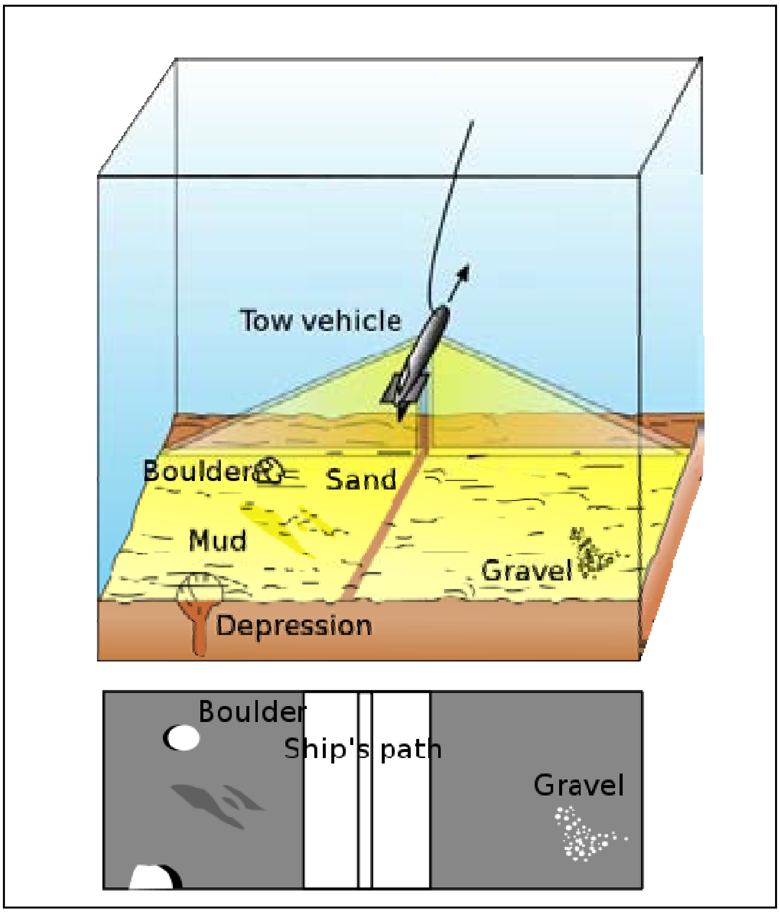


**Figure 3.5 Schematic of a typical side scan sonar device and resulting information.**

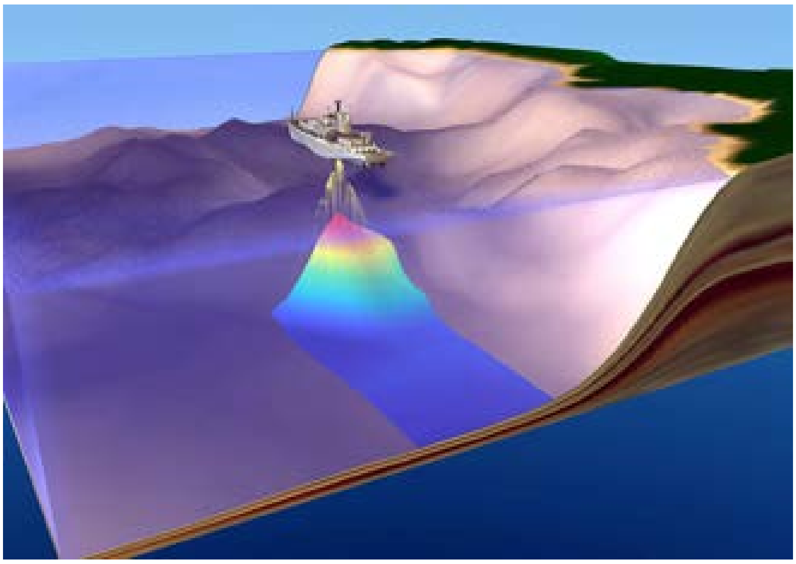

**Figure 3.6 Illustration of a vessel using multibeam depth/echo sounders.**

Table 3.2 lists the survey equipment (and its source level noise) that is likely to be used for the sonar bathymetry survey.

**Table 3.2: Specifications of acoustic equipment to be utilised in the proposed survey.**

| Sound Type | Frequency | Duration (in seconds) | Source level (dB re 1 μPa at 1m) |
|---|---|---|---|
| Depth Sounders | 12 to 200 kHz | > 0.025 | 180+ |
| Fish Finders | 20 to 30 kHz | > 0.025 | 216-223 |
| Bottom Profilers | 0.4 to 30 kHz | 0.1-160 | 200-230 |
| Side Scan | 50 to 500 kHz | 0.01-0.1 | 220-230 |
| Multibeam | 92 to 98 kHz | 0.02 | Up to 235 |
| Airgun Array | 0.001 to 1 kHz | < 1 | 216-260 |

### 3.4.3 DESCRIPTION OF DROP CORE SAMPLING

Total E&P is proposing to use a piston coring system to undertake sediment core samples of the seabed surface (see Figure 3.7). The piston coring rig is comprised of a trigger assembly, the coring weight assembly, core barrels, tip assembly and piston. The core barrels are in lengths of 6 to 9 m with a diameter of 10 cm. The cores are recovered in butyrate tubes that contain the sample.

The system is mounted over the deck of the survey vessel and utilises the "free fall" of the coring rig to create the initial impact force on the seabed and a sliding piston inside the core barrel to reduce the inside wall friction with sediment. The sliding piston also helps with the evacuation of displaced water from the top of the corer.

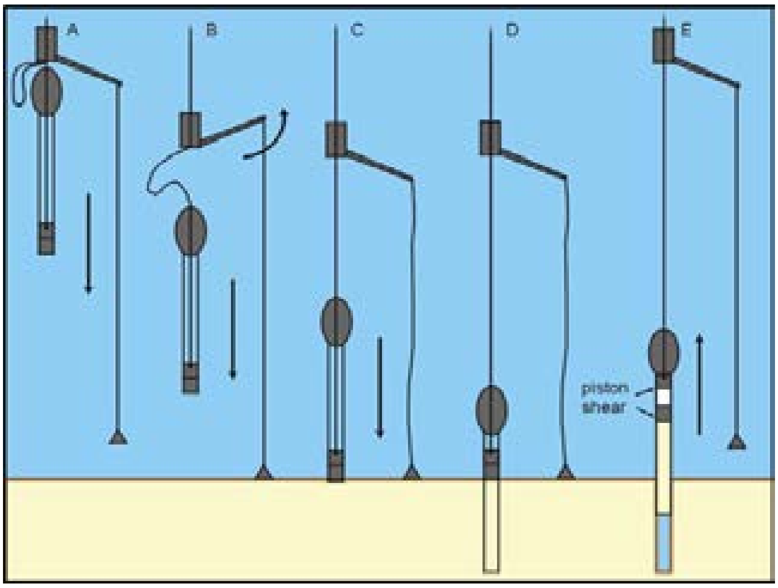


**Figure 3.7** **Schematic of the piston core operation at the seabed. The core barrel is dropped from about 3 meters above the seabed allowing good penetration and vertical orientation.**

Once on deck the core liner is divided and labeled into 20 cm sections. The core sections are then capped and taken to an onboard laboratory for processing. Each core section is extruded and the top and bottom 1 cm of sediment is discarded. Generally, three core sections from near the bottom of the core are sampled for the various analytical requirements and a fourth is saved as an archive. Detailed records are kept for each core, describing subsampling procedures and noting unusual features in the sample (e.g. visible oil, hydrogen sulphide odour, etc.). Water depth, date, time and WGS 84 latitude and longitude are also recorded for each sample.

Total E&P would collect approximately 150 to 200 core samples across the 2D seismic survey area. This number and the exact location of the core samples would be confirmed following the analysis of the 2D seismic survey and sonar bathymetric survey results.

Noise measurements taken for coring equipment used in a previous coring exercise found that at a distance of 25 m from the tool the noise was measured at 160 – 180 dB re 1µPa. At a distance of 110 m from the tool the noise is typically 155 dB re 1µPa and 164dB re 1µPa. The 1/3 octave analysis showed there was a 1/3 octave tone at 100 Hz and 125 Hz with harmonics at 200Hz and 250Hz (Hegley, 2010).

# 4. THE AFFECTED ENVIRONMENT

This chapter provides a description of the South Coast region and the environment likely to be affected by the proposed exploration activities.

## 4.1 INTRODUCTION

The Exploration Right area is 76 060 km$^2$ in extent stretching roughly between Cape Agulhas in the Western Cape and Cape St Francis in the Eastern Cape. The proposed survey area is located beyond the 200 m depth contour, with the closest point to shore being approximately 90 km from Cape St Francis (refer to Figure 1.1).

The South Coast region is here defined as lying between Cape Agulhas (34° 35'S; 20° 00'E) and Cape Padrone (33° 45'S; 26° 30'E). The region is dominated by the Agulhas Bank, a roughly 116 000 km$^2$ triangular extension of the continental shelf. The Agulhas Bank represents a transition zone between the warm Agulhas Current waters to the east and the cool waters of the Benguela system to the west. The coastline is characterised by a number of capes separated by sheltered sandy embayments.

## 4.2 METEOROLOGY

The main features affecting the weather patterns along the South Coast are the mid-latitude cyclones generated to the south-west of the country and the South Atlantic and Indian Ocean high pressure cells (Shannon, 1985; Preston-Whyte and Tyson, 1988) (see Figure 4.1). The northward movement and weakening of the high-pressure cells during winter and the corresponding northward shift of easterly-moving mid-latitude cyclones (which occur to the south of the region in summer) cause the frontal systems and their associated westerly winds to move overland, affecting coastal weather patterns (Heydorn and Tinley, 1980; Schumann, 1998). Associated with the passage of mid-latitude cyclones are the shallow low-pressure systems that move around the coast from west to east ahead of frontal systems (Heydorn and Tinley, 1980). These may produce warm offshore winds followed by colder westerly to south-westerly winds (Schumann, 1998). Westerly winds predominate in winter, with a marked increase in easterly wind direction in summer. Gale force winds are most frequent 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). The strongest winds are observed at capes, including Agulhas, Infanta, Cape Seal, Robberg and Cape Recife (Jury & Diab 1989). Calm periods are most common in autumn (CSIR & CCA, 1998).

## 4.3 PHYSICAL OCEANOGRAPHY

### 4.3.1 BATHYMETRY AND SEDIMENTS

The bathymetry of the South Coast is dominated by the Agulhas Bank. From its narrowest point (40 km) on the West Coast between Cape Columbine and Cape Point, the continental shelf widens to the south reaching its apex 250 km offshore on the Agulhas Bank. Between 22° and 26° E, the shelf break indents towards the coast forming the Agulhas 'bight' (Schumann, 1998) narrowing eastwards to approximately 115 km offshore in the region of Algoa Bay. The bathymetry drops steeply at the coast to approximately

50 m, with depth increasing gradually to the shelf break at a depth of 140 m off Port Elizabeth, 130 m off Cape St Francis, and 300 m south of Cape Agulhas (Birch & Rogers, 1973). Major bathymetric features on the Agulhas Bank include the Alphard Banks, situated south of Cape Infanta, the Agulhas Arch and Aphard Rise (Birch & Rogers, 1973, CCA & CSIR, 1998). Outside the shelf break, depth increases rapidly to more than 1 000 m (Hutchings, 1994).

The coastline of the South Coast is characterised by a number of capes separated by sheltered sandy embayments.

A large expanse of the mid-shelf region of the Agulhas Bank comprises either rock or areas with sparse sediment cover, with an inner shelf sediment-wedge extending up to 30 km offshore (Birch & Rogers, 1973; Schumann, 1998). Although mud patches occur inshore east of Cape Infanta and south of Cape Agulhas, the majority of unconsolidated sediment is sand to muddy sand (Birch & Rogers, 1973).

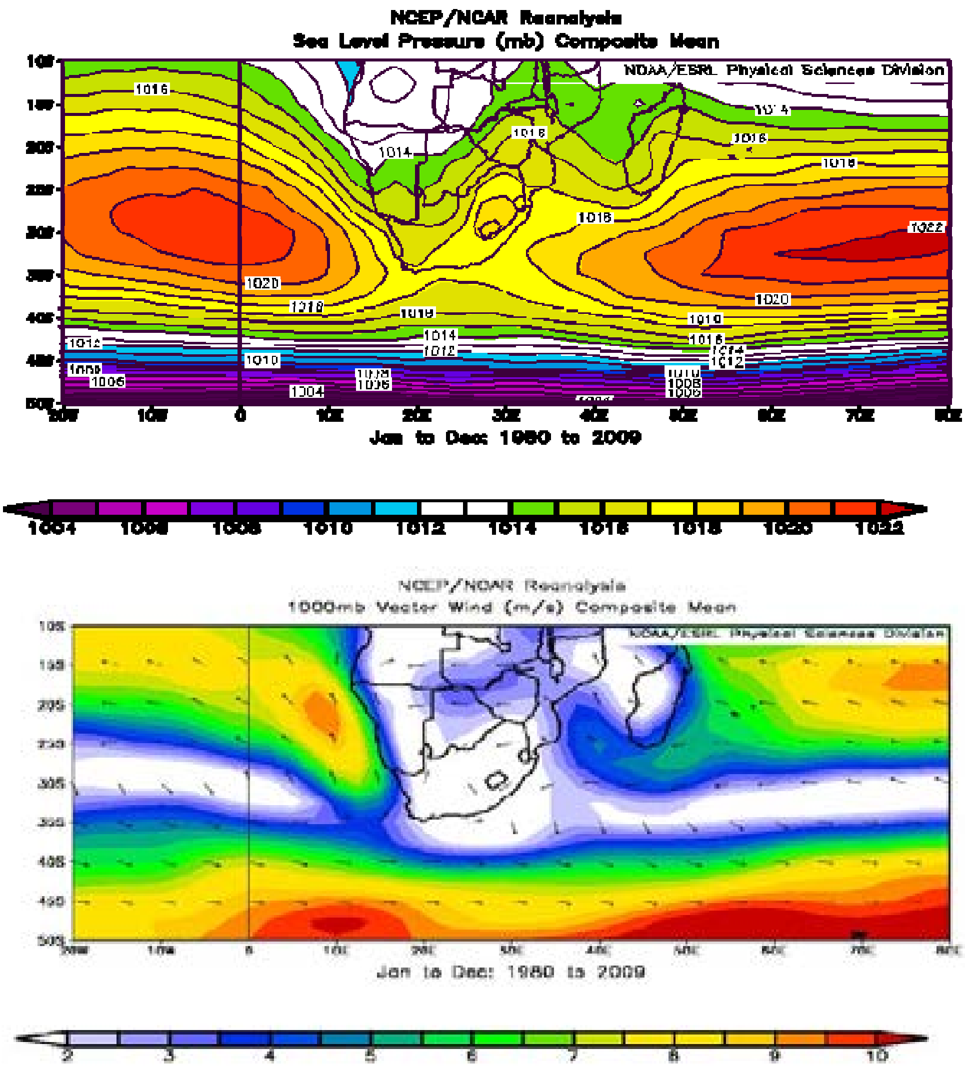


**Figure 4.1: Average sea level pressure (top; hPa) and wind speed and direction (bottom; m.s-1) for the period 1979 – 2009 for both the Atlantic and Indian Oceans from NCEP reanalysis data. Images provided from the NCEP reanalysis site (http://www.esrl.noaa.gov/psd/data/reanalysis/reanalysis.shtml).**

### 4.3.2 WATER MASSES AND CIRCULATION

The oceanography off the South Coast is almost totally dominated by the warm Agulhas Current. The current forms between 25° and 30° S, flowing southwards along the shelf edge of the East Coast of southern Africa as part of the anticyclonic Indian Ocean gyre, before retroflecting between 16° and 20° E (Schumann, 1998). 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/sec or more and water transport rates of over 60 × $10^6$ $m^3$/sec having been recorded (Pearce *et al.,* 1978; Gründlingh, 1980). 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. It may also shed eddies, which travel at around 20 cm/sec and advect onto the Agulhas Bank (Swart & Largier, 1987). After detaching from the shelf edge at 15° E, the Agulhas Current retroflects and flows eastwards (Schumann, 1998) (Figure 4.2 and 4.3).

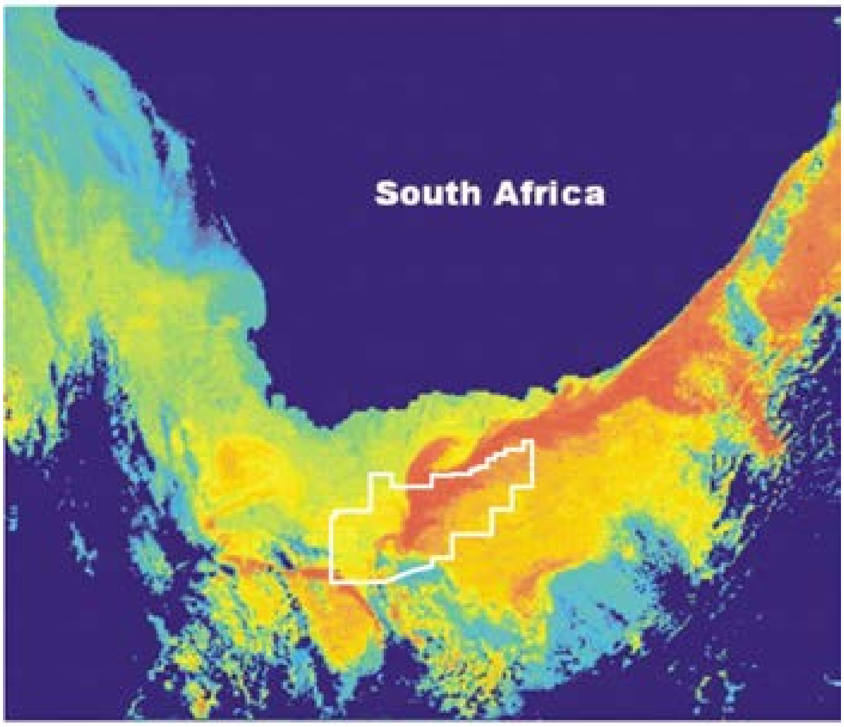


**Figure 4.2: The predominance of the Agulhas Current in the oceanography of the proposed survey area (white outline).**

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 to 75 cm/sec midshelf and 10 to 40 cm/sec nearshore. Eastward flow may occur close inshore (Boyd *et al*., 1992; Boyd & Shillington, 1994), being particularly strong off 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).

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. The surface waters 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 25º C in summer and 21º C in winter and have lower salinities than the Equatorial Indian Ocean and 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 14º C and a salinity of 35.3 ppt occurs below the surface water layers at between 150 to 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 20º C often intrudes into the Agulhas Current at depths of 150 to 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. South of Mbashe and East London, a persistent wedge of cooler water is present over the continental shelf during summer (Beckley & Van Ballegooyen, 1992), extending northwards to the southern KwaZulu-Natal coast in winter. This wedge is typically cooler than 19° C, but may be cooler than 16° C between East London and Port Alfred, and south of Mbashe. Inshore, waters are warmest during autumn, with warm water tongues found off Cape Recife (near Port Elizabeth) from January to March and off 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).

Strong and persistent thermoclines are common over the shelf, extending inshore during the summer, but breaking down during the cooler and windier winter conditions (Schumann & Beekman, 1984; Boyd & Shillington, 1994). Thermoclines at the eastern edge of the South Coast are located at 20 to 40 m depth, whereas they are deeper at the western edge (40 to 60 m) (Largier & Swart, 1987).

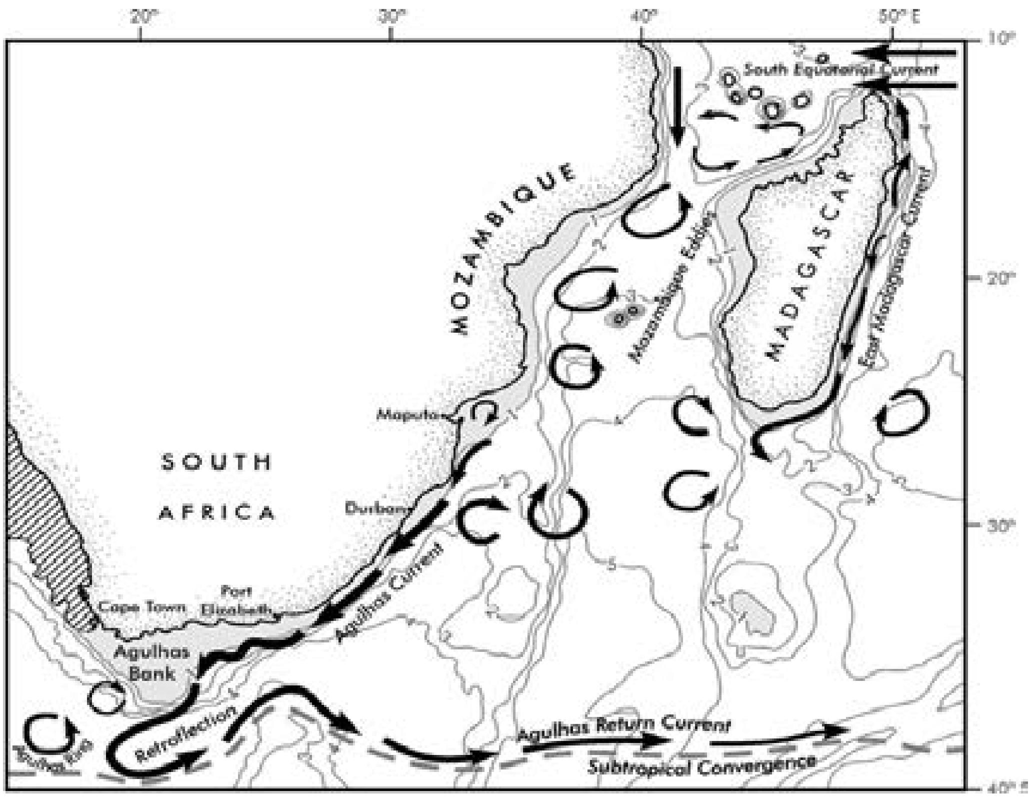


**Figure 4.3:** **A schematic representation of the ocean circulation in the South-West Indian Ocean. In the figure the black circular features represent the rotating masses of water known as eddies. Black arrows represent the oceanic currents. The gray shade areas represent the bathymetric features with less than 1 000 m depth. The numbers represent the depths of the bathymetric contours, intervals in kilometers. The broken line is a representation of the Subtropical Convergence (after Lutjeharms, 2006).**

### 4.3.3 SWELLS AND WAVES

On the South Coast, the majority of waves arrive from the south-west quadrant (Whitefield *et al*., 1983), dominating wave patterns during winter and spring (Carter & Brownlie, 1990). Waves from this direction frequently exceed 6 m (Swart & Serdyn 1981, 1982) and can reach up to 10 m (Heydorn, 1989). During summer, easterly wind-generated 'seas' occur (Heydorn & Tinley, 1980; Heydorn, 1989; Carter & Brownlie, 1990). Giant waves (>20 m high) that are at times encountered within the Agulhas Current (Heydorn & Tinley, 1980). These arise from the meeting of the south-westerly swells and the southerly flowing Agulhas Current, and may be a navigation hazard at times.

### 4.3.4 TIDES

Tides are typically semi-diurnal along the South Coast with an average tidal range of between 0.5 m during neap tides and 1.5 to 2.0 m during springs (Schumann, 1988). The tidal range increases slightly from west to east. Tides propagate from west to east along the South African coast eastwards of Cape Point, so that high water is earlier in the west than east along the South Coast (Schumann, 1998).

**Table 4.1: Tide data (m) for different sites along the South Coast (from SA Tide Tables, 1995 & 2009).**

| Site | | MLWS | MLWN | ML | MHWN | MHWS | HAT |
|---|---|---|---|---|---|---|---|
| Mossel Bay | | 0.25 | 0.84 | 1.13 | 1.41 | 2.00 | 2.42 |
| Knysna | | 0.36 | 0.90 | 1.16 | 1.43 | 1.96 | 2.31 |
| Port Elizabeth | | 0.29 | 0.84 | 1.09 | 1.35 | 1.90 | 2.35 |

MLWS - Mean low water spring
MLWN - Mean low water neap
ML - Mean level
MHWN - Mean high water neap
MHWS - Mean high water spring
HAT - Highest astronomical tide

### 4.3.5 UPWELLING

Wind-driven upwelling occurs inshore along the South Coast, especially during summer when easterly winds prevail (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). Marked changes in sea surface temperatures (up to 8°C) have been reported within a few hours during such upwelling (Hutchings, 1994).

Intensive upwelling of Indian Ocean Central Water occurs periodically over the shelf and shelf edge along the inner boundary of the Agulhas Current (Schumann, 1998) (see Figure 4.4). Such upwelling is generally as a result of frictional interactions between the Agulhas Current and bottom topography (Hutchings, 1994). This shelf edge upwelling largely defines the strong thermocline topography of the Agulhas Bank region. Cold water, upwelled over the shelf edge, forms the basal layer on the shelf, while intrusive plumes of more saline surface water replenish the warm mixed water at the surface, resulting in intensive thermo- and haloclines. These dominate in summer and are broken down through turbulence in winter.

A cool ridge of upwelled water (evident in a shallow thermocline) extends in a north-east/south-west line over the mid-shelf regions inshore of the Agulhas Current (Swart and Largier, 1987; Boyd & Shillington, 1994; Schumann, 1998). This ridge divides the waters of the Agulhas Bank into the two-layered structure in the inshore region and a partially mixed structure in the eastern offshore region (Schumann, 1998).

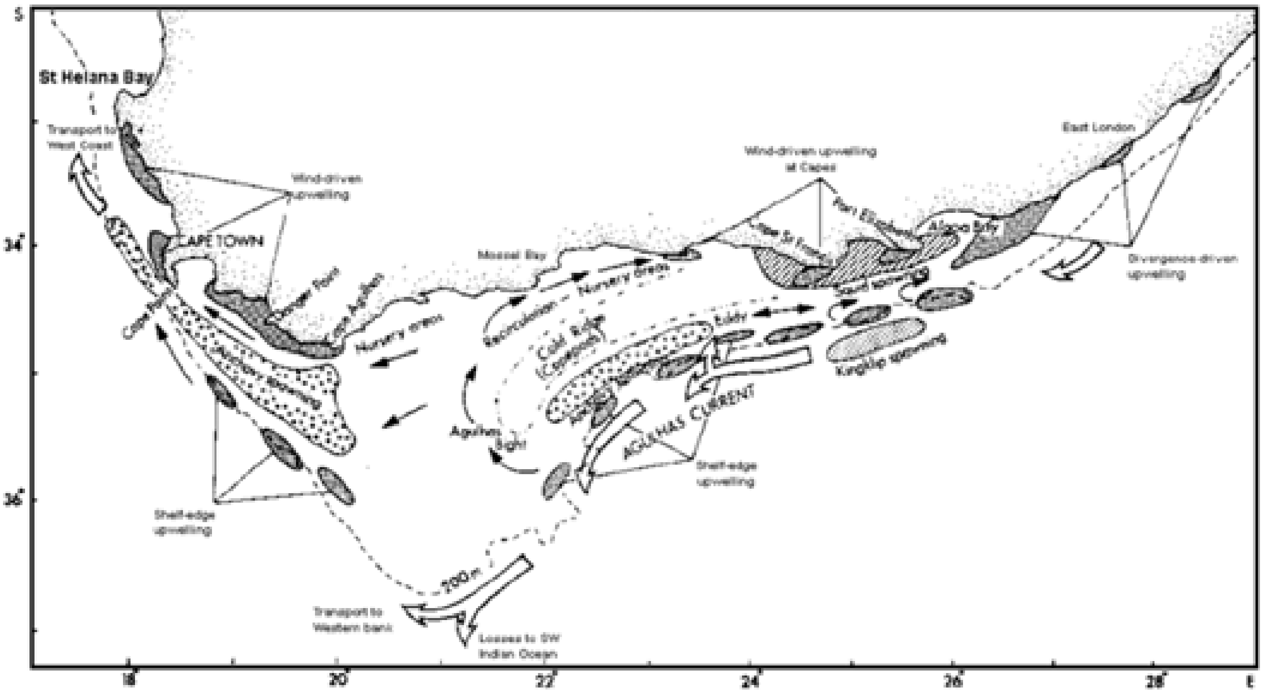

**Figure 4.4: Areas of upwelling off the South and East coasts. Redrawn from Dingle *et al.* (1987).**

### 4.3.6 TURBIDITY

Natural turbidity and/or suspended sediment concentration measurements from the South Coast are sparse. Suspended sediment distributions within South African nearshore waters range between 5 mg/l to 5 g/l (Zoutendyk, 1985). The higher values are associated with high wave conditions resulting from storms and/or flood-waters as substantial sediment loads are also deposited into the East Coast marine environment by summer river run-off (Flemming and Hay, 1988).

### 4.3.7 NUTRIENT DISTRIBUTION

Nitrate-nitrogen concentrations in Agulhas Current source water range from 7 to 10 μM/l, while those of sub-thermocline water may be up to 20 μM/l (Carter *et al.,* 1987). Primary production is nitrogen-limited in the upper layers of the euphotic zone, but light-limited in the sub-surface chlorophyll maximum layer (Probyn and Lucas, 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 (CSIR and CCA, 1998).

## 4.4 BIOLOGICAL OCEANOGRAPHY

### 4.4.1 INTRODUCTION

South Africa is divided into nine bioregions, four of which occur in the proposed survey area (namely Atlantic Offshore, South-western Cape, Agulhas and Indo-Pacific Offshore) (see Figure 4.5) (Lombard *et al*. 2004).

The South African National Biodiversity Institute (SANBI) has initiated a process to identify potential benthic priority areas for spatial management in the offshore environment that require protection (Sink, et. al., 2012). The proposed survey area includes areas that are considered to be Vulnerable and Critically Endangered (see Figure 4.6). The Southwest Indian Seamounts and Browns Bank which are located within the proposed survey area, have been identified as priority areas for seabed protection (see Figure 4.7).

Communities within the offshore marine habitat are comparatively homogenous, largely as a result of the greater consistency in water temperature at depths around the South African coastline, than in the shallower coastal waters. The biological communities occurring in the proposed survey area consist of many hundreds of species, often displaying considerable temporal and spatial variability (even at small scales). The deep-water marine ecosystems comprise a limited range of habitats, namely unconsolidated seabed sediments, deep-water reefs and the water column. The biological communities 'typical' of these habitats are described briefly below, focussing both on dominant, commercially important and conspicuous species, as well as potentially threatened species.

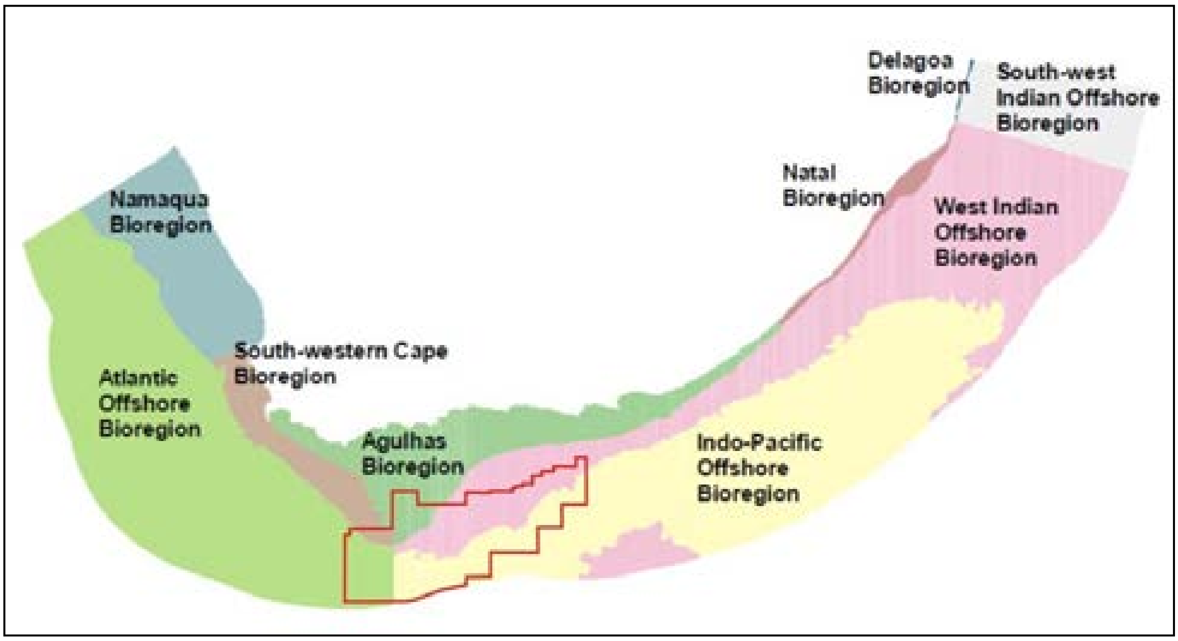


**Figure 4.5: The inshore and offshore bioregions occurring in the proposed survey area (red outline) (adapted from Lombard *et al*., 2004).**

### 4.4.2 OFFSHORE REGION

#### 4.4.2.1 Plankton

*(a) Phytoplankton*

The nutrient-poor characteristics of the Agulhas Current water are reflected in comparatively low primary productivity in the southern portion of the proposed survey area with mean *chlorophyll a* concentrations of 1.46 mg/m$^3$ in the top 30 m of the water column in inshore areas (<200 m depth) dropping to 1.00 mg/m$^3$ further offshore (200 m to 500 m depth) (Brown *et al*., 1991; Brown, 1992). *Chlorophyll a* concentrations vary seasonally, being minimal in winter and summer (<1 to 2 mg/m$^3$) and maximal (2 to 4 mg/m$^3$) in spring and autumn (Brown, 1992). 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, phytoplankton concentrations are usually higher than further west and the phytoplankton comprises predominantly large cells (Hutchings, 1994).

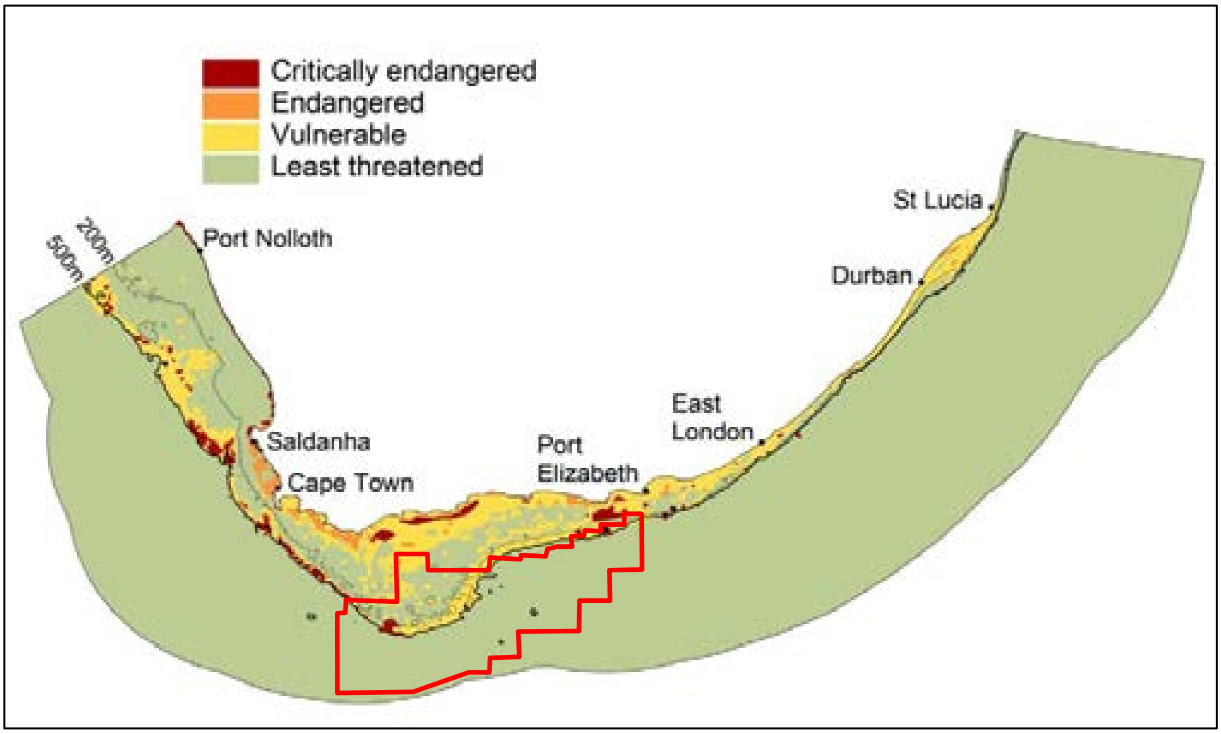


**Figure 4.6: Ecosystem status map (from Sink, *et al.*, 2012).**

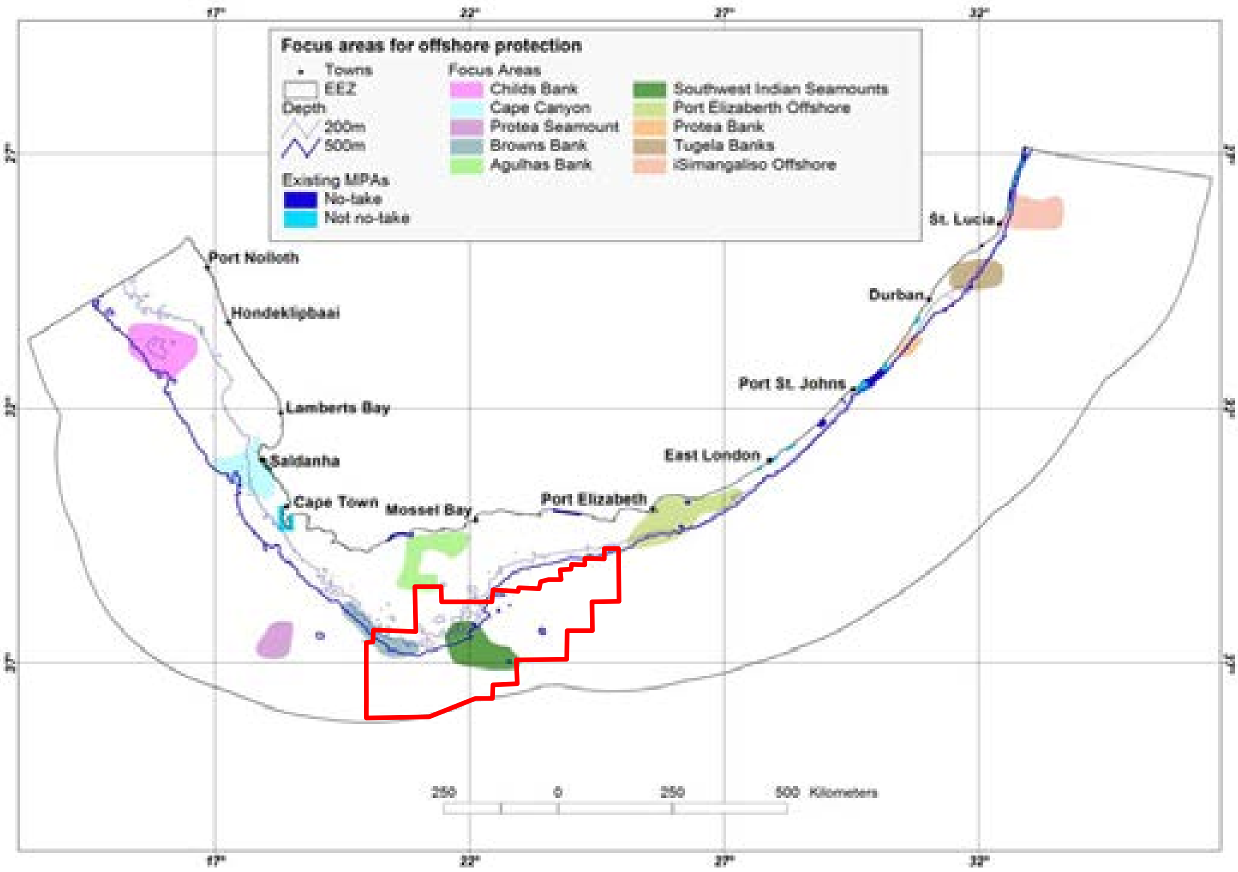


**Figure 4.7: Potential priority areas for seabed protection off the coast of South Africa (from Sink, *et al.*, 2012).**

*(b) Zooplankton*

On the South Coast zooplankton communities have comparatively high species diversity (De Decker, 1984), with standing stocks along the eastern half of the South Coast ranging from 3 – 6 gC/m$^2$. The South Coast mesozooplankton (>200 µm) 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). Biomass of mesozooplankton increases from west (~0.5 to ~1.0 gC/m$^2$) to east (~1.0 to ~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. Macrozooplankton (>1600 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).

*(c) Ichthyoplankton*

The Agulhas Bank (particularly the western portion) is an important spawning area for a variety of pelagic species, including anchovy, pilchard and horse mackerel. East of Cape Agulhas anchovy spawning has been reported between the shelf-edge upwelling and the cold-water ridge, where copepod availability is highest (Hutchings, 1994) (Figure 4.8). 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). Pilchards also spawn on the Agulhas Bank (Crawford, 1980), with adults moving eastwards and northwards after spawning. Round herring are also reported to spawn along the South Coast (Roel & Armstrong, 1991). Demersal species that spawn along the South Coast include the cape hake and kingklip, the latter spawning off the shelf edge to the south of St Francis and Algoa Bays (Shelton, 1986; Hutchings, 1994) (Figure 4.8). Squid (*Loligo* spp.) larvae are widely distributed in inshore waters (<50 m) (Augustyn *et al*., 1994). Eggs and larvae of important linefish species (e.g. elf, leervis and geelbek) are also present inshore along the South Coast, with a significant proportion of the eggs and larvae originating from spawning grounds located along the East Coast (Beckley & van Ballegooyen, 1992). The inshore waters of the Agulhas Bank, especially between the cool water ridge and the shore, acts as a nursery area for numerous fish species (Wallace *et al*., 1984; Smale *et al*., 1994).

Pilchard (*Sardinops sagax*) eggs occur in inshore waters along the Eastern Cape and the southern KwaZulu-Natal coast after the “sardine run” between June and August (Anders, 1975; Connell, 1996). Anchovy (*Engraulis japonicus*) eggs were reported in the water column during December as far north as St Lucia (Anders, 1975). Numerous linefish species (e.g. elf *Pomatomus saltatrix*, leervis *Lichia amia*, geelbek *Atractoscion aequidens*) undertake spawning migrations along the coast into KwaZulu-Natal waters (Van der Elst, 1976, 1981; Griffiths, 1987; Garret, 1988). The eggs and larvae of these species are subsequently dispersed southwards by the Agulhas Current, with juveniles occurring on the inshore Agulhas (Van der Elst, 1976, 1981; Garret, 1988).

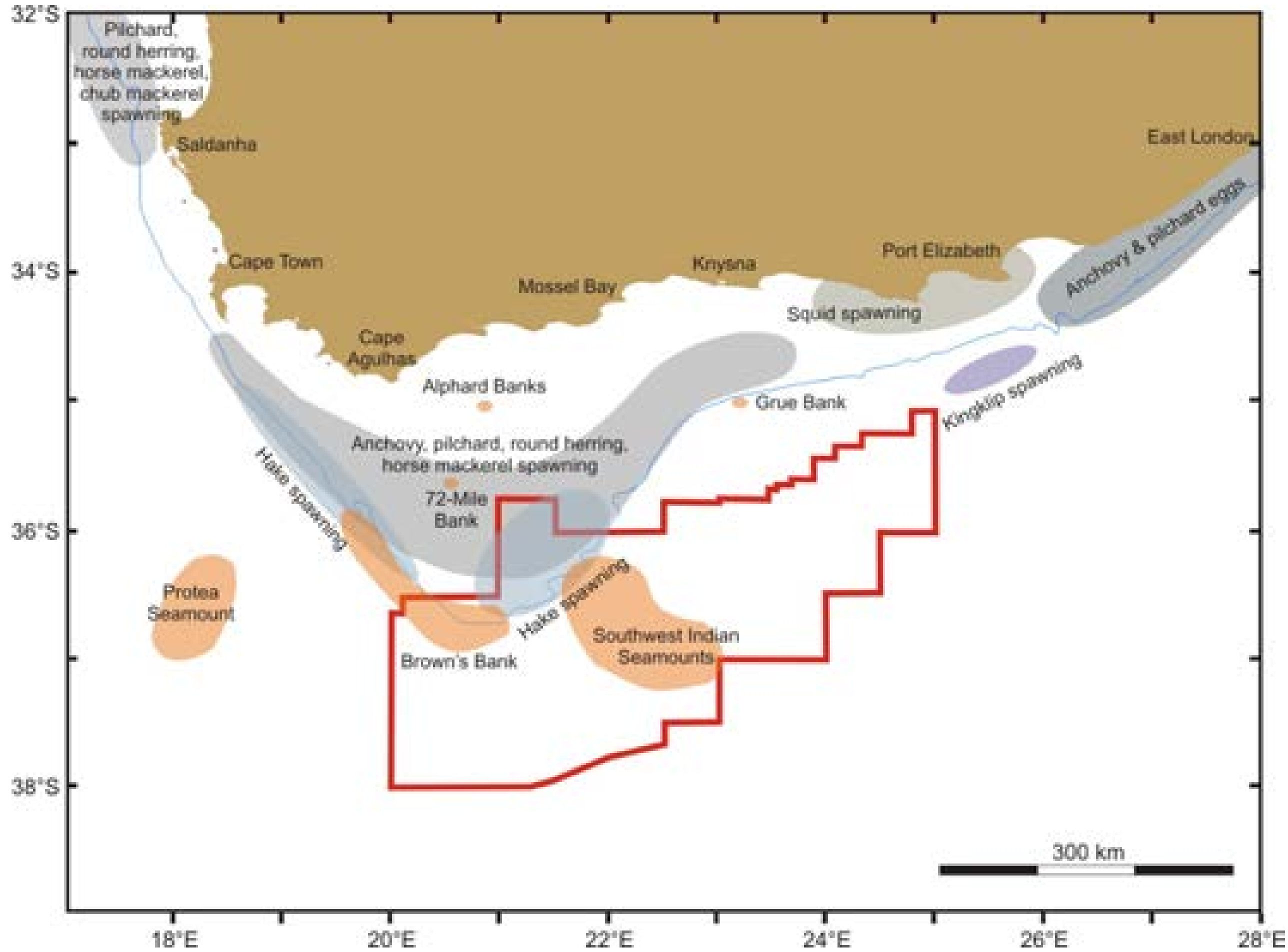


**Figure 4.8:** **Important fishing banks, pelagic and demersal fish and squid spawning areas in relation to the proposed survey area (red outline) (after Anders, 1975, Crawford *et al*., 1987, Hutchings, 1994).**

#### 4.4.2.2 Invertebrates

Information on offshore invertebrates occurring along the South Coast is sparse. However, two commercially important species that are found in the south coast are described below.

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 to 130 m. These spawning aggregations are a seasonal occurrence reaching a peak in November and December.

The deep-water rock lobster (*Palinurus gilchristi*) occurs on rocky substrate in depths of 90 to 170 m between Cape Agulhas and southern KwaZulu-Natal. Larvae drift southwards in the Agulhas Current, settling in the south 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 to 200 m depth range south of Cape Agulhas on the Agulhas Bank, and off Cape St Francis, Cape Recife and Bird Island.

Other deep-water crustaceans that may occur in the proposed survey 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. Other rock lobster species occurring on the South Coast include the West Coast rock lobster (*Jasus lalandii*) and the East Coast rock lobster (*Palinurus homarus*), all of 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).

The benthic biota of offshore soft bottom 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 soft-bottom communities is primarily a function of abiotic factors such as water depth and sediment grain size, but others such as current velocity and organic content abundance also play a role (Snelgrove & Butman, 1994; Flach & Thomsen, 1998; Ellingsen, 2002). Further shaping is derived from biotic factors such as predation, food availability, larval recruitment and reproductive success. The high spatial and temporal variability for these factors results in seabed communities being both patchy and variable. In nearshore waters 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 where near-bottom conditions are more stable, the macrofaunal communities will primarily be determined by sediment characteristics and depth.

There is insufficient information available on benthic invertebrates in the proposed survey area to allow for a description of the zoogeographic distribution of benthic macrofaunal communities (McClurg, 1998). However, from studies conducted off the West Coast (Christie & Moldan, 1977; Moldan, 1978; Jackson & McGibbon, 1991; Environmental Evaluation Unit, 1996; Parkins & Field, 1997; 1998; Pulfrich & Penney, 1999; Goosen *et al*., 2000; Savage *et al*., 2001; Steffani & Pulfrich, 2004a, 2004b; 2007; Steffani, 2007a; 2007b; Atkinson, 2009) and off Richards Bay in northern KwaZulu-Natal (Connell *et al*., 1985, 1989; McClurg *et al*., 1999, 2000, 2001, 2002, 2003, 2004; McClurg & Blair, 2005, 2006, 2007, 2008; CSIR, 2007, 2009) it can be deduced that in general species diversity, abundance and biomass is relatively low on inshore substrates, but increasing from the shore to approximately 80 m depth. Communities are characterised equally by polychaetes, crustaceans (of which amphipods, copepods and ostracods are the dominant types), echinoderms and molluscs. Further offshore to 120 m depth, the midshelf is a particularly rich benthic habitat where biomass can attain 60 g/m$^2$ dry weight (Christie, 1974; Steffani, 2007b). The comparatively high benthic biomass in this midshelf region represents an important food source to carnivores such as the mantis shrimp, cephalopods and demersal fish species. Outside of this rich zone biomass declines to 4.9 g/m$^2$ at 200 m depth and then is consistently low (<3 g/m$^2$) on the outer shelf (Christie, 1974). The meiobenthos includes the smaller species such as nematode worms, flat worms, harpacticoid copepods, ostracods and gastrotriches. Some of the meiofauna are adept at burrowing while others live in the interstitial spaces between the sand grains.

The benthic fauna of the continental slope beyond approximately 450 m depth are poorly known. With little seafloor topography and hard substrate, such areas are likely to offer minimal habitat diversity or niches for animals to occupy. Detritus-feeding crustaceans, holothurians and echinoderms tend to be the dominant epi-benthic organisms of such habitats. Also associated with soft-bottom substrates are demersal communities that comprise bottom-dwelling invertebrate species, many of which are dependent on the invertebrate benthic macrofauna as a food source. Atkinson (2009) reported numerous species of urchins and burrowing anemones beyond 300 m depth off the West Coast.

In recent years there has also been increasing interest in deep-water corals and sponges because of their likely sensitivity to disturbance and their long generation times. These benthic filter-feeders generally occur at depths exceeding 150 m. Some coral species form reefs while others are smaller and remain solitary. 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 Agulhas Bank hosts a diversity of deep-water corals and sponges (Plate 4.1a & b), that have establish 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. Substantial shelf areas should thus potentially be capable of supporting rich, deep-water benthic, filter-feeding communities.

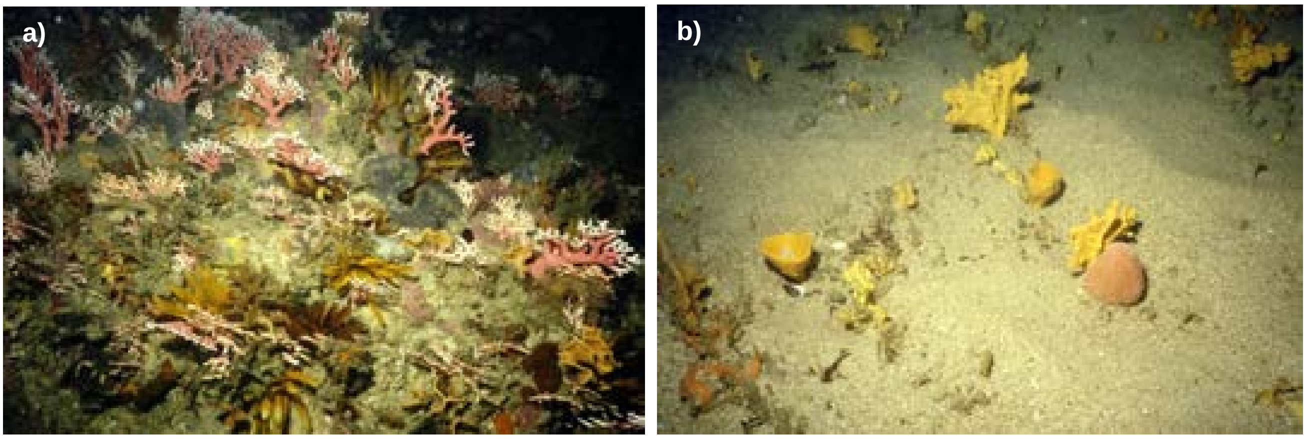


**Plate 4.1: Offshore benthic communities occurring on reefs on the central Agulhas Bank include protected cold water porcelain coral *Allopora nobilis*, sponges, crinoids and bryozoans (a), whereas a variety of habitat-forming sponges, colonial ascidians and hydroids occur on sandy seabed (b). (Photos: Andrew Penney).**

#### 4.4.2.3 Seamount communities

Geological features of note in the proposed survey area include various banks, knolls and seamounts (referred to collectively here as "seamounts").

These seabed features protrude into the water column, and are subject to, and interact with, the water currents surrounding them. The effects of such seabed features on the surrounding water masses can include the upwelling of relatively cool, nutrient-rich water into nutrient-poor surface water thereby resulting in higher productivity (Clark *et al.,* 1999), which can in turn strongly influences the distribution of organisms on and around seamounts. Evidence of enrichment of bottom-associated communities and high abundances of demersal fishes has been regularly reported over such seabed features.

The enhanced fluxes of detritus and plankton that develop in response to the complex current regimes lead to the development of detritivore-based food-webs, which in turn lead to the presence of seamount scavengers and predators. Deep- and cold-water corals (including stony corals, black corals and soft corals) are a prominent component of the suspension-feeding fauna of many seamounts, accompanied by barnacles, bryozoans, polychaetes, molluscs, sponges, sea squirts, basket stars, brittle stars and crinoids (Rogers, 2004). There is also associated mobile benthic fauna that includes echinoderms (sea urchins and sea cucumbers) and crustaceans (crabs and lobsters) (Rogers, 1994).

The coral frameworks offer refugia for a great variety of invertebrates and fish within, or in association with, the living and dead coral framework thereby creating spatially fragmented areas of high biological diversity (biological hotspots). Such complex benthic ecosystems in turn enhance foraging opportunities for many other predators, serving as mid-ocean focal points for a variety of pelagic species with large ranges (turtles, tunas and billfish, pelagic sharks, cetaceans and pelagic seabirds) that may migrate large distances in search of food or may only congregate on seamounts at certain times (Hui, 1985; Haney *et al.,* 1995). Seamounts thus serve as feeding grounds, spawning and nursery grounds and possibly navigational markers for a large number of species (SPRFMA, 2007). Consequently, seamounts are usually highly unique and are usually, but not always, identified as Vulnerable Marine Ecosystems (VMEs). South Africa's seamounts and their associated benthic communities have not been sampled by either geologists or biologists (Sink & Samaai, 2009).

#### 4.4.2.4 Fishes

The South Coast ichthyofauna is diverse, comprising a mixture of temperate and tropical species. As a transition zone between the Agulhas and Benguela current systems, the South Coast ichthyofauna includes many species occurring also along the West and/or East coasts. The seabed of the Agulhas Bank substrate is also diverse comprising areas of sand, mud and coral thereby contributing to increased benthic fauna and fish species.

Marine fish can generally be divided in three different groups, pelagic (those species associated with water column), demersal (those associated with the substratum) or meso-pelagic (fish found generally in deeper water and may be associated with both the seafloor and the pelagic environment). Pelagic species include two major groups, the planktivorous clupeid-like fishes such as anchovy or pilchard and piscivorous predatory fish. Demersal fish can be grouped according to the substratum with which they are associated, for example rocky reef or soft substrata. It must be noted that such divisions are generally simplistic, as certain species associate with more than one community.

*(a) Pelagic species*

Small pelagic shoaling species occurring along the South Coast include anchovy (*Engraulis encrasicolus*), pilchard (*Sardinops sagax*), round herring (*Etrumeus japonicas*), chub mackerel (*Scomber japonicas*) and horse mackerel (*Trachurus trachurus capensis*). Anchovies are usually located between the cool upwelling ridge and the Agulhas Current (Hutchings, 1994) and are larger than those of the West Coast. Having spawned spawn 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. The Agulhas Bank area is, however, is not considered an important anchovy recruitment ground (Hampton, 1992). 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. Spawning occurs on the Agulhas Bank during spring and summer (Crawford, 1980), with recruits being found inshore along the South Coast (Hutchings, 1994). It is thought that the Agulhas Bank may be a refuge for pilchard under low population levels and, therefore, vital for the persistence of the species (CCA & CSIR, 1998). During the winter months of June to August, the penetration of northerly-flowing cooler water along the Eastern Cape coast and up to southern KwaZulu-Natal effectively expands the suitable habitat available for this species, resulting in the movement of large shoals northwards along the coast in what has traditionally been known as the 'sardine run'. The shoals can attain lengths of 20 to 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). Catch rates of several important species in the recreational shoreline fishery of KwaZulu-Natal have been shown to be associated with the timing of the sardine run (Fennessey *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*), which are all regular spawners within KwaZulu-Natal waters (Van der Elst, 1988).

Large migratory pelagic species that occur in offshore waters and beyond the shelf break include dorado (*Coryphaena hippurus*), sailfish (*Istiophorus platypterus*) and black, blue and striped marlin (*Makaira indica, M. nigricans, Tetrapturus audax*), frigate tuna (*Auxis thazard*), skipjack (*Katsuwonus pelamis*), longfin tuna/albacore (*Thunnus alalunga*), bigeye tuna (*Thunnus obesus*), yellowfin tuna (*Thunnus albacares*), Southern Bluefin tuna and Bluefin tuna (*Thunnus maccoyii* and *T. thynnus thynnus*, respectively) (Van der Elst, 1988; Smale *et al*., 1994).

*(b) Demersal species*

There is a high diversity of Teleosts (bony fish) and Chondrichthyans (cartilaginous fish) associated with the inshore and shelf waters of the South and East coasts, many of which are endemic to the Southern African coastline and form an important component of the demersal trawl and long-line fisheries.

The Cape hake (*Merluccius capensis*) is distributed widely on the Agulhas Bank, while the deep-water hake (*Merluccius paradoxus*) is found further offshore in deeper water (Boyd *et al*., 1992; Hutchings, 1994). 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 whole of the South Coast, especially on rocky substrate (Japp *et al*., 1994). They are reported to spawn in an isolated area beyond the 200 m isobaths between Cape St Francis and Port Elizabeth during spring (see Figure 4.8). Juveniles occur further inshore. 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*).

The shallower inshore areas (<100 m) along the South and East coasts comprise a varied habitat of rocky reefs and soft-bottom substrates, which support a high diversity of endemic sparid and other teleost species (Smale *et al*., 1994), some of which move into inshore protected bays to spawn (Buxton, 1990) or undertake spawning migrations up the coast to KwaZulu-Natal. Those species that undertake migrations along the South Coast 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 form an important component of the commercial and recreational linefishery (see Table 4.2). Furthermore, there are numerous pelagic species that frequent nearshore waters and are targeted by line-fishermen (see Table 4.2).

A wide variety of chondrichthyans occur in nearshore waters of the South Coast (Table 4.3), 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.

**Table 4.2: Some of the more important demersal and pelagic linefish species landed by commercial and recreational boat fishers and shore anglers along the South Coast (adapted from CCA & CMS 2001).**

| Common name | Scientific name | Common name | Scientific name |
|---|---|---|---|
| **Demersal teleosts** | | | |
| Bank steenbras | Chirodactylus grandis | Red roman | *Chrysoblephus laticeps* |
| Belman | *Umbrina canariensis* | Red steenbras | *Petrus rupestris* |
| Blacktail | *Diplodus sargus* | Red stumpnose | *Chrysoblephus gibbiceps* |
| Blue hottentot | *Pachymetopon aeneum* | Rockcod | *Epinephalus* spp. |
| Bronze bream | *Pachymetopon grande* | Sand steenbras | *Lithognathus mormyrus* |
| Cape bank steenbras | *Chirodactylus grandis* | Santer | *Cheimerius nufar* |
| Cape stumpnose | *Rhabdosargus holubi* | Seventyfour | *Polysteganus undulosus* |
| Carpenter | *Argyrozona argyrozona* | Spotted grunter | *Pomadasys commersonnii* |
| Dageraad | *Chrysoblephus christiceps* | Steentjie | *Spondyliosoma emarginatum* |
| Fransmadam | *Boopsoidea inornata* | Strepie | *Sarpa salpa* |
| Galjoen | *Dichistius capensis* | White steenbras | *Lithognathus lithognathus* |
| Grey chub | *Kyphosus biggibus* | White stumpnose | *Rhabdosargus globiceps* |
| Kob | *Argyrosomus hololepidotus* | Wreckfish | *Polyprion americanus* |
| Musselcracker | *Sparodon durbanensis* | Zebra | *Diplodus cervinus* |
| Poenskop | *Cymatoceps nasutus* | | |
| **Pelagic teleosts** | | | |
| Elf | *Pomatomus saltatrix* | Queenfish | *Scomberoides commersonianus* |
| Garrick/leerfish | *Lichia amia* | Queen mackerel | *Scomberomorus plurilineatus* |
| Geelbek | *Atractoscion aequidens* | Tenpounder | *Elops machnata* |
| Green jobfish | *Aprion virescens* | Wahoo | *Acanthocybium solandri* |
| King mackerel | *Scomberomorus commerson* | Yellowtail | *Seriola lalandi* |
| Kingfish species | *Caranx* spp. | | |

**Table 4.3: Some of the chondrichthyan species occurring along the South Coast (adapted from CCA & CMS 2001).**

| Common name | Scientific name | Common name | Scientific name |
|---|---|---|---|
| Great white shark | *Carcharodon carcharias* | St Joseph shark | *Callorhincus capensis* |
| Ragged-tooth shark | *Odontaspis taurus* | Soupfin shark | *Galeorhinus galeus* |
| Bronze whaler shark | *Carcharhinus brachyurus* | Diamond ray | *Gymnura natalensis* |
| Dusky shark | *Carcharhinus obscures* | Tiger catshark | *Halaelurus natalensis* |
| Blacktip shark | *Carcharhinus limbatus* | Izak | *Halohalaelurus regani* |
| Hammerhead shark | *Sphyrna* spp. | Puffadder shyshark | *Haploblepharus edwardsii* |
| Lesser Sandshark | *Rhinobatus annulatus* | Houndsharks | *Mustelus* spp. |
| Milkshark | *Rhizoprionodon acutus* | Bullray | *Myliobatis aquilla* |
| Gully shark | *Triakis megalopterus* | Yellowspotted catshark | *Scyliorhinus capensis* |
| Skates | Rajiformes | Spiny dogfish | *Squalus* spp. |
| Stingrays | Dasyatidae | Electric ray | *Torpedo fuscomaculata* |

#### 4.4.2.5 Turtles

Three species of turtle occur along the South Coast, namely the leatherback (*Dermochelys coriacea*), and occasionally the loggerhead (*Caretta caretta*) and the green (*Chelonia mydas*) turtle.

- Leatherback turtles (Critically Endangered) 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 (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. Leatherback turtles from the East Coast of South Africa have been satellite tracked swimming around to the west coast of South Africa and remaining in the warmer waters west of the Benguela ecosystem (Lambardi *et al*., 2008).
- Loggerhead turtles (Endangered) tend to keep more inshore, hunting around reefs, bays and rocky estuaries along the East Coast of Africa, 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).
- The green turtle (Endangered) is a non-breeding resident along the East Coast of South Africa and together with loggerhead turtles are expected to occur only as occasional visitors along the South Coast.

Both the leatherback and the loggerhead turtle nest on the beaches of the northern KwaZulu-Natal coastline between October and February, extending into March. The southern extremity of the nesting area is thus located over 1 000 km to the north of the proposed seismic area. Hatchlings are born from late January through to March when the Agulhas Current is warmest. Once hatchlings enter the sea, they move southward in the Agulhas Current and are thought to remain in the southern Indian Ocean gyre for the first five years of their lives, as there is an absence of turtles between 10 to 60 cm from the southern African East Coast. Beach strandings of juvenile loggerhead and leatherback turtles along the South African coast suggest juvenile turtles in the Agulhas Current between Algoa Bay and Mossel Bay (Hughes, 1974).

Since concerted turtle conservation efforts began in KwaZulu-Natal in the early 1960, the average number of nesting leatherback females has risen from only five in 1966 to over 90 in the early 2000s. The number of loggerhead turtles has also risen from less than 100 in the early 1960s to approximately 2 000 currently nesting annually within the Maputaland Marine Reserve (Mann-Lang, 2000; www.southafricablog.co.za/archives/loggerhead-turtle/).

#### 4.4.2.6 Seabirds

South Coast seabirds can be categorized into three categories: ‘breeding resident species’, ‘non-breeding migrant species’ and ‘rare vagrants’ (Shaughnessy, 1977; Harrison, 1978; Liversidge & Le Gras, 1981; Ryan & Rose, 1989). Overall, 60 species are known, or thought likely to occur, along the South Coast. Thirteen species breed within the South Coast region (see Table 4.4), including Cape gannets (Algoa Bay islands), African penguins (Algoa Bay islands), Cape cormorants (a small population at Algoa Bay islands and mainland sites), whitebreasted cormorant, roseate tern (Bird and St Croix Islands), damara tern (inshore between Cape Agulhas and Cape Infanta), swift term (Stag Island) and kelp gulls.

On the Agulhas Bank seabirds at times intensively target shoals of pelagic fish. Small pelagic species such as anchovy and pilchard form important prey items for Agulhas Bank seabirds, particularly the Cape gannet, the African penguin and the various cormorant species. Most of the breeding resident seabird species feed on fish (with the exception of the gulls, which scavenge, and feed on molluscs and crustaceans). 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.

African penguin colonies along the South Coast occur at Dyer Island, Cape Recife and on the Algoa Bay islands (St Croix Island, Jaheel Island, Bird Island, Seal Island, Stag Island and Brenton Rocks). The African penguin forages at sea with most birds being found within 20 km of the coast. The majority of Algoa Bay penguins forage to the south of Cape Recife. 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.

**Table 4.4: Breeding resident seabirds found on the South Coast, and their conservation status (adapted from CSIR and CCA, 1998).**

| Common name | Scientific name | Conservation status |
|---|---|---|
| African penguin | *Spheniscus demersus* | Endangered |
| Great cormorant | *Phalacrocorax carbo* | Least Concern |
| Cape cormorant | *Phalacrocorax capensis* | Near Threatened |
| Bank cormorant | *Phalacrocorax neglectus* | Endangered |
| Crowned cormorant | *Phalacrocorax coronatus* | Least Concern |
| Cape gannet | *Morus capensis* | Vulnerable |
| Kelp gull | *Larus dominicanus* | Least Concern |
| Greyheaded gull | *Larus cirrocephalus* | Least Concern |
| Hartlaub's gull | *Larus hartlaubii* | Least Concern |
| Caspian tern | *Sterna caspia* | Vulnerable |
| Swift tern | *Sterna bergii* | Least Concern |
| Roseate tern | *Sterna dougalii* | Least Concern |
| Damara tern | *Sterna balaenarum* | Near Threatened |

#### 4.4.2.7 Marine mammals

The marine mammal fauna occurring off the South Coast of South Africa include cetaceans (whales and dolphins) and seals.

*(a) Cetaceans*

The cetacean fauna of the South Coast comprises between 35 and 38 species of whales and dolphins known (historic sightings or strandings) or likely (habitat projections based on known species parameters) to occur here (see Table 4.5). The offshore areas have been particularly poorly studied with almost all available information from deeper waters (>200 m) arising from historic whaling records. Information on smaller cetaceans in deeper waters is particularly poor.

The distribution of whales and dolphins on the South Coast can largely be split into those associated with the continental shelf and those that occur in deep, oceanic waters. Species from both environments may, however, be found associated with the shelf (200 - 1 000 m), making this 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 thousands of kilometres. The most common species within the proposed survey area (in terms of likely encounter rate not total population sizes) are likely to be the common bottlenose dolphin, long finned pilot whale, southern right whale and humpback whale.

Cetaceans comprise two basic taxonomic groups: the mysticetes (filter-feeding baleen whales) and the odontocetes (toothed predatory whales and dolphins).

Mysticete cetaceans occurring in the proposed survey area include the southern right, humpback, blue, fin, sei, minke, dwarf minke and two populations of Bryde's whale. Most of these species occur in pelagic waters, with only occasional visits into shelf waters. All of these species show some degree of migration either to, or through, the proposed survey 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 area. As whales follow geographic or oceanographic features, the northward and southward migrations may take place at difference 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.

- The most abundant baleen whales off the coast of South Africa are southern right (listed as Vulnerable) and humpback whales (listed as Endangered).

  Southern right whales migrate to the southern African subcontinent to breed and calve, where they tend to have an extremely coastal distribution mainly in sheltered bays (90% <2 km from shore; Best, 1990, Elwen & Best, 2004). Winter concentrations have been recorded all along the South and East coasts of South Africa as far north as Maputo Bay, with the most significant concentration currently on the South Coast between Cape Town and Port Elizabeth. They typically arrive in coastal waters off the South Coast between June and November each year, although animals may be sighted as early as April and as late as January. While in local waters, southern rights are found in groups of 1 to 10 individuals, with cow-calf pairs predominating in inshore nursery areas. From July to October, animals aggregate and become involved in surface-active groups, which can persist for several hours. Best (2000) estimated that southern right population was increasing at approximately 7% per annum. The most recent abundance estimate for the South African Southern right whale population (2008) puts the population at approximately 4 600 individuals of all age and sex classes, which is thought to be at least 23% of the original population size (Brandão et al., 2011).

  The majority of humpback whales on the South Coast of South Africa are migrating past the southern African continent to their main winter concentration areas off Mozambique, Madagascar, Kenya and Tanzania. Three principal migration routes for humpback whales in the south-west Indian Ocean have been proposed. On the first route up the East Coast, the northern migration reaches the coast in the vicinity of Knysna continuing as far north as central Mozambique. The second route approaches the coast of Madagascar directly from the south, possibly via the Mozambique Ridge. The third, less well established route, is thought to travel up the centre of the Mozambique Channel to Aldabra and the Comore Islands (Findlay *et al*., 1994; Best *et al*., 1998). Humpbacks have a bimodal distribution off the East Coast, most reaching southern African waters around April, continuing through to September/October when the southern migration begins and continues through to December. The calving season for humpback whales extends from July to October, peaking in early August (Best 2007). Cow-calf pairs are typically the last to leave southern African waters on the return southward migration, although considerable variation in the departure time from breeding areas has been recorded (Barendse *et al*., 2010). Off Cape Vidal whale abundances peak around June/July on their northward migration, although some have been observed still moving north as late as October. Southward moving animals on their return migration were first seen in July, peaking in August and continuing to late October (Findlay & Best, 1996a, b).

**Table 4.5: Cetacean occurrence off the South Coast of South Africa, their seasonality and likely encounter frequency with proposed seismic survey operations.**

| Common Name | Species | Shelf | Offshore | Seasonality (note: letters refer to months of the year) | Likely encounter freq. |
|---|---|---|---|---|---|
| ***Delphinids*** | | | | | |
| Common bottlenose dolphin | *Tursiops truncatus* | Yes | Yes | Year round | Monthly |
| Indo-Pacific bottlenose dolphin | *Tursiops aduncus* | Yes | | Year round | Monthly |
| Common (short beaked) dolphin | *Delphinus delphis* | Yes | Yes | Year round | Monthly |
| Common (long beaked) dolphin | *Delphinus capensis* | Yes | | Year round | Monthly |
| Fraser's dolphin | *Lagenodelphis hosei* | | Yes | Year round | Occasional |
| Spotted dolphin | *Stenella attenuata* | Yes | Yes | Year round | Occasional |
| Striped dolphin | *Stenella coeruleoalba* | | Yes | Year round | Occasional |
| Indo-Pacific humpback dolphin | *Sousa chinensis* | Yes | | Year round | Monthly |
| Long-finned pilot whale | *Globicephala melas* | | Yes | Year round | <Weekly |
| Short-finned pilot whale | *Globicephala macrorhynchus* | | Yes | Year round | <Weekly |
| Killer whale | *Orcinus orca* | Occasional | Yes | Year round | Occasional |
| False killer whale | *Pseudorca crassidens* | Occasional | Yes | Year round | Monthly |
| Risso's dolphin | *Grampus griseus* | Yes (edge) | Yes | Year round | Occasional |
| Pygmy killer whale | *Feresa attenuata* | | Yes | Year round | Occasional |
| ***Sperm whales*** | | | | | |
| Pygmy sperm whale | *Kogia breviceps* | | Yes | Year round | Occasional |
| Dwarf sperm whale | *Kogia sima* | | Yes | Year round | Occasional |
| Sperm whale | *Physeter macrocephalus* | | Yes | Year round | Occasional |
| ***Beaked whales*** | | | | | |
| Cuvier's | *Ziphius cavirostris* | | Yes | Year round | Occasional |
| Arnoux's | *Beradius arnouxii* | | Yes | Year round | Occasional |
| Southern bottlenose | *Hyperoodon planifrons* | | Yes | Year round | Occasional |
| Hector's | *Mesoplodon hectori* | | Yes | Year round | Occasional |
| Layard's | *Mesoplodon layardii* | | Yes | Year round | Occasional |
| True's | *Mesoplodon mirus* | | Yes | Year round | Occasional |
| Gray's | *Mesoplodon grayi* | | Yes | Year round | Occasional |
| Blainville's | *Mesoplodon densirostris* | | Yes | Year round | Occasional |
| ***Baleen whales*** | | | | | |
| Minke | *Balaenoptera bonaerensis* | Yes | Yes | >Winter | Monthly |
| Dwarf minke | *B. acutorostrata* | Yes | | Year round | Occasional |

| **Common Name** | **Species** | **Shelf** | **Offshore** | **Seasonality (note: letters refer to months of the year)** | **Likely encounter freq.** |
|---|---|---|---|---|---|
| Fin whale | *B. physalus* | | Yes | MJJ & ON, rarely in summer | Occasional |
| Blue whale | *B. musculus* | | Yes | MJJ | Occasional |
| Sei whale | *B. borealis* | | Yes | MJ & ASO | Occasional |
| Bryde’s (inshore) | *B brydei (subspp)* | | Yes | Year round | Occasional |
| Pygmy right | *Caperea marginata* | Yes | | Year round | Occasional |
| Humpback | *Megaptera novaeangliae* | Yes | Yes | AMJJASOND | Daily |
| Southern right | *Eubalaena australis* | Yes | | JJASON | Daily |

- Two types of Bryde's whales are recorded from South African waters - a smaller neritic form (of which the taxonomic status is uncertain) and a larger pelagic form described as *Balaenoptera brydei*. The migration patterns of Bryde's whales differ from those of all other baleen whales in the region as they are not linked to seasonal feeding patterns. 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 during winter. Sightings over the last two decades suggest that the distribution of this population has shifted eastwards, with sightings on the West Coast very rare compared to pre-1980s whaling records (Best 2001, 2007; Best *et al*., 1984). Although this is a very small population, which is possibly decreasing in size (Penry, 2010), its current distribution implies that it is likely to be encountered in the proposed survey area. The offshore population of Bryde's whale lives off the continental shelf (>200 m depth), and migrates between wintering grounds off equatorial West Africa (Gabon) and summering grounds off the South African West Coast (Best, 2001). Its seasonality within South African waters is thus opposite to the majority of the balaenopterids, with abundance on the West Coast highest in January-February. This population of Bryde's whales is unlikely to be encountered in the proposed survey area.

- Sei whales (listed as Endangered) migrate through South African waters to unknown breeding grounds further north. Their migration pattern 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. Almost all information is based on whaling records (1958-1963). All whales were caught in waters deeper than 200 m, with most deeper than 1 000 m (Best & Lockyer, 2002).

- Fin whales (listed as Vulnerable) 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.

- Although blue whales (listed as Endangered) 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 and 1975 were rare and concentrated in March to May (Branch *et al*., 2007). However, scientific search effort (and thus information) in pelagic waters is very low. The chance of encountering the species in the proposed survey area is considered low.

- Minke whales are present year-round with a large portion of this population consisting of small, sexually immature animals that primarily occur beyond 30 nm from the coast during summer and autumn. Off Durban minke whales are reported to increase in numbers in April and May, remaining at high levels through June to August and peaking in September (Best, 2007).

- Sperm whales are the largest of the toothed whales and have a complex, well-structured social system with adult males behaving differently from younger males and female groups. They live in deep ocean waters, occasionally coming into depths of 200 to 500 m on the shelf (Best, 2007). Seasonality of catches off the East Coast suggest that medium- and large-sized males are more abundant during winter, while female groups are more abundant in summer, although animals occur year round (Best, 2007). Sperm whales feed at great depth, during dives in excess of 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).

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 South and East coasts of South Africa. 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 (Best, 2007). Their presence in the area may fluctuate seasonally, but insufficient data exist to define this clearly.

Of the smaller odontocetes, the common bottlenose dolphin offshore and humpback dolphins are known to be resident on the shelf and offshore and are likely to be frequently encountered in the survey area. Similarly, the long-finned pilot whale, which is usually associated with the shelf edge (S. Elwen pers commn), is likely to be commonly encountered. False killer whales, killer whales and the offshore form of the bottlenose dolphin are also likely to be encountered with some regularity in deeper waters (Findlay *et al*., 1992, Best, 2007).

(b) Seals

The Cape fur seal (Arctocephalus pusillus pusillus) is the only seal species that has breeding colonies along the South Coast, namely at Seal Island in Mossel Bay, on the northern shore of the Robberg Peninsula in Plettenberg Bay and at Black Rocks (Bird Island group) in Algoa Bay (see Figure 4.9).

The timing of the annual breeding cycle is very regular occurring between November and January. 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 is poorly known, however, although limited tracking of Algoa Bay animals has suggested these seals to be feeding 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.

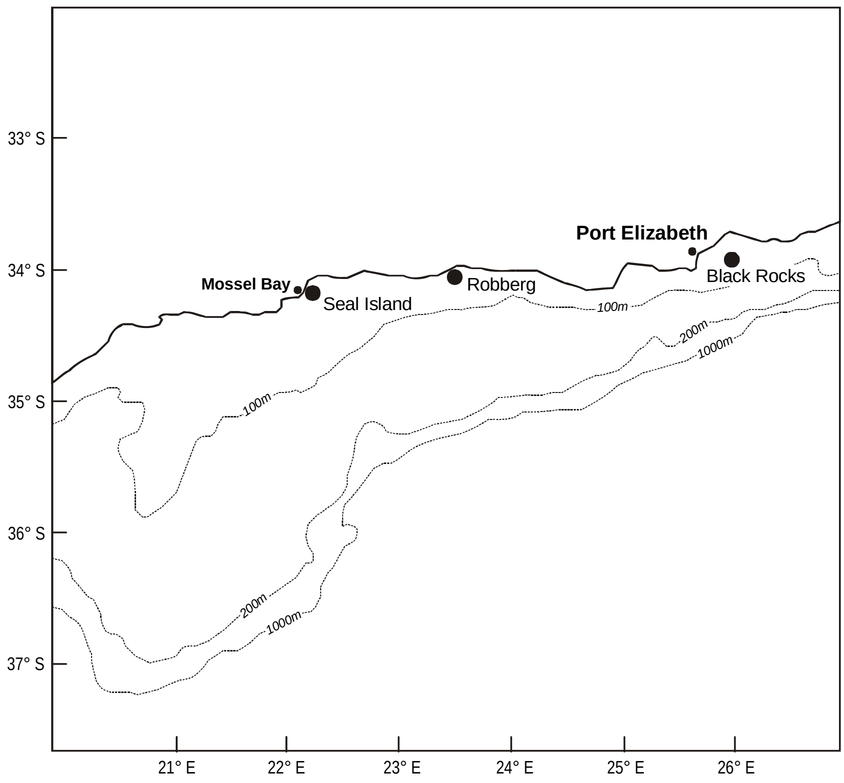


**Figure 4.9: The distribution of seal colonies on the South Coast (after Wickens *et al.* 1992).**

### 4.4.3 NEAR-SHORE REGION

As is typical of the South African near-shore region exposed rocky shores and sandy beaches dominate the South Coast.

The National Biodiversity Spatial Assessment (NBSA) (Lombard and Strauss, 2004) study analysed available data on rocky shores, mixed shores, sandy beaches, pebble beaches and boulder beaches and identified areas of high value / irreplaceability (see Figure 4.10). Two totally irreplaceable habitats have been identified on the South Coast in the vicinity of the proposed survey area.

#### 4.4.3.1 Rocky shores

Some 60% of the South Coast is rocky, 57% of this total comprising exposed rocky headlands, with the remainder comprising wave-cut rocky platforms (Jackson and Lipschitz, 1984). South Coast rocky intertidal fauna is more diverse than that along the West Coast or East Coast due to the presence of species of both tropical and temperate origin.

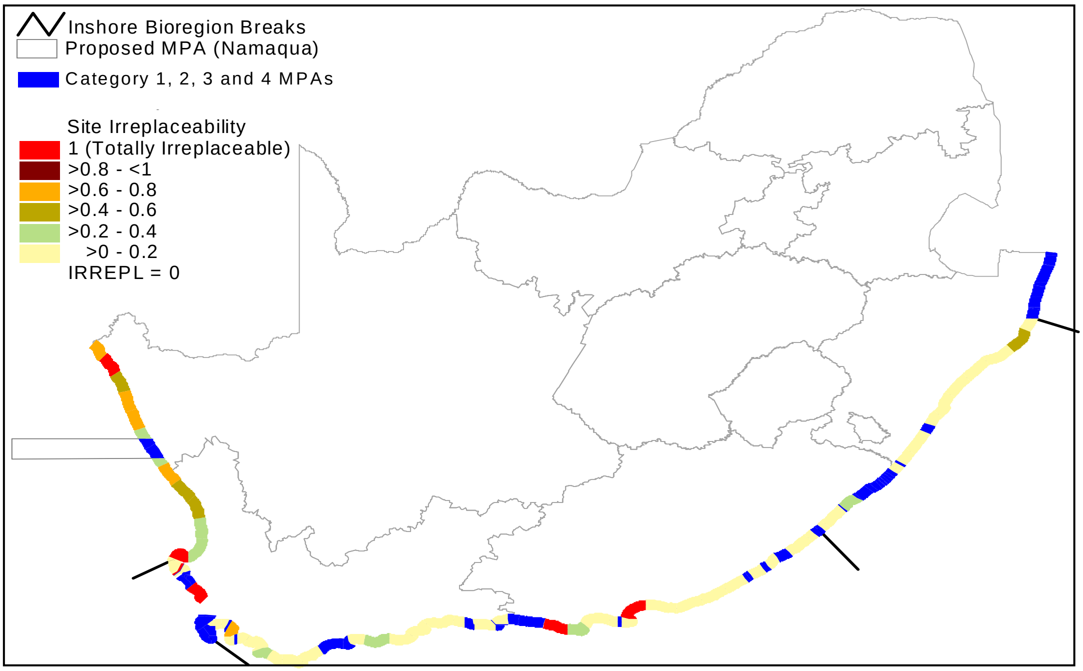


**Figure 4.10: Irreplaceability analyses for intertidal habitats, in 50 km strips around South Africa, per bioregion (Lombard and Strauss, 2004).**

#### 4.4.3.2 Sandy shores

Some 38% of the South Coast comprises sandy beaches (Jackson and Lipschitz, 1984). The sandy beaches of the region are generally high energy and unstable environments and despite having low diversity, biomass may be high. The surf zones off sandy beaches are important nursery areas for a variety of fish species.

#### 4.4.3.3 Shallow subtidal

Shallow subtidal soft sediment communities are relatively simple, containing few species of large organisms, although the most common ones may be very abundant. Communities inhabiting shallow reefs are more diverse.

#### 4.4.3.4 Estuaries

Thirty-six estuarine systems are found along the South Coast, of which 15 are permanently open (Jackson and Lipschitz, 1984). These open systems are important recruitment sites for some inshore linefish species, while certain systems are important roosting and breeding sites for estuarine birds. The Heuningnes estuary, located within the De Mond Nature Reserve, is a Ramsar site (Cowan, 1995).

## 4.5 HUMAN UTILISATION

### 4.5.1 FISHERIES

The South African fishing industry consists of at least 20 commercial sectors operating within the country's 200 nautical mile Exclusive Economic Zone (EEZ). The following fisheries are active in the vicinity of the proposed survey area

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

*(a) 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*) and Agulhas sole (*Austroglossus pectoralis*). These sectors are divided at the 110 m depth contour on the South Coast. The inshore fishery does not occur west of 20°E longitude.

On the South Coast, deep-sea trawlers may not fish shallower than 110 m depth or within 20 nm of the coast. In addition, rocky terrain largely forces trawlers to concentrate on the offshore edge of the Agulhas Bank. Inshore trawl grounds are located between Cape Agulhas and the Great Kei River. In this region hake directed trawling is most intense along the 100 m depth contour, although in the vicinity of Mossel Bay trawling occurs close inshore. Sole directed fishing takes place primarily between Mossel Bay and Struisbaai and there is no sole-directed activity west of 20°E longitude. The Total Allowable Catch of hake for the demersal trawl fishery is currently set at 144 741 tons (2012). The majority of vessels licensed to conduct hake deep-sea trawl are registered at the ports of Cape Town and Saldanha Bay, with 15 of a total of 98 vessels registered at South and East coast harbours.

Trawling grounds extend across the western portion of the proposed survey area (west of 22°E), inshore of the 1 000 m isobaths (see Figure 4.11). Approximately 4 510 km$^2$ of trawling grounds coincide with the proposed survey area which is equivalent to approximately 6.4 % of the total ground available to the fishery. Over the period 2006 to 2010, 7.8 % of the total effort of the demersal trawl fishery was conducted within the proposed survey area at an average of 2 740 trawls per year.

The towed gear typically consists of trawl warps, bridles and trawl doors, a footrope, headrope, net and codend (see Figure 4.12).

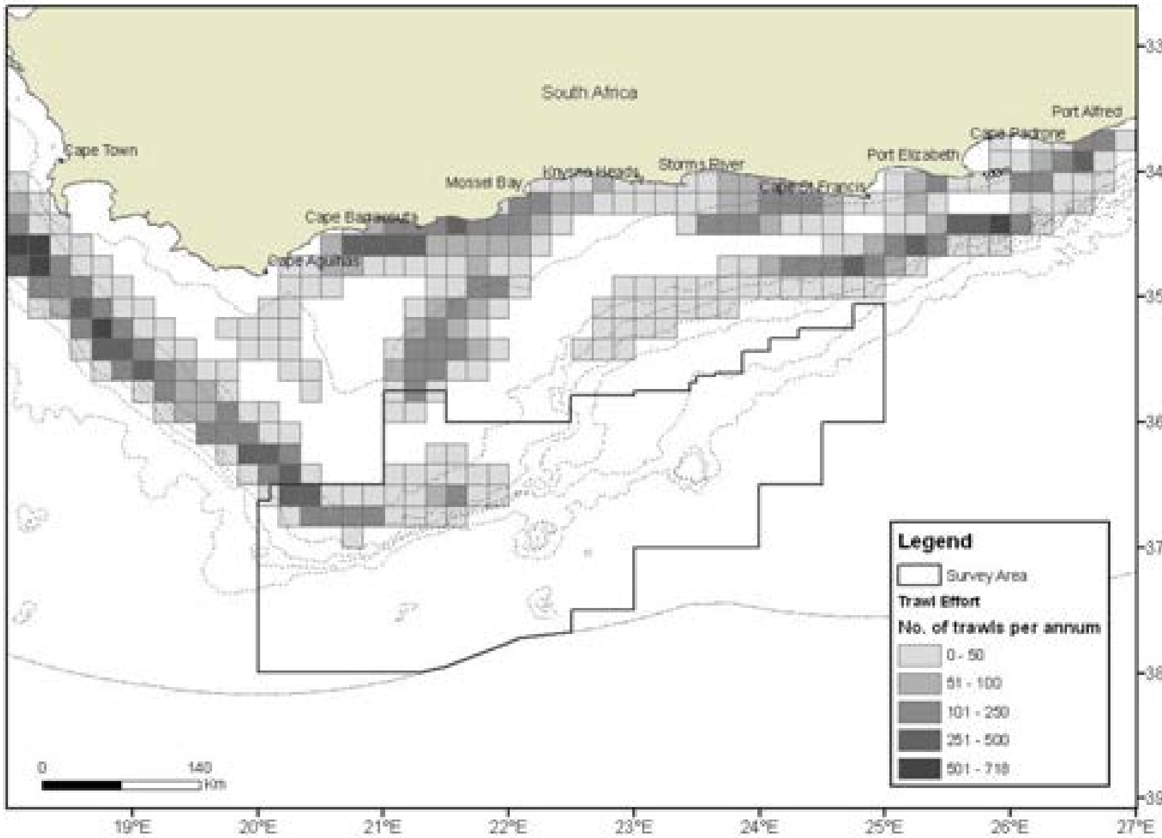


**Figure 4.11: Distribution of fishing activity within the demersal trawl fishery over the period 2006 to 2010 in relation to the proposed survey area.**

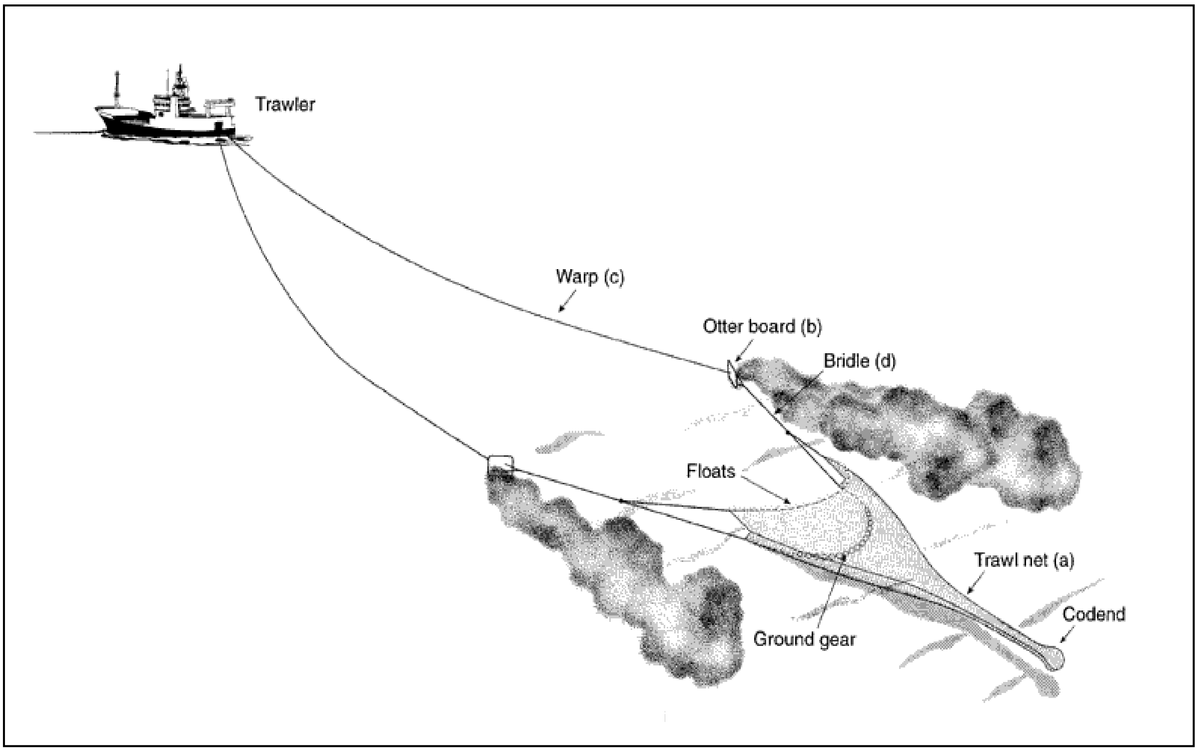


**Figure 4.12: Typical gear configuration used by demersal trawlers (offshore) targeting hake.**

*(b) Small pelagic purse-seine*

The South African small pelagic purse seine fishery is the largest fishery by volume and the second most important in terms of value. The two main targeted species are sardine and anchovy, with associated by-catch of round herring (red-eye) and juvenile horse mackerel. Small pelagic species abundance and distribution fluctuates considerably in accordance with the upwelling ecosystem in which they exist. Annual landings have fluctuated between 300 000 and 600 000 tons over the last decade, with landings of 312 000 tons recorded for 2009.

Fishing grounds occur primarily along the West and South coasts of the Western Cape and the Eastern Cape coast up to a distance of 50 nm offshore, but usually closer inshore. The majority of the fleet of 78 vessels operates from St Helena Bay, Saldanha Bay and Hout Bay with fewer vessels operating on the South Coast from the harbours of Gansbaai, Mossel Bay and Port Elizabeth.

The sardine-directed fishery tends to concentrate effort in a broad area extending from St Helena Bay, southwards past Cape Town towards Cape Point and then eastwards along the coast to Mossel Bay and Port Elizabeth. The anchovy-directed fishery takes place predominantly on the South-West Coast from St Helena Bay to Cape Point and is most active in the period from March to September. Round herring (non-quota species) is targeted when available and specifically in the early part of the year (January to March) and is distributed South of Cape Point to St Helena Bay.

The pelagic purse-seine fishery operates predominantly on the West and South Coast up to a distance of 50 nautical miles offshore, usually inshore of the 100 m isobaths. The fishery thus operates well inshore of the proposed survey area and no impact is expected.

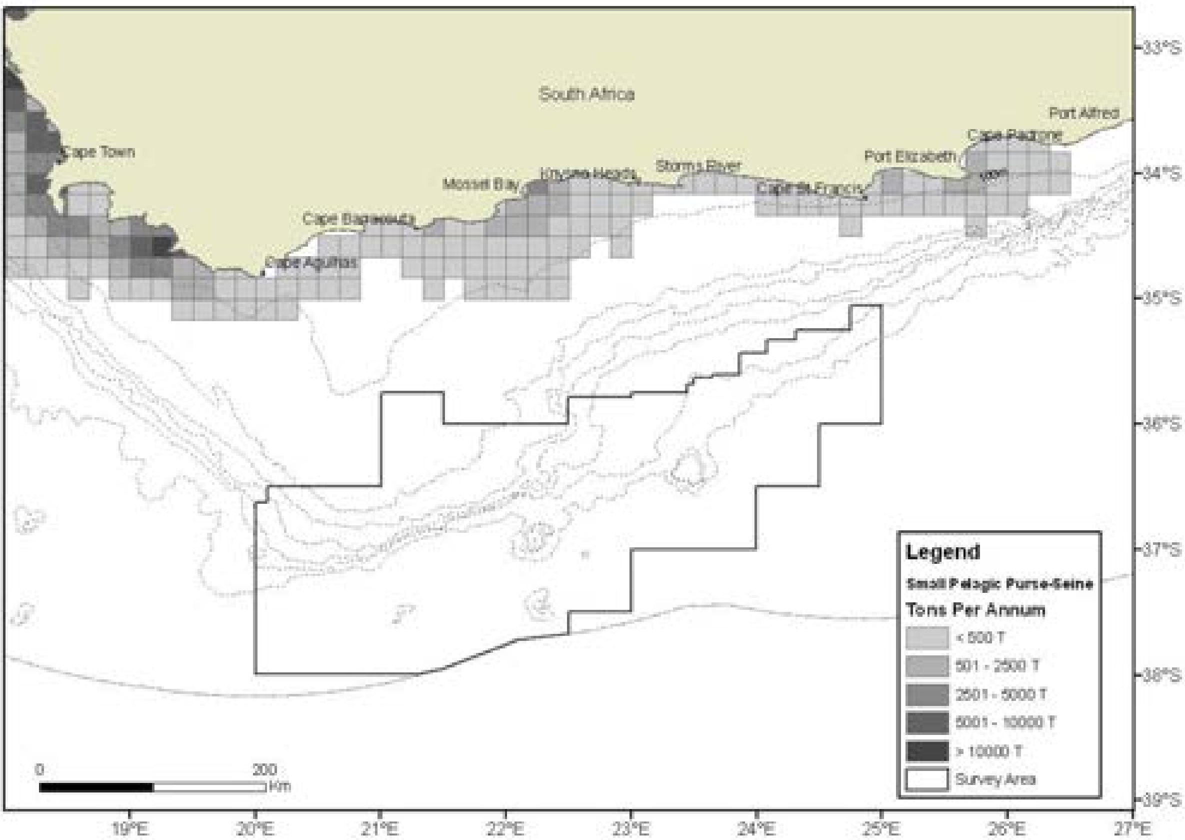


**Figure 4.13: Distribution of fishing activity within the small pelagic purse-seine fishery well inshore of the proposed survey area (1987 – 2009).**

*(c) Demersal long-line*

The demersal long-line fishing technique is used to target bottom-dwelling species of fish (see Figure 4.14). Two fishing sectors utilise this method of capture, namely:

- The hake long-line fishery

  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. A total nominal catch weight of 9 493.8 tons has been set for this fishery in 2012. Fishing takes place along the West and South East coasts in areas similar to those targeted by the demersal trawl fleet. There are currently 64 vessels licensed within the sector, operating from all major harbours, including Cape Town, Hout Bay, Mossel Bay and Port Elizabeth. 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 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.

  Demersal hake long-line vessels operate in well-defined areas extending along the shelf break from Port Nolloth to Port Elizabeth (see Figure 4.15). Fishing activity would be expected to occur within the survey area along and inshore of the 500 m depth contour. Long-line grounds coincide with approximately 2 304 km$^2$ of the proposed survey area, which is estimated to be 3.9 % of the total grounds fished by the demersal long-line fishery. An annual average of 1 million hooks were set and 215 tons of hake (whole, gutted) were caught in the area over the period 2002 to 2008, corresponding to 2.6 % of the overall national effort and 2.8 % of the total landings, respectively.

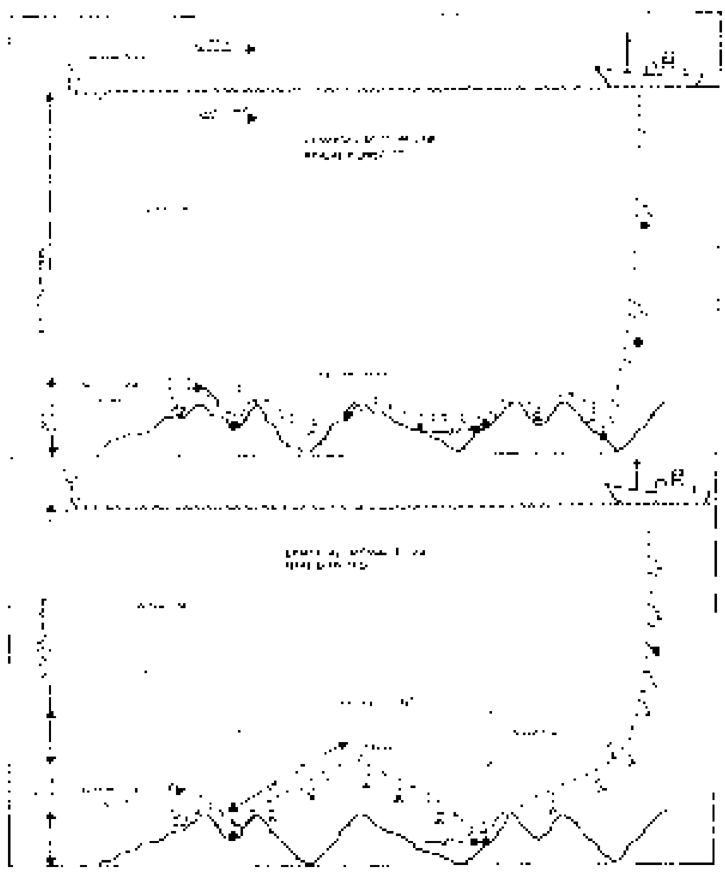

**Figure 4.14: Typical configuration of demersal (bottom-set) hake long-line gear used in South African waters.**

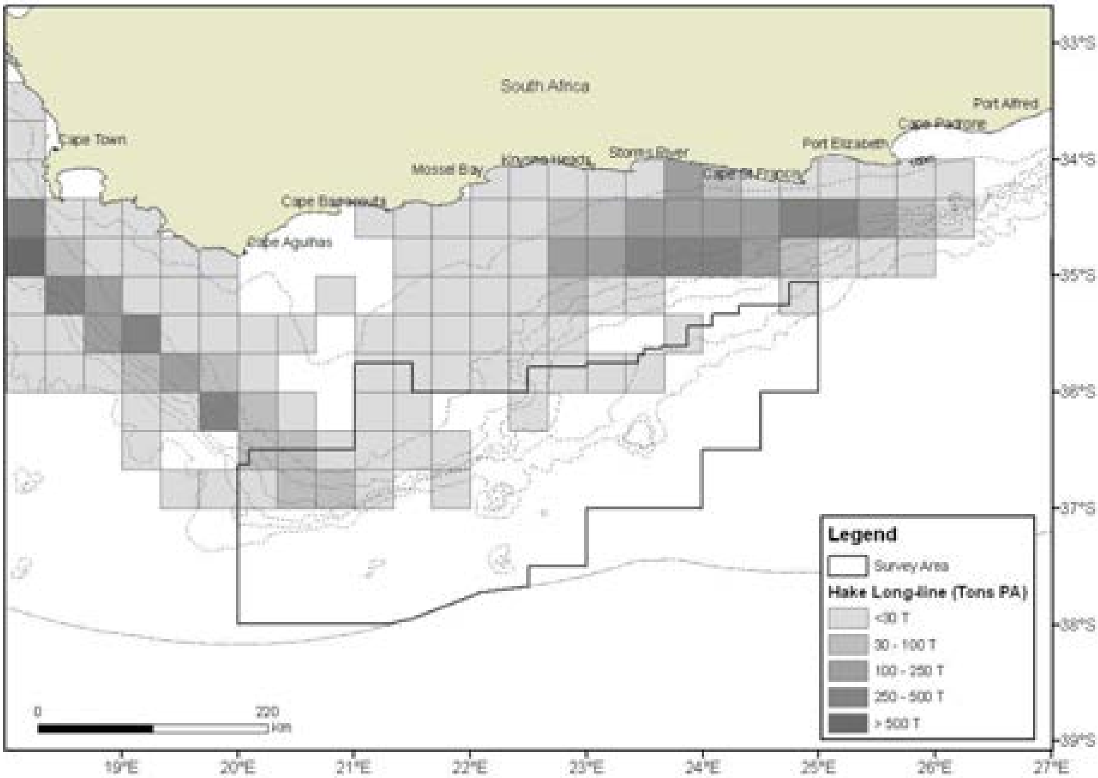


**Figure 4.15: Distribution of fishing effort of the demersal long-line fisheries for hake (2002 – 2008) in the vicinity of the proposed survey area.**

- <u>The shark long-line sector fishery</u>

  The demersal shark fishery targets soupfin shark (*Galeorhinus galeus*), smooth-hound shark (*Mustelus spp*.), spiny dogfish (*Squalus* spp), St Joseph shark (*Callorhinchus capensis*), *Charcharhinus* spp., rays and skates. Other species which are not targeted but may be landed include cape gurnards (*Chelidonichthys capensis*), jacopever (*Sebastichthys capensis*) and smooth hammerhead shark (*Sphyrna zygaena*). Catches are landed at the harbours of Cape Town, Hout Bay, Mossel Bay, Plettenberg Bay, Cape St Francis, Saldanha Bay, St Helena Bay, Gansbaai and Port Elizabeth and currently six permit holders have been issued with long-term rights to operate within the fishery.

  The shark long-line fishery operates inshore of the 100 m isobath. The proposed survey area lies beyond the 200 m isobaths and thus would not coincide with the demersal shark-directed longline fishing grounds

*(d) Pelagic long-line*

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. Twenty-nine foreign and South-African-flagged vessels operate within South African waters. Nominal reported landings of 2 136 tons were recorded within the fishery for 2009 within the South African EEZ and on the high seas.

Although most vessels operate from the Cape Town harbour, the areas of operation are extensive within the entire South African EEZ. Pelagic long-line effort for tuna extends along and offshore of the 500 m isobath, whilst pelagic shark species are targeted primarily along the 200 m isobath. Grounds are extensive within the proposed survey area (see Figures 4.16 and 4.17). Within the South African and foreign-flagged fleet combined, approximately 8.1 % of the total national effort is conducted within the proposed survey area annually (approximately 387 000 hooks) and 19.8 % of the total national catch is taken by this fishery (approximately 289 tons of targeted species).

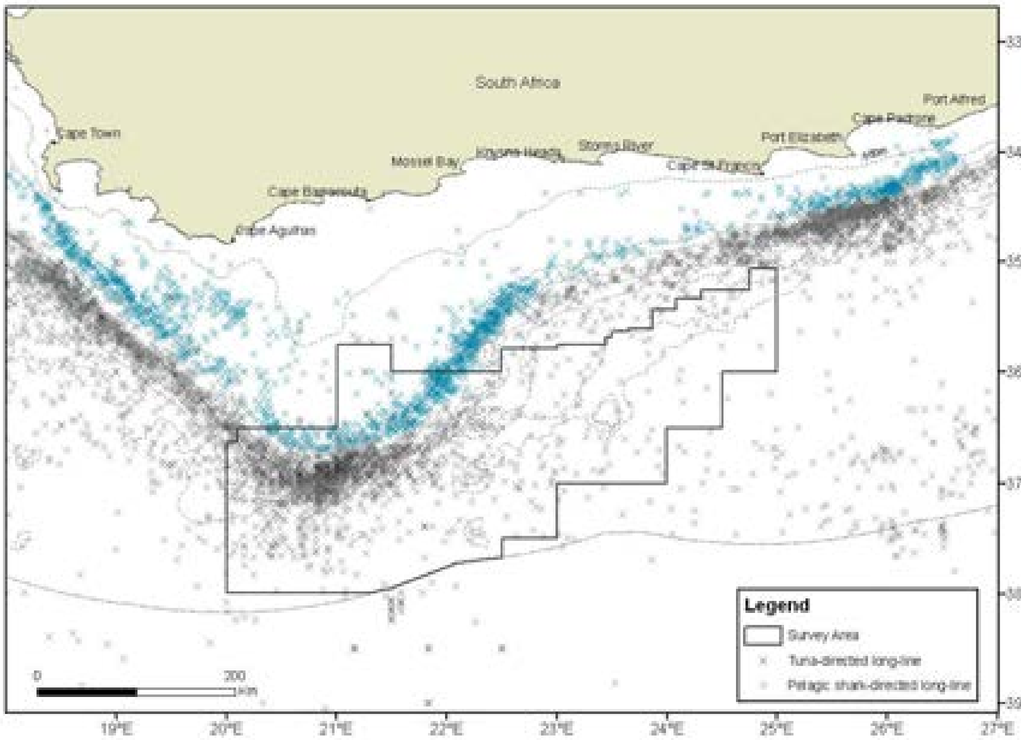


**Figure 4.16: Distribution of fishing positions of the tuna-directed (1998 to 2007) and shark-directed pelagic (2003 to 2008) long-line fisheries in relation to the proposed survey area.**

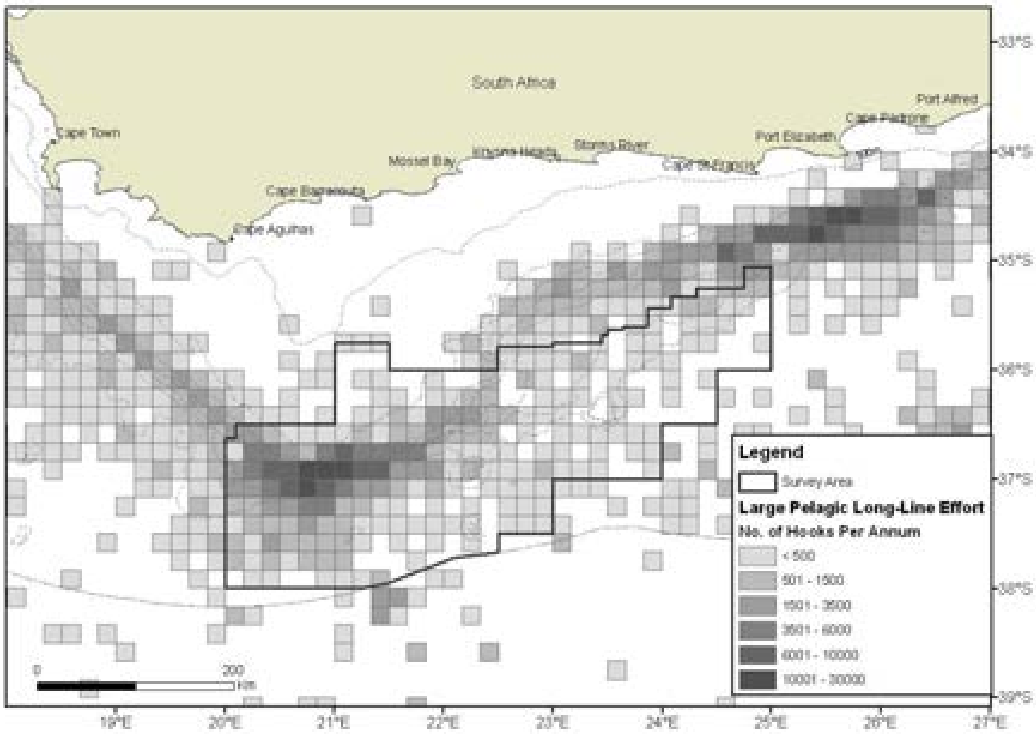


**Figure 4.17: Distribution of long-line fishing effort targeting large pelagic species (tuna, swordfish) in relation to the proposed survey area (1997 to 2007).**

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 4.18). 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 it’s 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. The presence of long-lines would present a potential threat to the survey operation in terms of entanglements with towed seismic gear. Extreme vigilance would be needed to avoid any drifting lines and regular communications with vessels in the area would be essential.

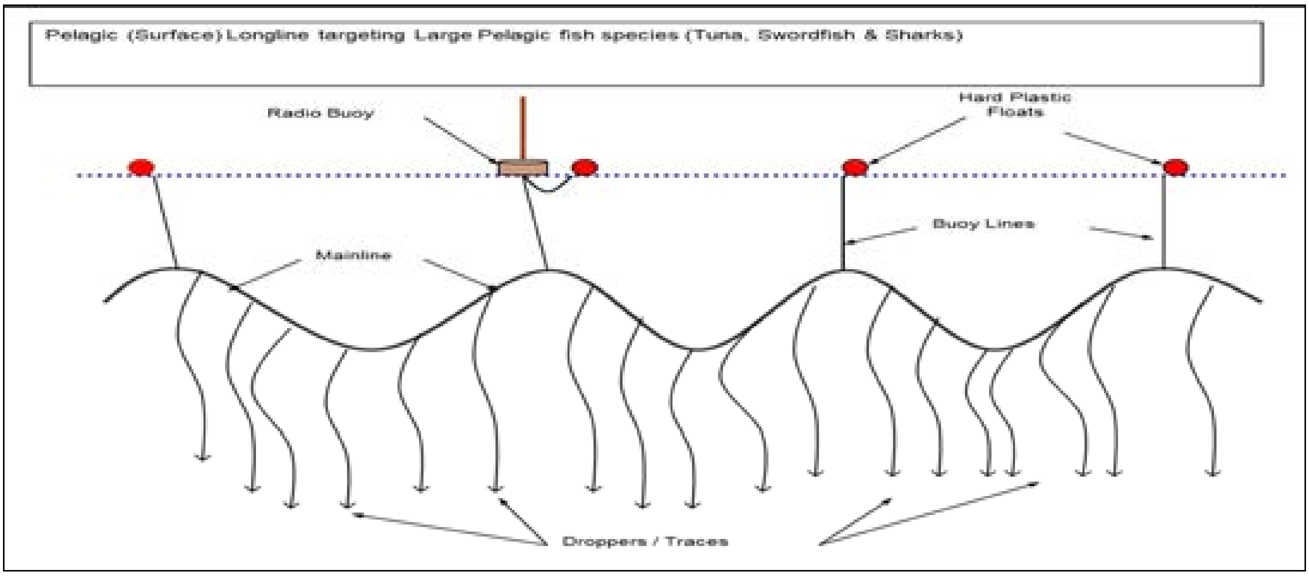


**Figure 4.18: Typical pelagic long-line configuration targeting tuna, swordfish and shark species.**

*(e) Traditional line fish*

This fishery includes commercial, subsistence and recreational sectors. The South African commercial line fishery is the country’s third most important fishery in terms of total tons landed and economic value. The bulk of the fishery catch is made up of approximately 35 species. Different assemblages of species are targeted according to the region in which they are being fished and include tuna species, sparidae, serranidae, caragidae, scombridae and sciaenidae.

The commercial 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. Gear consists of hand line or rod-and-reel. Recreational permit-holders fish via skiboat 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. There are currently about 450 commercial vessels operating extensively around the coast and many more skiboats used in the recreational sector which may be launched from a number of slipways and harbours.

In the vicinity of the proposed survey area, vessels are restricted to water depths of approximately 100 m due to the fast-flowing Agulhas current (see Figure 4.19). As such the fishery does not coincide with the proposed survey area and is not expected to be impacted by seismic operations.

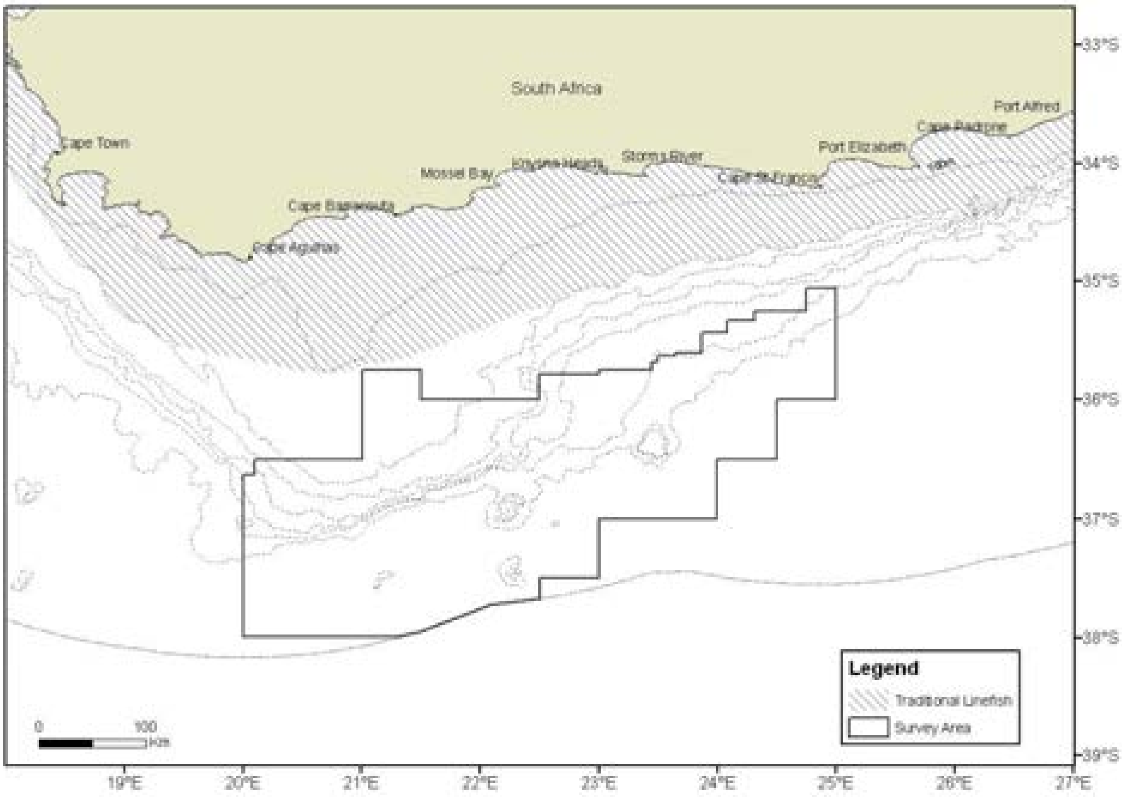


**Figure 4.19: Approximate range of traditional line and hake hand-line fisheries in relation to the proposed survey area.**

*(f) South Coast rock lobster*

The South Coast rock lobster (*Palinurus gilchristi*) occurs on the continental shelf of the South Coast between depths of 50 m and 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 (see Figure 4.20). The fishery is restricted by the Agulhas Current from operating far offshore. The proposed survey area coincides with approximately 278 km$^2$ of South Coast rock lobster fishing grounds on the Agulhas Bank. Within the proposed survey area an average of 93 500 traps were set per annum between 2001 and 2008. This is approximately 3.4 % of the total effort conducted within South African water by the fishery. During this time the catch of rock lobster taken from the area amounted to 13.3 tons (tail) which is 3.6 % of the total catch taken by the fishery.

The South Coast rock lobster fishery is a deep-water long-line trap fishery. 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. The fishery operates year-round with the month of October showing relatively low activity within the fishery. There are currently (2012) seven vessels operating within the fishery.

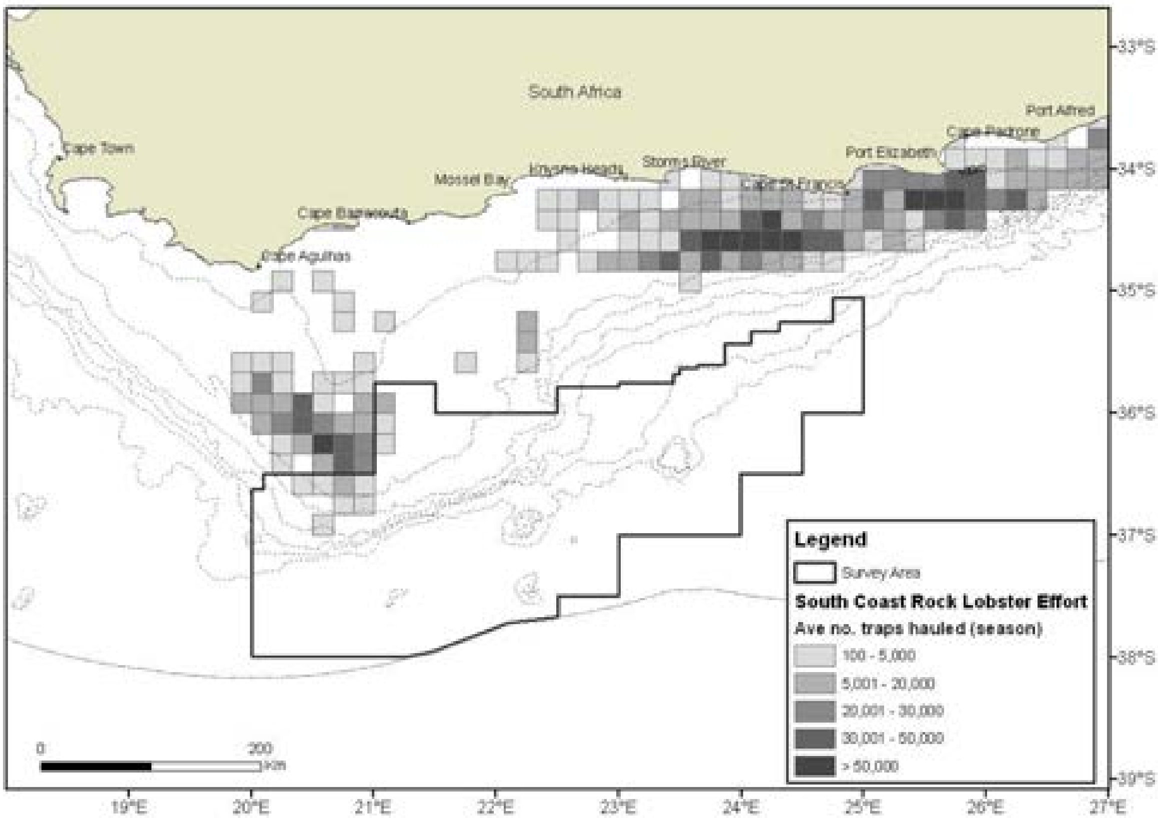


**Figure 4.20: Distribution of the South Coast rock lobster trap fishery in relation to the proposed survey area. Data are presented as the average annual number of traps hauled on a 10' by 10' grid basis for the period 2001 to 2008.**

*(g) 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 4.21). The fishery is seasonal, with most effort conducted between November and March.

The squid fishery is managed in terms of the Total Allowable Effort (TAE) allowed within the fishery and also sees an annual four week closure between October and November during which time the Department of Agriculture, Forestry and Fisheries (DAFF) undertakes a survey on spawning aggregations in the bay areas. Fishing rights were issued to 121 companies for the period 2006 to 2013 with the number of crew and vessels active within the fishery listed as 2422 and 136, respectively. A maximum landed catch of 9 000 tons was recorded between 2005 and 2008. The annual average catch value is approximately R180 million.

The grounds for the squid fishery lie well inshore of the proposed survey area with no overlap expected.

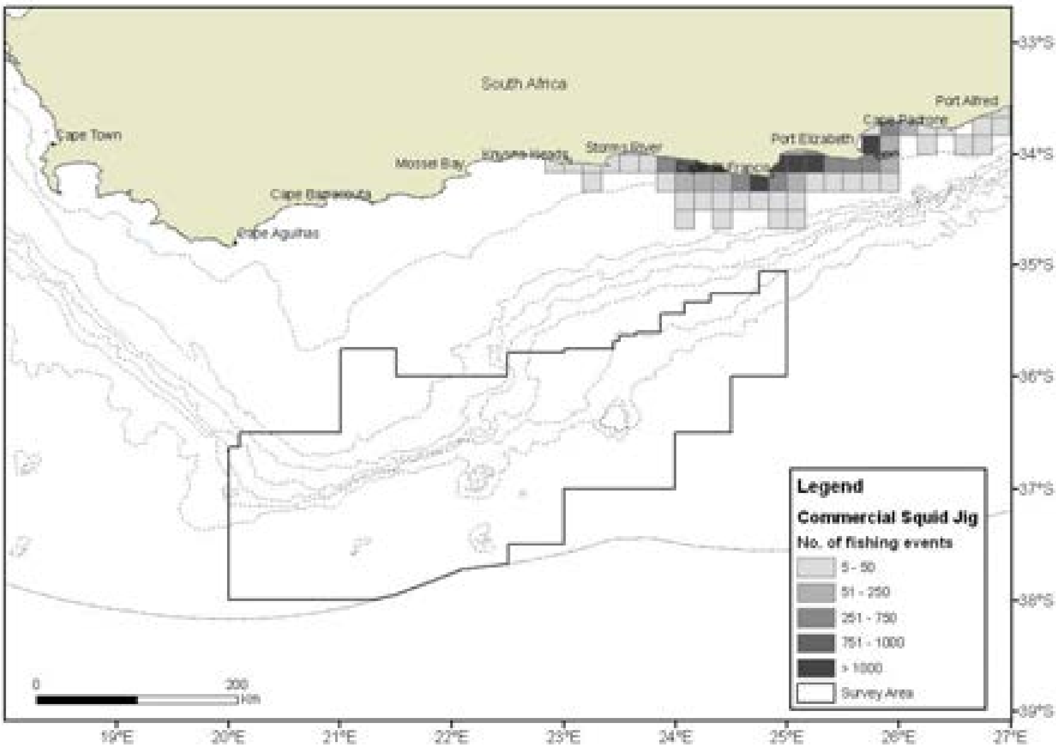


**Figure 4.21: Distribution of the squid jig fishery in relation to the proposed survey area.**

*(h) 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 condensed into three areas on the shelf edge of the South and East coasts:

1. Between 22ºE and 23ºE at a distance of approximately 70 nm offshore from Mossel Bay;
2. Between 24ºE to 27ºE 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). Mid-water trawling grounds to the South of the Agulhas Bank coincide with the proposed survey area, inshore of the 500 m isobaths between 21°E and 22.5°E (see Figure 4.22). Approximately 1 291 km$^2$ of the fishing grounds coincide with the proposed survey area which is equivalent to approximately 7.8 % of the total ground available to the fishery. Between 2000 and 2008, 1.7 % of the total effort of the fishery was conducted within the proposed survey area at an average of approximately 22 trawls per year. An annual average of approximately 1.6 % (339 tons) of the total catch (all species landed) was taken within this area.

Mid-water trawling gear configuration is similar to that of demersal trawlers, except that the net is manoeuvred vertically through the water column. Currently the FMV *Desert Diamond* is the only dedicated mid-water trawler. The towed gear may extend up to 1 km astern of the vessel and comprises trawl warps, net and codend (see Figure 4.23). 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.

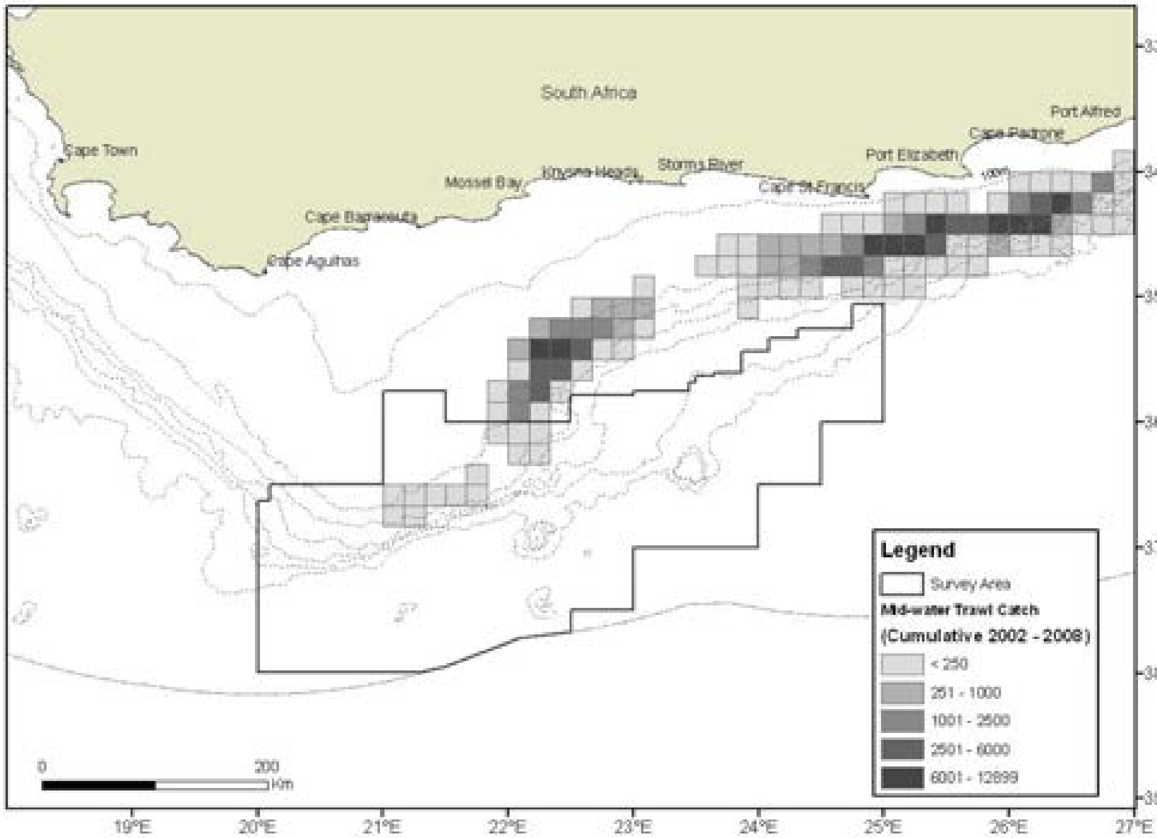


**Figure 4.22: Distribution of fishing effort of the mid-water trawl fishery in the vicinity of the proposed survey area. Data are presented as the number of trawl start positions on a 10' by 10' grid for the period 2000 to 2008.**

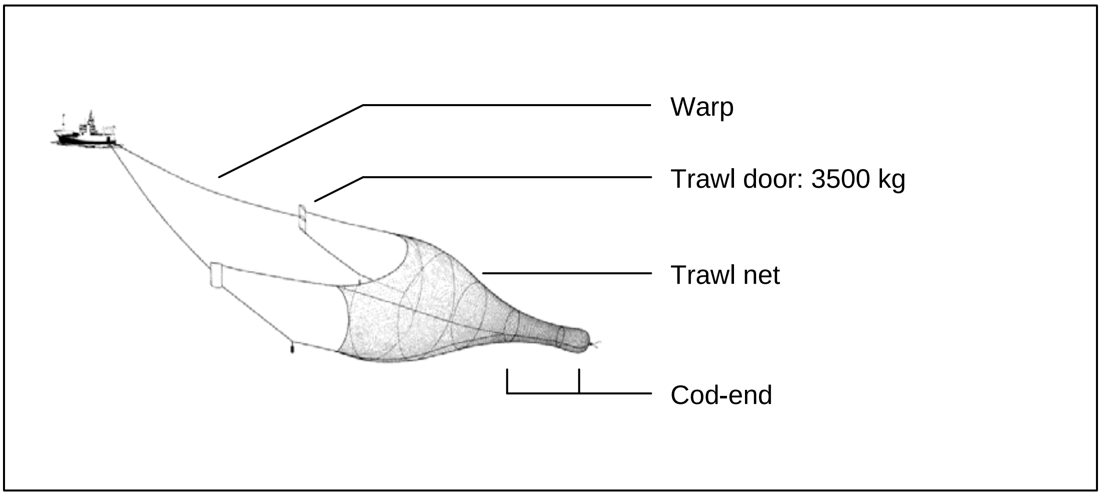


**Figure 4.23: Schematic diagram showing the typical configuration of mid-water trawl gear.**

### 4.5.2 SHIPPING TRANSPORT

A large number of vessels navigate along the South Coast on their way around the southern African subcontinent (see Figure 4.24 and Table 4.6). The majority of this vessel traffic, including commercial and fishing vessels, remains relatively close inshore and is, therefore, expected to pass inshore of the proposed survey area.

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. Some offshore commercial traffic departs east off the East Coast. Charted Traffic Separation Schemes, which are International Maritime Organisation (IMO) adapted and other relevant information are listed in the South African Annual Notice to Mariners No 5, of 2010. Figure 4.25 shows the safe shipping routes along the South African coast, as well as the traffic separation scheme around the Alphard Banks and F-A Platform.

Laden tankers carrying more than a half percent of their deadweight tonnage should maintain a minimum distance of 20 nautical miles off South Sand Bluff, Mbashe Point, Hood Point and Cape Recife when westbound. Westbound tankers should steer to pass through the westbound or northern lanes of the traffic separation schemes off the F-A Platform and Alphard Banks and maintain a minimum distance of 20 nautical miles off Cape Agulhas, Quion Point, Cape Point, Slangkop Point and Cape Columbine. Laden tankers, when eastbound, should maintain a minimum distance of 25 nautical miles when passing the landmarks mentioned above. Eastbound tankers between Cape Agulhas and Cape Recife should steer to pass through the eastbound or southern lanes of the traffic separation schemes off the Alphard Banks and F-A Platform.

Important South Coast commercial harbours include Port Elizabeth and Mossel Bay, while fishing harbours and slip-ways include Struis Bay, Arniston, Still Bay, Mossel Bay, Plettenberg Bay, St Francis Bay and Port Elizabeth.

**Table 4.6: Number of vessels calling at South African ports and sailing past Cape Point, during 1998. From Silvermine Maritime Intelligence.**

| Vessel type | Number of Cape Point Roundings | Number of vessels calling at ports | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Cape Town | Durban | East London | Mossel Bay | Port Elizabeth | Richard's Bay | Saldanha |
| Bulk | 135 | 421 | 814 | 18 | | 86 | 1063 | 159 |
| Cargo | 113 | 961 | 1444 | 103 | 4 | 262 | 287 | 19 |
| Unknown | 128 | | | | | | | |
| Vehicle carrier | 12 | 54 | 130 | 7 | | 26 | 13 | 1 |
| Container carrier | 74 | 672 | 852 | 45 | | 376 | 25 | 2 |
| Miscellaneous | 7 | | | | | | | |
| Tanker | 140 | 217 | 570 | 70 | 30 | 87 | 199 | 36 |
| **Total vessels / yr** | **609** | **2 325** | **3 810** | **243** | **34** | **837** | **1 587** | **217** |

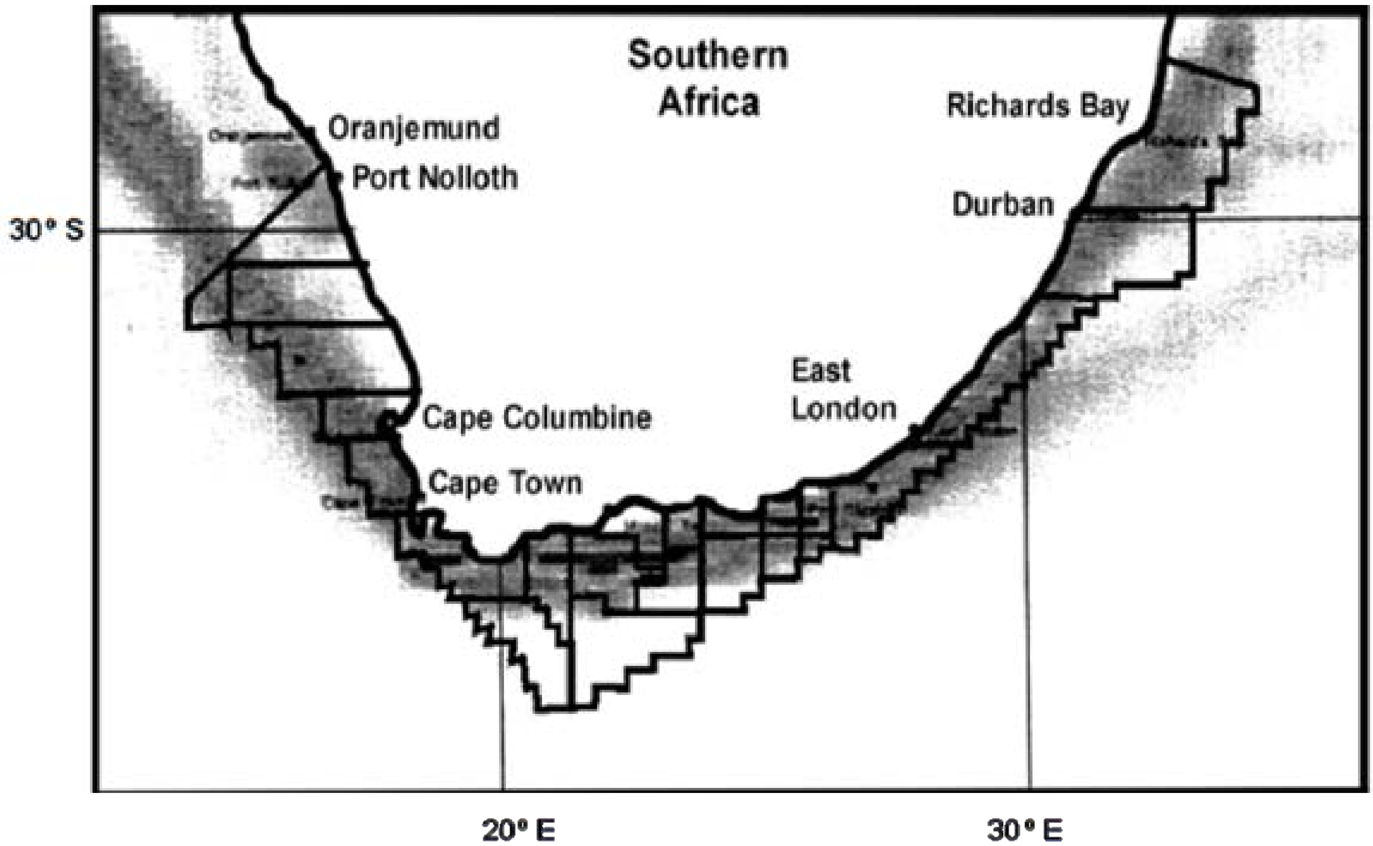


**Figure 4.24: The major shipping routes off the coast of South Africa showing petroleum license blocks. Data from the South African Centre for Oceanography.**

### 4.5.3 EXPLORATION, PRODUCTION AND MINING

#### 4.5.3.1 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.

Exploration
The proposed survey area includes a number of license blocks off the South Coast of South Africa (see Figure 1.1). Licence block rights holders and applicants surrounding the Total E&P survey area are presented in Figure 4.26.

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 102 meters. Gas and associated condensate from the associated gas fields (F-A, E-M and South Coast Gas) are processed through the platform. The produced gas and condensate are exported through two separate 93 km pipelines to the PetroSA Gas-to-Liquid (GTL) plant in Mossel Bay.

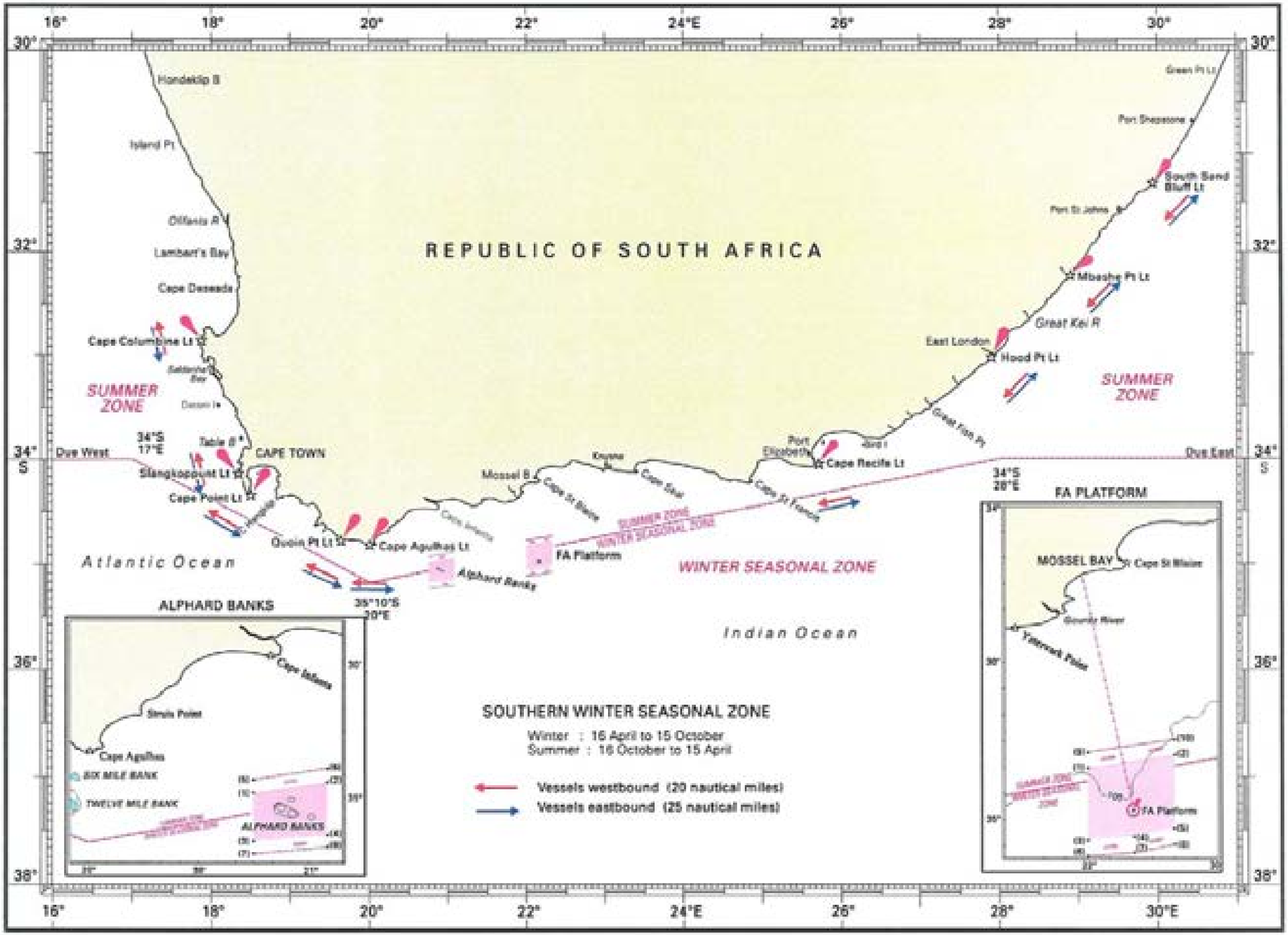


**Figure 4.25:** **Safe shipping routes around the coast of South Africa. From the South African Notices to Mariners No 5 of 2010 with authorisation from the Navy Hydrographic Office.**

PetroSA is currently producing oil from the Oryx/Oribi oil fields (E-AR and E-BT fields). These fields are tied back to the ORCA floating production platform. The ORCA lies approximately 130 km south-west of Mossel Bay. The gas and oil are separated on the ORCA and the gas is flared (burned off). The stabilised (degassed) oil is exported through a calm buoy to a shuttle tanker.

PetroSA brought the Sable Oil Field into production in 2003. The Sable Field consists of the E-BD and E-CE reservoirs, which lie 17 km to the west of the Oryx/Oribi Oil Field and 85 km south-west of the F-A Platform. Sable is currently not producing.

A 500 m statutory exclusion zone around any floating production storage and offloading unit and sea structures prohibits entry of all unauthorized vessels and aircraft. Larger safety zones around the E-M, F-A, South Coast Gas and Oryx/Oribi developments, established by the SA Navy Hydrographic Office, prohibit any activities that impact on the seafloor, i.e. anchoring, deploying of trawling gear, etc. to take place in these areas.

There are currently no production activities within the proposed seismic survey area.

#### 4.5.3.2 Prospecting and mining of other minerals

<u>Glauconite and phosphorite</u>

Glauconite pellets (an iron and magnesium rich clay mineral) and bedded and peletal 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 indicated that they may no longer be valid. These concentrations represent potentially commercial sources of agricultural phosphate and potassium (Birch, 1979a, b; Dingle *et al.*, 1987; Rogers and Bremner, 1991).

<u>Manganese nodules in ultra-deep water</u>

Rogers (1995) and 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 coasts (Figure 4.27). The nickel, copper and cobalt contents of the nodules fall below the current mining economic cut-off grade of 2%.

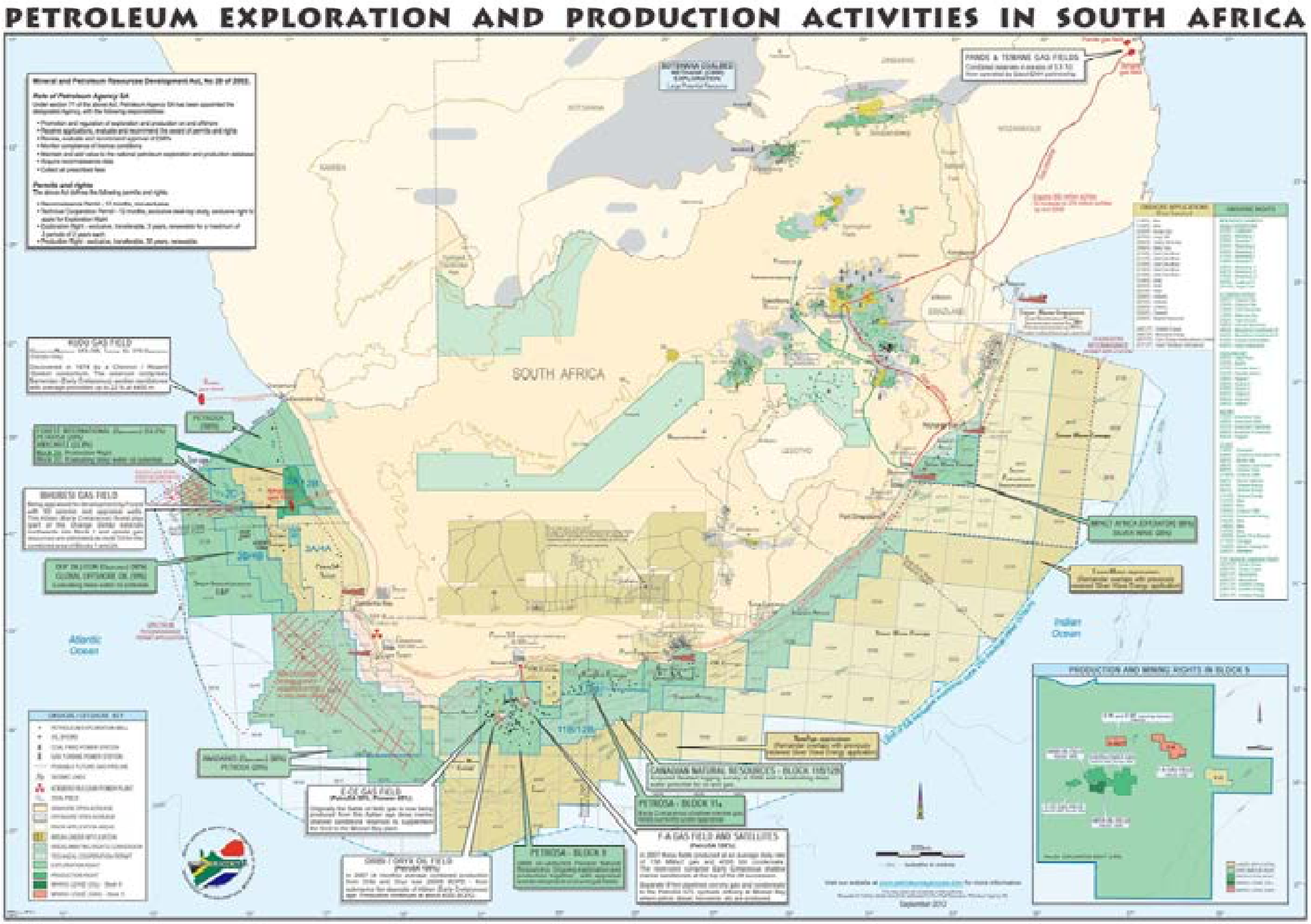


Figure 4.26: Petroleum licence blocks off the West, South and East coasts of South Africa (after PASA, 2012)..

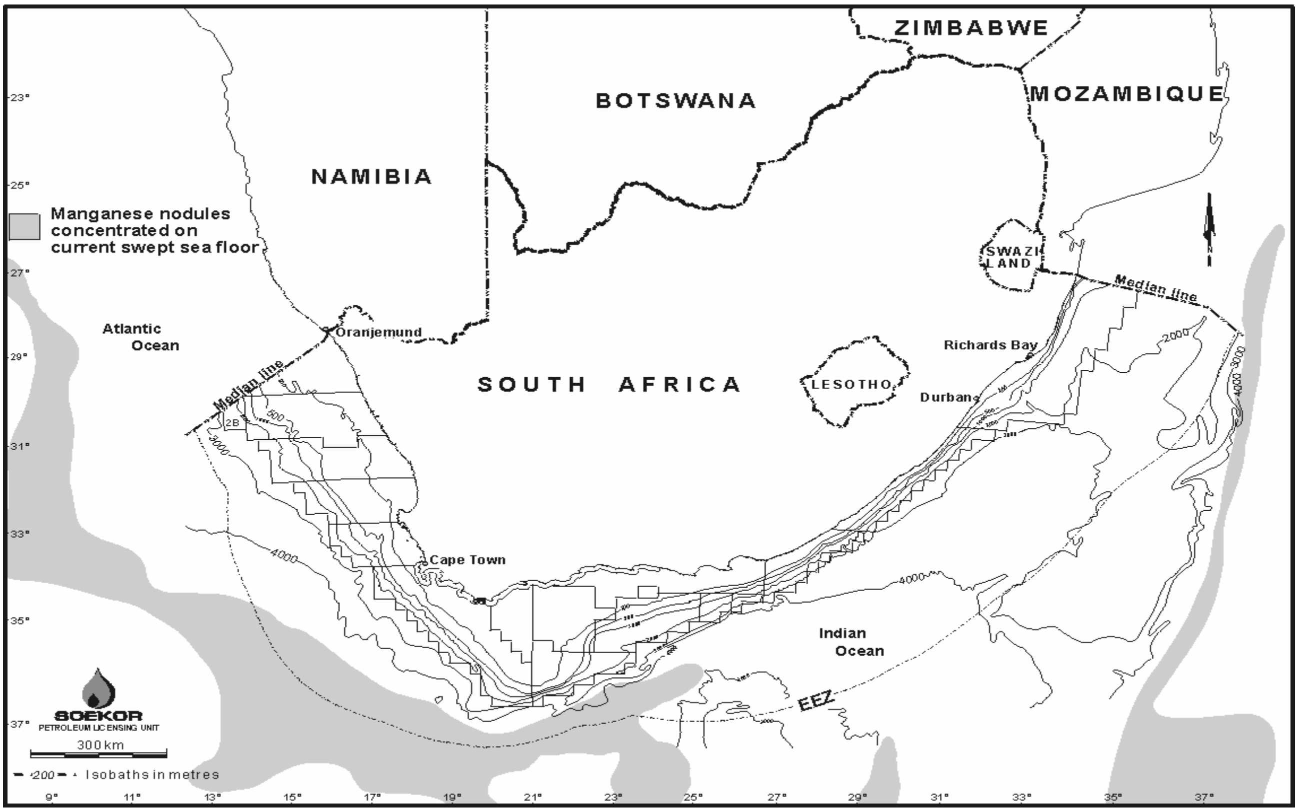


**Figure 4.27: Schematic of location of manganese nodules off Southern Africa, showing petroleum licence blocks. Modified from Rogers (1995) and Fuggle & Rabie (1992).**

### 4.5.4 RECREATIONAL UTILISATION

Coastal recreation along the South Coast may involve either consumptive or non-consumptive use of the marine environment.

Consumptive utilisation is sub-divided into two separate categories along the South Coast. The one involves subsistence fishers who rely on intertidal resources as an important source of protein. They predominantly exploit a wide variety of intertidal organisms. The second category includes recreational exploiters who do not rely on marine resources as an important protein source. They include: shore and boat-based anglers and spearfishers (Brouwer *et al.*, 1997; Mann *et al.*, 1997) who target a wide range of linefish species, some of which are also targeted by commercial anglers, skin divers who collect rock lobsters (*Panulirus homarus*) and other subtidal invertebrates, bait collectors (collecting mussels, limpets, red bait), and non-subsistence collectors of intertidal organisms (especially mussels).

Non-consumptive utilisation includes water sports, nature watching and beach recreation. Most non-consumptive utilisation practices are undertaken largely for the aesthetic value of the region.

## 4.5.5 OTHER

### 4.5.5.1 Anthropogenic marine hazards

*Seafloor Hazards*

Human use of the marine environment has resulted in the addition of numerous hazards on the seafloor. The Annual Summary of South African Notices to Mariners No. 5 or charts from the South African Navy or Hydrographic Office identifies the location of different underwater hazards along the South Coast.

*Undersea cables*

There is a submarine telecommunications cable system across the Atlantic and the Indian Ocean (see Figure 4.28). This system is called “SAT3/WASC/SAFE” (South Atlantic Telecommunications cable no.3 / West African Submarine Cable / South Africa Far East). The cable system is divided into two sub-systems, SAT3/WASC in the Atlantic Ocean and SAFE in the Indian Ocean. The SAT3/WASC sub-system connects Portugal (Sesimbra) with South Africa (Melkbosstrand). From Melkbosstrand the SAT-3/WASC sub-system is extended 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).

There is also a high bandwidth fibre optic cable system, Eastern Africa Submarine Cable System (EASSy), which connects countries of eastern Africa to the rest of the world (see Figure 4.28). EASSy runs from Mtunzini in South Africa to Port Sudan in Sudan, with landing points in nine countries, and connected to at least ten landlocked countries.

In addition to the new 14 000 km long West Africa Cable System (WACS), which links South Africa to London, and the 17 000 km long Africa Coast to Europe (ACE) cable system to link Africa to France, three new cable systems to link South America and Africa (SAex, WASACE and BRICS) are also being proposed for 2014 (see Figure 4.28).

There is an exclusion zone applicable to the telecommunication cables one nautical mile each side of the cable in which no anchoring is permitted.

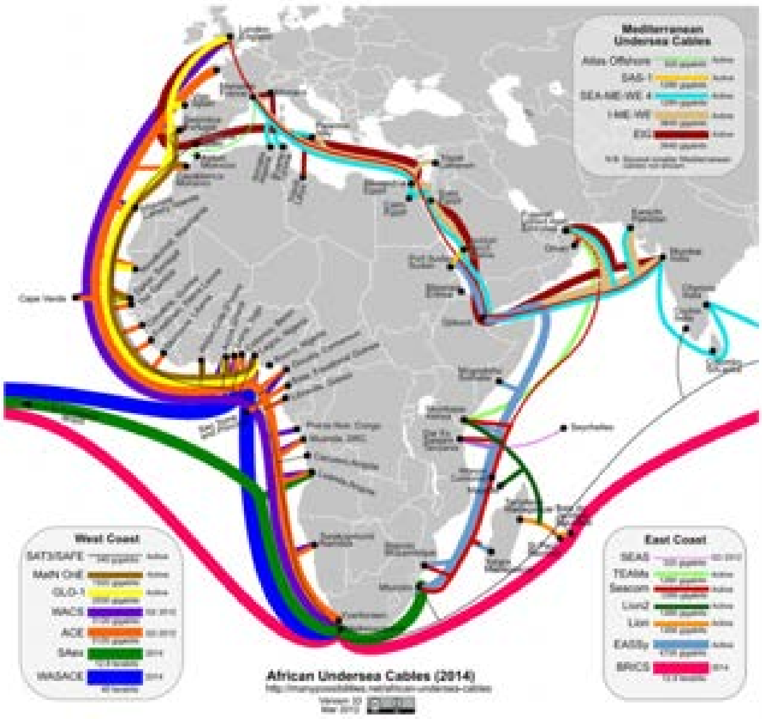


**Figure 4.28: Configuration of the current African undersea cable systems as well as cables proposed for 2013 and 2014 (From http://www.manypossibilities.net).**

#### 4.5.5.2 Archaeological sites

Over 2 000 shipwrecks are present along the South African coastline (Gribble, 1997). The majority of known wrecks lost along the South Coast are located in relatively shallow water close inshore (Turner, 1988). These are important archaeological sites as they represent an almost complete microcosm of their historical periods. As a result, wrecks older than 50 years old are declared national monuments (Gribble, 1997).

#### 4.5.5.3 Conservation areas and marine protected areas

Numerous conservation areas and marine protected areas (MPAs) exist along the South Coast, although none fall within the proposed survey area (see Figure 4.29).

There are four MPAs off the South Coast of South Africa, namely De Hoop, Goukama, Robberg and Tsitsikama. These MPAs and closed areas extend offshore only a few nautical miles and thus do not overlap directly with the proposed seismic survey area.

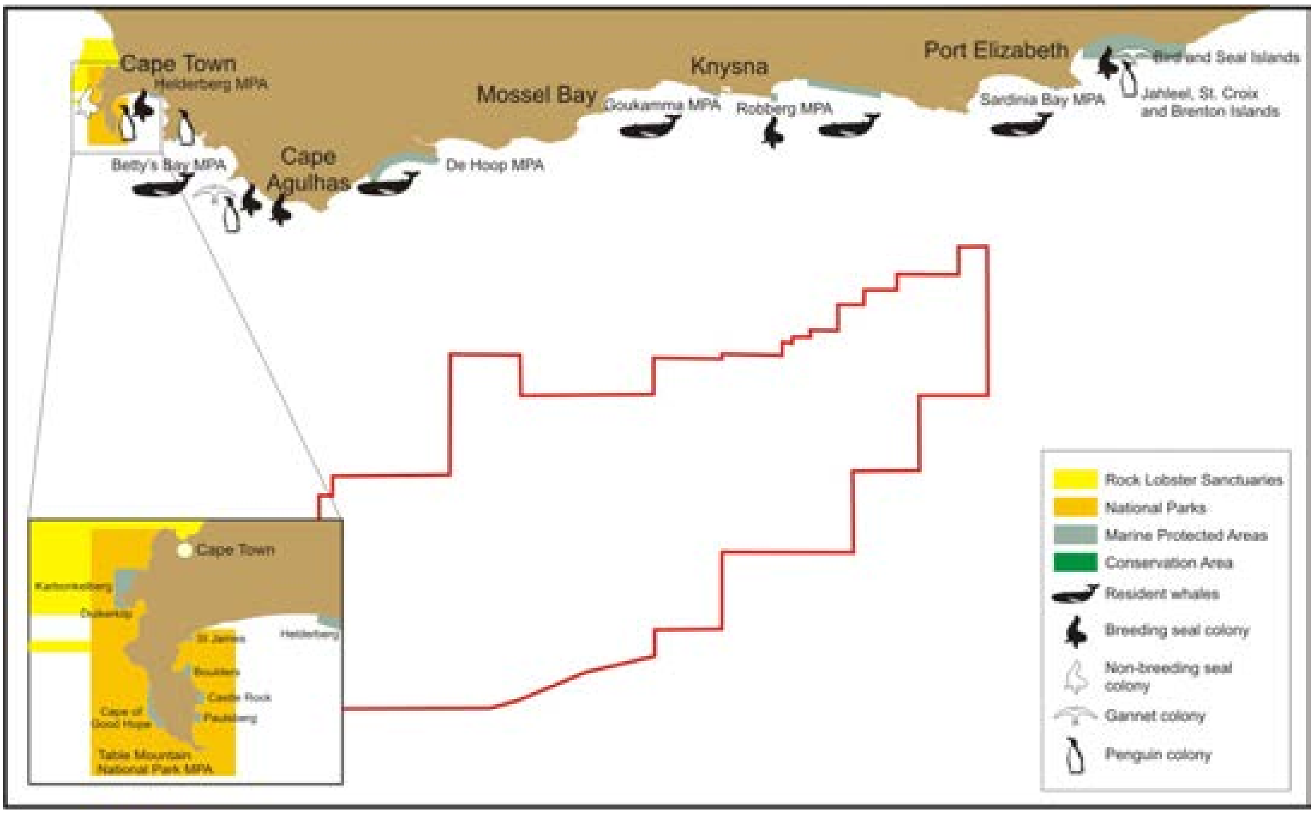


**Figure 4.29: Project - environment interaction points on the South Coast, illustrating the location of seabird and seal colonies, seasonal whale populations, and reserves and marine protected areas in relation to the proposed survey area (red outline).**

#### 4.5.5.4 Mariculture industries

Perlemoen, mussel and oyster farming facilities are located near Port Elizabeth (O'Sullivan, 1998). Oysters are also farmed within the Knysna Lagoon, while they are reported to be exploited commercially at numerous other sites along the South Coast (Jackson and Lipschitz, 1984).

#### 4.5.5.5 Marine outfall/intake pipes

Eleven outfalls and one intake are located along the South Coast (Jackson and Lipschitz, 1984). The most important pipelines include the sewerage outfall at Port Elizabeth, which discharges 60 000 $m^3$/day, and the PetroSA refinery outfall at Vlees Bay, which discharges approximately 8 000 $m^3$/day of saline effluent. Other less important outfalls are located off Cape Recife and Drift Sands in Port Elizabeth, and at Mossel Bay. A 2.5 km long product pipeline is also located off Voorbaai, which is used to import and export hydrocarbon products.

#### 4.5.5.6 Ammunition dump sites

The location of the ammunition dumpsites situated along the South Coast and details of dumped munitions are given on the relevant SAN charts. There are no ammunition dumpsites located near the proposed survey area.

# 5. ENVIRONMENTAL IMPACT ASSESSMENT

This chapter describes and assesses the significance of potential impacts related to the proposed exploration activities in the Outeniqua South Area. The potential impacts of the proposed activities are addressed in three categories, namely:

1. Seismic and support vessels (incl. helicopter) operation;
2. Impacts of seismic noise on marine fauna; and
3. Impacts of seismic activities on other users of the sea.

All impacts are systematically assessed and presented according to predefined rating scales (see Appendix 3). For each potential impact a table is provided that summarises the significance level assessment for that impact. Mitigation or optimisation measures are proposed which could ameliorate the negative impacts or enhance potential benefits, respectively. The status of all impacts should be considered to be negative unless otherwise indicated. The significance of impacts with and without mitigation is also assessed.

Unless otherwise indicated, all potential impacts discussed below would be for the duration of the survey only, i.e. short term (two to three months), because of the high-energy marine environment and/or the transient nature of survey activities.

## 5.1 IMPACT OF NORMAL SEISMIC / SUPPORT VESSELS AND HELICOPTER OPERATION

### 5.1.1 EMISSIONS TO THE ATMOSPHERE

Description of impact

Emissions to the atmosphere during the seismic survey may include exhaust gases from the use of diesel as fuel for generators and motors, and the burning of wastes.

Diesel exhaust comprises mainly carbon dioxide ($CO_2$) as well as several toxic gases such as nitrogen oxides ($NO_X$), sulphur oxides ($SO_X$) and carbon monoxide (CO). In addition, diesel combustion can produce hydrocarbons (Total Hydrocarbons and Volatile Organic Compounds). Smoke and particulate matter (soot) are also produced during diesel combustion.

Incineration of waste on board would also release soot as well as CO, $CO_2$ and dioxins (depending on the composition of the waste). However, many vessels do not have an incinerator on board. In these circumstances solid waste would be stored on board for later onshore disposal.

Assessment

The atmospheric emissions from the seismic and support vessels are expected to be similar to those from similar diesel-powered vessels of comparable tonnage (approximately 3 000 tonnes), with the addition of the emissions from the airgun compressors. The volume of solid waste incinerated on board, and hence also the volume of atmospheric emissions, would be minimal and incineration must comply with the relevant MARPOL 73/78[3] standards.

[3] MARPOL 73/78 is an International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978 relating thereto. All vessels operating within the South African Exclusive Economic Zone are required to conform to legal requirements for waste management and pollution control, including the Marine Pollution Act (No. 2 of 1986 – which incorporate MARPOL 73/78 standards) and the Dumping at Sea Control Act (No. 73 of 1965). These Acts make provision for the discharge of sewage, plastics, oil, galley wastes, hazardous liquids and packaged hazardous material.

The potential impact of emissions to the atmosphere during seismic survey operations would be limited to the survey area, of low intensity and is considered to be of **VERY LOW** significance with or without the implementation of mitigation measures (see Table 5.1).

Mitigation

No mitigation is deemed necessary, but it is recommended that all diesel motors and generators receive adequate maintenance to minimise soot and un-burnt diesel released to the atmosphere.

**Table 5.1: Impact of atmospheric emissions from the seismic and support vessels, and helicopter operation.**

| | Extent | Duration | Intensity | Probability | Significance | Confidence |
|---|---|---|---|---|---|---|
| **Without mitigation** | Local | Short-term | Low | Definite | **Very Low** | High |
| **With mitigation** | Local | Short-term | Low | Definite | **VERY LOW** | High |

### 5.1.2 DISCHARGES/DISPOSAL TO THE SEA

Discharges from the seismic and support vessel to the marine environment include deck drainage, machinery space drainage, sewage, galley wastes and solid wastes.

#### 5.1.2.1 Deck drainage

Description of impact

Drainage of deck areas may result in small volumes of oils, solvents or cleaners being introduced into the marine environment.

Assessment

Oils, solvents and cleaners could be introduced into the marine environment in very small volumes through spillage and drainage of deck areas. The potential impact of deck drainage on the marine environment would therefore be of low intensity across the survey area over the short-term, and is considered to be of **VERY LOW** significance with or without mitigation (see Table 5.2).

Mitigation

The following measures are recommended for mitigation of deck drainage discharges from the seismic and support vessel:

- Deck drainage should be collected in oily water separator systems. Discharged water must meet MARPOL 73/78 standards;
- Low-toxicity biodegradable detergents should be used in cleaning of all deck spillage;
- Training and awareness of crew in spill management could minimise contamination; and
- All hydraulic systems should be adequately maintained and hydraulic hoses should be frequently inspected.

**Table 5.2: Impact of deck drainage from the seismic and support vessels.**

| | Extent | Duration | Intensity | Probability | Significance | Confidence |
|---|---|---|---|---|---|---|
| **Without mitigation** | Local | Short-term | Low | Highly Probable | **Very Low** | High |
| **With mitigation** | Local | Short-term | Low | Highly Probable | **VERY LOW** | High |

#### 5.1.2.2 Machinery space drainage

Description of impact
Small volumes of oil such as diesel fuel, lubricants, grease, etc. used within the machinery space of the seismic and support vessels could enter the marine environment.

Assessment
The seismic and support vessels must comply fully with international agreed standards regulated under MARPOL 73/78. All machinery space drainage would pass through an oil/water separator to reduce the oil in water concentration to 15 mg/l, in accordance with MARPOL 73/78 requirements.

Concentrations of oil reaching the marine environment through drainage of machinery spaces are, therefore, expected to be low. The potential impact of such low concentrations would be of low intensity and limited to the survey area over the short-term. The potential impact of machinery space drainage on the marine environment is therefore considered to be of **VERY LOW** significance with or without mitigation (see Table 5.3).

Mitigation
No mitigation measures are recommended (assuming discharges are in compliance with the MARPOL 73/78 standards).

**Table 5.3: Impact of machinery space drainage from the seismic and support vessels.**

| | Extent | Duration | Intensity | Probability | Significance | Confidence |
|---|---|---|---|---|---|---|
| **Without mitigation** | Local | Short-term | Low | Highly Probable | **Very Low** | High |
| **With mitigation** | Local | Short-term | Low | Highly Probable | **VERY LOW** | High |

#### 5.1.2.3 Sewage

Description of impact
Sewage poses an organic and bacterial loading on the natural degradation processes of the sea, resulting in an increased biological oxygen demand (BOD). This could result in anaerobic conditions in the marine environment. Although treated sewage would also increase BOD, it does not pose a bacterial load.

Assessment
The proposed seismic survey is expected to take two to three months to complete and the proposed sonar bathymetry survey and drop core sampling would take up to 45 days, depending on, amongst other things, weather conditions. The volumes of sewage wastes released from the seismic and support vessel would be small and comparable to volumes produced by vessels of similar crew compliment (up to 50 people). All sewage would be treated to the required MARPOL 73/78 standard prior to release into the marine environment, where the high wind and wave energy is expected to result in rapid dispersal.

The potential impact of sewage effluent from the exploration and support vessels on the marine environment is expected to be limited to the survey area over the short-term, and is therefore considered to be of **VERY LOW** significance with or without mitigation (see Table 5.4).

Mitigation
No mitigation measures are recommended (assuming sewage discharges are in compliance with the MARPOL 73/78 standards).

**Table 5.4: Impact of sewage effluent discharge from the seismic and support vessels.**

| | Extent | Duration | Intensity | Probability | Significance | Confidence |
|---|---|---|---|---|---|---|
| **Without mitigation** | Local | Short-term | Low | Highly Probable | **Very Low** | High |
| **With mitigation** | Local | Short-term | Low | Highly Probable | **VERY LOW** | High |

#### 5.1.2.4 Galley waste

<u>Description of impact</u>

Galley wastes, comprising mostly of biodegradable food waste, would place a small organic and bacterial loading on the marine environment.

<u>Assessment</u>

The volume of galley waste from a seismic and support vessel would be small and comparable to wastes from any vessel of a similar crew compliment (up to 50 people). Discharges of galley wastes, according to MARPOL 73/78 standards, would be comminuted to particle sizes smaller than 25 mm prior to disposal to the marine environment if less than 12 nautical miles (± 22 km) from the coast, with no disposal within 3 nautical miles (± 5.5 km) of the coast. The potential impact of galley waste disposal on the marine environment would be of low intensity and limited to the survey area over the short-term. The potential impact of galley waste on the marine environment is therefore considered to be of **VERY LOW** significance with or without mitigation (see Table 5.5).

<u>Mitigation</u>

No mitigation measures are deemed necessary (assuming discharge is in compliance with the MARPOL 73/78 standards).

**Table 5.5: Impact of galley waste disposal from the seismic and support vessels.**

| | Extent | Duration | Intensity | Probability | Significance | Confidence |
|---|---|---|---|---|---|---|
| **Without mitigation** | Local | Short-term | Low | Highly Probable | **Very Low** | High |
| **With mitigation** | Local | Short-term | Low | Highly Probable | **VERY LOW** | High |

#### 5.1.2.5 Solid waste

<u>Description of impact</u>

The disposal of solid waste comprising non-biodegradable domestic waste, packaging and operational industrial waste into the sea could pose a hazard to marine fauna, may contain contaminant chemicals and could end up as visual pollution at sea, on the seashore or on the seabed.

<u>Assessment</u>

Solid waste would be incinerated or transported ashore for disposal on land, and consequently would have no impact on the marine environment. However, a spill may result in a small amount of waste entering the marine environment (e.g. blown by wind, spill during transfer to support vessel, etc.). Hazardous waste would be disposed of by specialist waste disposal contractors. The potential impact of the disposal of solid waste on the marine environment is therefore **INSIGNIFICANT** (see Table 5.6).

Mitigation

The following measures are recommended for the mitigation of waste:

- Initiate a waste minimisation system on board;
- Ensure on-board solid waste storage is secure; and
- Co-operate with the relevant local authority to ensure solid and hazardous waste disposal is carried out in accordance with the appropriate laws and ordinances.

**Table 5.6: Impact of solid waste disposal from the seismic and support vessels.**

| | Extent | Duration | Intensity | Probability | Significance | Confidence |
|---|---|---|---|---|---|---|
| **Without mitigation** | Local | Short- term | Zero | Improbable | **Insignificant** | Medium |
| **With mitigation** | Local | Short- term | Zero | Improbable | **INSIGNIFICANT** | Medium |

## 5.1.3 NOISE FROM VESSEL AND HELICOPTER OPERATIONS

### 5.1.3.1 Noise from seismic and support vessel operations

Impact description

The noise from seismic and support vessels could result in localised disturbance of marine fauna.

Impact assessment

Noise from seismic and support vessels is likely to be no higher than those from other small shipping vessels in the region. The potential impact of noise from seismic and support vessel operations on marine fauna is considered to be localised and of low intensity in the short-term. The significance of this impact is therefore assessed to be **VERY LOW** with and without mitigation (Table 5.7).

Mitigation measures

No measures are deemed necessary to mitigate noise impacts from seismic and support vessel operations.

**Table 5.7: Impact of noise from seismic and support vessel operations.**

| | Extent | Duration | Intensity | Probability | Significance | Confidence |
|---|---|---|---|---|---|---|
| **Without mitigation** | Local | Short-term | Low | Probable | **Very Low** | Medium |
| **With mitigation** | Local | Short-term | Low | Probable | **VERY LOW** | Medium |

### 5.1.3.2 Noise from helicopter operations

Impact description

Helicopters may be utilised for crew / supply transfers between the seismic and support vessels and the mainland, which could result in localised disturbance of marine fauna.

Impact assessment

Low altitude flight paths over bird breeding colonies could result in temporary abandonment of nests and exposure of eggs and chicks leading to increased predation risk. There are 13 species of seabirds that breed within the South Coast region, including Cape Gannets (Algoa Bay islands), African Penguins (Algoa Bay islands), Cape Cormorants (a small population at Algoa Bay islands and mainland sites), Whitebreasted

Cormorant, Roseate Tern (Bird and St Croix Islands), Damara Tern (inshore between Cape Agulhas and Cape Infanta), Swift Term (Stag Island) and Kelp Gulls. African Penguin colonies along the South Coast occur at Dyer Island, Cape Recife and on the Algoa Bay islands (St Croix Island, Jaheel Island, Bird Island, Seal Island, Stag Island and Brenton Rocks).

In addition, low altitude flight paths over seal colonies can cause stampedes of animals to sea resulting in trampling of pups and nesting seabirds within seal colonies. There are seal breeding colonies located at Seal Island in Mossel Bay, on the northern shore of the Robberg Peninsula in Plettenberg Bay and at Black Rocks (Bird Island group) in Algoa Bay. The timing of the annual breeding cycle is very regular occurring between November and January.

In terms of the Marine Living Resources Act, 1998 (No 18 of 1998) it is illegal for any vessel, including aircraft, to approach to within 300 m of whales within South African waters. Disturbance of cetaceans by helicopter would depend on the distance and altitude of the aircraft from the animals (particularly the angle of incidence of helicopter noise to the water surface) and the prevailing sea conditions. It is an offence in terms of the Sea Birds and Seals Protection Act, 1973 (No. 46 of 1973) to wilfully disturb seals on the coast or on offshore islands.

Indiscriminate or direct flying over seabird or seal colonies (or flying low level parallel to the coast) and cetaceans could have a significant disturbance impact on breeding success or mortalities of juveniles. Although such impacts would be local in the area of the colony, they may have wider ramifications over the range of affected species and are deemed to range from low to high intensity. The significance of the potential impact is considered to range from **low to medium** significance (see Table 5.8), if helicopter flight paths cross any of these areas at an altitude of less than 500 m.

<u>Mitigation measures</u>

- Flight paths must be pre-planned to ensure that no flying occurs over bird and seabird colonies, coastal reserves or marine islands. Important areas in the vicinity of the proposed survey area include: Algoa Bay islands (St Croix Island, Jaheel Island, Bird Island, Black Rocks, Seal Island, Stag Island and Brenton Rocks), Dyer Island, Cape Recife, Seal Island (Mossel Bay) and Robberg Peninsula (Plettenberg Bay);
- Extensive coastal flights (parallel to the coast within 1 nautical mile of the shore) should be avoided. There is a restriction of coastal flights (parallel to the coast within 1 nautical mile of the shore) on the South Coast between the months of June and November to avoid southern right whale breeding areas;
- Aircraft may not approach to within 300 m of whales in terms of the Marine Living Resources Act, 1998;
- The operator must comply with the Seabirds and Seals Protection Act, 1973, which prohibits the wilful disturbance of seals on the coast or on offshore islands;
- The contractor should comply fully with aviation and authority guidelines and rules; and
- All pilots must be briefed on ecological risks associated with flying at a low level parallel to the coast.

If the suggested mitigation measures are implemented, this impact is expected to be **VERY LOW** (see Table 5.8).

**Table 5.8: Impact of noise from helicopter operations.**

| | Extent | Duration | Intensity | Probability | Significance | Confidence |
|---|---|---|---|---|---|---|
| **Without mitigation** | Local | Short-term | Low to High | Probable | **Low to Medium** | Medium |
| **With mitigation** | Local | Short-term | Low | Improbable | **VERY LOW** | Medium |

## 5.2 IMPACTS ON MARINE FAUNA ACOUSTIC IMPACTS FROM SEISMIC AND SONAR NOISE

### 5.2.1.1 POTENTIAL IMPACTS ON PLANKTON

Plankton, which are species that are unable to determine their direction of travel within the water column, comprise phytoplankton (floral plankton) and zooplankton (faunal plankton). Zooplankton includes meroplankton[1] (planktonic larval stages of fish and invertebrate larvae and eggs) as well as holoplankton (species that spend their entire life-cycle as plankton).

Description of impact

Potential impacts of seismic and sonar pulses and core sampling activities on plankton could include physiological injury and/or mortality. No behavioural avoidance of the survey area by plankton or invertebrates would occur. Limited indirect impacts may arise from effects on predators or prey.

Assessment

Review of the literature suggests that mortality or injury to plankton would occur in the immediate vicinity of the airgun sound source within metres of the firing airguns. Impacts would thus be of high intensity at very close range (< 5 m from the airguns), but this would be no more significant than the effect of the wash from ships propellers and bow waves. The proposed survey area overlaps to some degree with hake and anchovy, pilchard, round herring and horse mackerel spawning areas on the Agulhas Bank. No overlap is, however, expected with squid spawning grounds in the Cape St Francis to Port Elizabeth area or the distribution of pilchard and anchovy eggs north of Port Elizabeth (see Figure 4.8). As plankton distribution is naturally temporally and spatially variable and natural mortality rates are high, any impacts would be of low to negligible intensity across the survey area and for the duration of the survey (short-term).

The overall potential impact of seismic noise on plankton is considered to be localised and of low intensity in the short-term. The significance of this impact is therefore assessed to be **VERY LOW** with and without mitigation (Table 5.9).

Mitigation

Considering the extreme offshore location of the proposed survey area, the low frequency of seismic surveys in the area, the spatial extent of the spawning areas and limited overlap of the proposed survey area with these, mitigation is not deemed necessary.

**Table 5.9: Impact of exploration noise on plankton.**

| | Extent | Duration | Intensity | Probability | Significance | Confidence |
|---|---|---|---|---|---|---|
| **Without mitigation** | Local | Short-term | Low | Probable | **Very Low** | Medium |
| **With mitigation** | Local | Short-term | Low | Probable | **VERY LOW** | Medium |

[1] Also termed "ichthyoplankton".

#### 5.2.1.2 POTENTIAL IMPACTS TO MARINE INVERTEBRATES

Description of impact

Most marine invertebrates do not possess hearing organs that perceive sound pressure, although many have mechanoreceptors or statocyst organs that are sensitive to hydroacoustic disturbances. Potential impacts of seismic pulses on invertebrates could include physiological injury and behavioural avoidance of seismic survey areas. Masking of environmental sounds and indirect impacts due to effects on predators or prey have not been documented and are highly unlikely.

Assessment

*Physiological injury and mortality*

There is little published information on the effects of seismic surveys on invertebrate fauna. It has been postulated, however, that shellfish, crustaceans and most other invertebrates can only hear seismic survey sounds at very close range (< 15 m away). This implies that only surveys conducted in very shallow water would have any detrimental effects on invertebrates associated with the seabed.

A species of potential concern in the proposed survey area is the commercially fished deep-water rock lobster, which occurs on rocky substrate in depths of 90 to 170 m. However, as the survey would be conducted in excess of 200 m depth, the received noise at the seabed would be within the far-field range and outside of distances at which physiological injury of these invertebrates would be expected. Giant squid strandings coincident with seismic surveys have been reported, although causative links to seismic surveys have not been established with certainty.

The potential impact of seismic noise on physiological injury or mortality of invertebrates is deemed of low to negligible intensity across the survey area and for the survey duration and is considered to be of **VERY LOW** significance both with and without mitigation (see Table 5.10).

*Behavioural avoidance of seismic survey areas*

Similarly, there is little published information on the effects of seismic surveys on the response of invertebrate fauna to seismic impulses. Limited avoidance of airgun sounds may occur in mobile neritic and pelagic invertebrates and is deemed to be of low intensity. Of the marine invertebrates only cephalopods are receptive to the far-field sounds of seismic airgun arrays. Squid occurs extensively on the Agulhas Bank out to the shelf edge (500 m depth contour). Adult squid are normally distributed in waters >100 m, except along the eastern half of the South Coast where they also occur inshore, forming dense seasonal spawning aggregations at depths between 20 and 130 m. The received noise at the seabed would be within the far-field range and outside of distances at which avoidance of benthic invertebrates would be expected, but potentially within the response range of cephalopods. Behavioural changes have been observed at 2 to 5 km from an approaching large seismic source, so avoidance of airgun sounds by squid may thus occur when surveying in the North-eastern corner of the survey area.

The potential impact of seismic noise on invertebrate behaviour (mainly cephalopods) is consequently deemed of medium intensity across the survey areas and for the survey duration and is considered to be of **low to very low** significance without mitigation and **VERY LOW** significance with mitigation (see Table 5.10).

Mitigation

It is recommend that the inshore area (<130 m water depth) off Port Elizabeth is avoided in November and December during the peak squid spawning aggregations. This is also the time when the highest catches are made by the commercial fishery. Interaction with the fleet is likely to be minimal, however, as fishing efforts are focused on nearshore waters.

**Table 5.10: Impact of seismic noise on marine invertebrates**

| | Extent | Duration | Intensity | Probability | Significance | Confidence |
|---|---|---|---|---|---|---|
| Physiological injury | | | | | | |
| **Without mitigation** | Local | Short-term | Low | Probable | **Very Low** | Medium |
| **With mitigation** | Local | Short-term | Low | Probable | **VERY LOW** | Medium |
| Behavioural avoidance | | | | | | |
| **Without mitigation** | Local | Short-term | Medium | Probable | **Low to Very Low** | Medium |
| **With mitigation** | Local | Short-term | Low | Probable | **VERY LOW** | Medium |

### 5.2.1.3 POTENTIAL IMPACTS ON FISH

The potential impact of seismic noise on fish larvae is discussed under Section 5.2.1 above and this section discusses the impact on adult fish only.

<u>Description of impact</u>
A review of the available literature suggests that potential impacts of seismic pulses to fish species (including sharks) could include physiological injury and mortality, behavioural avoidance of seismic survey areas, masking of environmental sounds and communication, and indirect impacts due to effects on predators or prey.

<u>Assessment</u>
*Physiological injury and mortality*
The greatest risk of physiological injury or mortality from seismic sound sources is for species that establish home ranges on shallow-water reefs or congregate in inshore waters to spawn, and those displaying an instinctive alarm response to hide on the seabed or in the reef rather than flee. Large demersal or reef-fish species with swim-bladders are also more susceptible than those without this organ. Such species may suffer severe hearing damage and the adverse effect may intensify and last for a considerable time after the termination of the sound source. However, as the proposed survey would be located more than 100 km offshore in water depths in excess of 200 m, the received noise by demersal species at the seabed would be within the far-field range, and outside of distances at which physiological injury or avoidance would be expected.

Given the high mobility of most fish that occur offshore of the 200 m isobaths, particularly the highly migratory pelagic species likely to be encountered in deeper water, it is assumed that the majority of fish species would avoid seismic noise at levels below those where physiological injury or mortality would result. Furthermore, in many of the large pelagic species, the swim-bladders are either underdeveloped or absent, and the risk of physiological injury through damage of this organ is therefore lower.

Possible injury or mortality in pelagic species could occur on initiation of a sound source at full pressure in the immediate vicinity of fish, or where reproductive or feeding behaviour override a flight response to seismic survey sounds. As there are various seamounts and important fishing banks in the proposed survey area, the likelihood of encountering feeding aggregations of large pelagic species is high. The potential physiological impact on pelagic species would be of high intensity, but limited to the short-term. The potential physiological impact on demersal and deep water reef species would, however, be insignificant as they would only be affected in the far-field range. The impact is therefore considered to be of **low** significance without mitigation and of **VERY LOW** significance with mitigation measures.

*Behavioural avoidance of seismic survey areas*

Behavioural responses to seismic sounds have been documented at received levels of about 160 dB re 1 μPa @ 1m. Responses are varied and include avoidance of seismic survey areas, changes in depth distribution and schooling behaviour, startle response and changes in feeding behaviours of some fish. Behavioural effects are generally short-term with duration of the effect being less than or equal to the duration of exposure, although these vary between species and individuals, and are dependent on the properties of the received sound.

The potential impact on fish behaviour could therefore be of high intensity (particularly in the near-field of the airgun array), but limited to the survey area and short-term. Consequently it is considered to be of **low** significance without mitigation and of **VERY LOW** significance with mitigation.

*Spawning and reproductive success*

Fish populations could be further impacted if behavioural responses result in deflection from migration paths or disturbance of spawning. If fish on their migration paths or spawning grounds are exposed to powerful external forces, they may be disturbed or even cease spawning altogether thereby affecting recruitment to fish stocks.

The magnitude of effect in these cases would depend on the biology of the species and the extent of the dispersion or deflection. Studies undertaken experimentally exposing the eggs and larvae of various fish species to airgun sources, however, identified mortalities and physiological injuries at very close range (< 5 m) only. Considering the wide range over which the potentially affected species occur, the spatial extent of the spawning areas, the relatively short duration of the seismic surveys and that the migration routes do not constitute narrow restricted paths, the impact is considered to be of **low** significance without mitigation and **VERY LOW** significance with mitigation.

*Masking of environmental sounds and communication*

Fish deliberately produce sounds by three processes, including by stridulation (caused by friction of adjacent skeletal components), by vibration of the swimbladder, or by rapid head movement. Chorus sounds range across frequencies higher than the majority of produced seismic survey energy, but some frequency overlap may occur.

Communication and the use of environmental sounds by fish in the offshore environment off the South Coast of South Africa are unknown. However, impacts arising from masking of sounds are expected to be of low intensity due to the duty cycle of seismic surveys (one firing every 10 to 15 seconds) in relation to the more continuous biological noise. Furthermore, as the proposed survey would be conducted at depths in excess of 200 m, any effects on demersal fish species would be in the far field. Such impacts would occur across the survey area in the short-term, and are consequently considered of **VERY LOW** significance with and without mitigation.

*Indirect impacts due to effects on predators or prey*

The assessment of indirect effects of seismic surveys on fish is limited by the complexity of trophic pathways in the marine environment. The impacts are difficult to determine and would depend on the diet make-up of the fish species concerned and the effect of seismic surveys on the diet species. Indirect impacts of seismic surveying could include attraction of predatory species such as sharks and tuna to small pelagic fish species stunned by seismic noise. In such cases where feeding behaviour overrides a flight response to seismic survey sounds, injury or mortality could result if the seismic sound source is initiated at full power in the immediate vicinity of the feeding predators. Little information is available on the feeding success of large migratory species in association with seismic survey noise. Considering the extensive range over which large pelagic fish species feed in relation to the survey area, the impact is likely to be of low intensity in the short-term. The significance of impact is consequently deemed **VERY LOW** with or without mitigation.

Mitigation

- Implement a "soft-start" procedure of a minimum of 20 minutes' duration when initiating seismic surveying. This requires that the sound source be ramped from low to full power rather than initiated at full power, thus allowing a flight response to outside the zone of injury or avoidance. Such a "soft-start" procedure would allow fish to move out of the survey areas and thus avoid potential physiological injury as a result of seismic noise;
- All breaks in airgun firing of longer than 20 minutes must be followed by a "soft-start" procedure of at least 20 minutes prior to the survey operation continuing. Breaks of shorter than 20 minutes should be followed by a "soft-start" of similar duration;
- During night time line changes, especially when turning in inshore areas, low level warning airgun discharges should be fired at regular intervals in order to keep animals away from the survey operation while the vessel is repositioned;
- Airgun firing should be terminated if mass mortalities of fish as a direct result of shooting are observed; and
- No survey-related activities are to take place within proclaimed MPAs.

**Table 5.11: Impact of seismic noise on fish.**

| | Extent | Duration | Intensity | Probability | Significance | Confidence |
|---|---|---|---|---|---|---|
| Physiological injury | | | | | | |
| **Without mitigation** | Local | Short-term | High | Probable | **Low** | Medium |
| **With mitigation** | Local | Short-term | Low to Medium | Improbable | **VERY LOW** | Medium |
| Behavioural avoidance | | | | | | |
| **Without mitigation** | Local | Short-term | High | Probable | **Low** | Medium |
| **With mitigation** | Local | Short-term | Low to Medium | Improbable | **VERY LOW** | Medium |
| Spawning and reproductive success | | | | | | |
| **Without mitigation** | Local | Short-term | High | Probable | **Low** | Medium |
| **With mitigation** | Local | Short-term | Low to Medium | Improbable | **VERY LOW** | Medium |
| Masking sounds and communication | | | | | | |
| Masking sounds and communication | Local | Short-term | Low | Improbable | **Very Low** | Low |
| **Without mitigation** | Local | Short-term | Low | Improbable | **VERY LOW** | Low |
| Indirect impacts | | | | | | |
| **Without mitigation** | Local | Short-term | Low | Improbable | **Very Low** | Low |
| **With mitigation** | Local | Short-term | Low | Improbable | **VERY LOW** | Low |

#### 5.2.1.4 POTENTIAL IMPACTS ON SEABIRDS

<u>Description of effect</u>

Among the marine avifauna occurring along the South Coast of South Africa, it is only the species that feed by plunge-diving or that rest on the sea surface (non-diving), which may be affected by the underwater noise of seismic surveys. Potential impacts of seismic pulses to seabirds could include physiological injury, behavioural avoidance of seismic survey areas and indirect impacts due to effects on predators or prey.

<u>Assessment</u>

Impacts on seabirds are summarised in Table 5.12 (non-diving seabirds) and 5.13 (diving seabirds).

*Physiological injury and mortality*

The continuous nature of the intermittent seismic survey pulses suggest that African penguins and other diving birds would hear the sound sources at distances where levels would not induce mortality or injury. Diving seabirds are all highly mobile and would be expected to flee from approaching sound sources at distances well beyond those that could cause physiological injury, although initiation of a sound source at full power in the vicinity of diving seabirds could result in injury or mortality where feeding behaviour override a flight response to seismic survey sounds. The potential for physiological impact of seismic noise on diving birds and African penguins could be of high intensity but would be limited to the survey area and survey duration (short term). In the vicinity of Cape St Francis, the inshore boundary of the proposed survey area is located approximately 100 km offshore. Of the plunge diving species that occur along the South Coast, only the Cape gannet regularly feeds as far offshore as 100 km, the rest foraging in nearshore areas up to 20 km from the coast.

The African Penguin forages at sea with most birds being found within 20 km of the coast. The nearest African penguin colonies along the South Coast occur at Dyer Island, Cape Recife and on the Algoa Bay islands (St Croix Island, Jaheel Island, Bird Island, Seal Island, Stag Island and Brenton Rocks). The majority of Algoa Bay penguins forage to the south of Cape Recife. There is thus a very low likelihood of the survey encountering foraging penguins.

The potential for physiological impact of seismic noise on diving bird species is considered to be of high intensity and would be limited to the survey areas and survey duration (short-term). The potential physiological impact on diving species is considered to be of **low** significance without mitigation and of **VERY LOW** significance with mitigation.

No physiological injury or mortalities impacts would occur in non-diving seabirds, as flying seabirds are highly mobile and would be expected to flee from approaching seismic noise sources at distances well outside of that that could cause physiological injury. The potential physiological impact on non-diving species is considered to be **INSIGNIFICANT**.

*Behavioural avoidance of seismic survey areas*

There is a very low likelihood of the survey encountering foraging African penguins. However, Cape gannets are likely to be encountered. African penguins and Cape gannets would be expected to hear seismic sounds at considerable distances as they have good hearing at low frequencies (which coincide with seismic shots). Avoidance behaviour by diving seabirds would only last for as long as the seismic survey continues and would be limited to the vicinity of the operating airgun within the survey area.

The impact is likely to be of medium to high intensity. The potential impact on the behaviour of diving seabirds is considered to be of **low** significance without mitigation and of **VERY LOW** significance with mitigation.

Avoidance behaviour would only last for as long as the seismic survey continues. The behavioural impact of seismic noise on non-diving seabirds is considered to be **INSIGNIFICANT**.

*Indirect impacts due to effects on predators or prey*

The assessment of indirect effects of seismic surveys on diving seabirds is limited by the complexity of trophic pathways in the marine environment and depends on the diet make-up of the bird species concerned and the effect of seismic surveys on the diet species. No information is available on the feeding success of seabirds in association with seismic survey noise. With few exceptions, most plunge-diving birds forage on small shoaling fish prey species relatively close to the shore and are unlikely to feed extensively in offshore waters that would be targeted during the seismic survey. The broad ranges of potential fish prey species (in relation to potential avoidance patterns of seismic surveys of such prey species) and extensive ranges over which most seabirds feed suggest that indirect impacts would be **VERY LOW** with and without mitigation.

<u>Mitigation</u>

Recommendations to mitigate the potential impacts on seabirds are the same as recommended for fish (refer to Section 5.2.3). In addition, the following is recommended:

- It is recommended that an area with a radius of 500 m be scanned for the presence of diving seabirds prior to the commencement of “soft-starts”. “Soft-start” procedures must only commence once it has been confirmed (visually during the day and using night-vision/infra-red binoculars at night) that there is no significant diving seabird activity within 500 m of the vessel;
- Daylight observations of the survey region should be carried out by an onboard Observer or Marine Mammal Observer (MMO). Seabird incidence and behaviour should be recorded. Any attraction of predatory seabirds by mass disorientation and stunning of fish as a result of seismic survey activities, and incidents of feeding behaviour near the hydrophone streamer, should be recorded;
- If obvious mortality or injuries to seabirds are observed, the survey should be terminated temporarily. However, it is important that Observers or MMOs have a full understanding of the financial implications of terminating firing, and that such decisions are made confidently and expediently. In this light it is suggested that Observers or MMOs advise when surveys are to be terminated and a log of all termination decisions is kept (for inclusion in both daily and close out reports);
- Lighting on board the survey vessel should be reduced to minimum safety levels to minimise stranding of pelagic seabirds on the survey vessel at night. All stranded seabirds must be retrieved and released according to appropriate guidelines; and
- All data recorded by the Observers or MMO should form part of a survey close-out report. Furthermore, daily reports should be forwarded to the necessary stakeholders to ensure compliance with the mitigation measures.

**Table 5.12: Impact of seismic noise on non-diving seabirds.**

| | Extent | Duration | Intensity | Probability | Significance | Confidence |
|---|---|---|---|---|---|---|
| Physiological injury | | | | | | |
| **Without mitigation** | Local | Short-term | Zero | Improbable | **Insignificant** | High |
| **With mitigation** | Local | Short-term | Zero | Improbable | **INSIGNIFICANT** | High |
| Behavioural avoidance | | | | | | |
| **Without mitigation** | Local | Short-term | Zero | Improbable | **Insignificant** | High |
| **With mitigation** | Local | Short-term | Zero | Improbable | **INSIGNIFICANT** | High |

**Table 5.13: Impact of seismic noise on diving seabirds.**

| | Extent | Duration | Intensity | Probability | Significance | Confidence |
|---|---|---|---|---|---|---|
| Physiological injury | | | | | | |
| **Without mitigation** | Local | Short-term | High | Probable | **Low** | Medium |
| **With mitigation** | Local | Short-term | Low | Improbable | **VERY LOW** | Medium |
| Behavioural avoidance | | | | | | |
| **Without mitigation** | Local | Short-term | Medium to High | Probable | **Low** | Medium |
| **With mitigation** | Local | Short-term | Low | Improbable | **VERY LOW** | Medium |
| Indirect impacts | | | | | | |
| **Without mitigation** | Local | Short-term | Low | Improbable | **Very Low** | Low |
| **With mitigation** | Local | Short-term | Low | Improbable | **VERY LOW** | Low |

### 5.2.1.5 POTENTIAL IMPACTS ON TURTLES

Description of impact

The most likely impacts on turtles from seismic survey operations include physiological injury (including disorientation) or mortality from seismic noise and collision with or entanglement in towed seismic apparatus, behavioural avoidance of seismic survey areas and indirect effects due to the effects of seismic sounds on prey species.

Assessment

Three species of turtles occur on the South Coast of South Africa. Although loggerhead and leatherback turtles nest on the beaches of northern KwaZulu-Natal, this is over 1 000 km to the north of the proposed survey area, and abundances in the survey area are likely to be extremely low comprising occasional vagrants or hatchlings moving southwards in the Agulhas Current. Impacts on turtles are summarised in Table 5.14.

*Physiological injury and mortality*

The overlap of turtle hearing sensitivity with the higher frequencies produced by airguns suggest that turtles may be considerably affected by seismic noise. Recent evidence, however, suggests that turtles only detect airguns at close range (<10 m) or are not sufficiently mobile to move away from approaching airgun arrays (particularly if basking). Initiation of a sound source at full power in the immediate vicinity of a swimming or basking turtle would be expected to result in physiological injury. This applies particularly to hatchlings and juveniles as they are unable to avoid seismic sounds whilst being transported in the Agulhas Current, and consequently are more susceptible to seismic noise. The potential impact could therefore be of high intensity, but remain within the short-term.

There is also the potential for collision between adult turtles and the seismic vessel or entanglement of turtles in the towed seismic equipment and surface floats. The potential impact on turtles is highly dependent on the abundance and behaviour of turtles in the survey area at the time of the survey. The abundance of adult turtles and hatchlings along the South Coast is low. Thus, the likelihood of encountering turtles during the proposed survey is also expected to be low. Turtles encountered occasionally during the survey are likely to be migrating vagrants and impacts through collision or entanglement would be of low intensity and short-term.

The potential physiological impact on turtles and the potential for mortality through collision or entanglement is considered to be of **low** significance without mitigation and **VERY LOW** significance with mitigation.

*Behavioural avoidance of seismic survey areas*
Behavioural changes by turtles in response to seismic sounds range from startle response and avoidance by fleeing an operating sound source, through to apparent lack of movement away from active airgun arrays. The impact of seismic sounds on turtle behaviour is of high intensity, but would persist only for the duration of the survey, and be restricted to the survey areas.

Given the general extent of turtle migrations relative to seismic survey target grids and the low abundance of turtles in the area, the impact of seismic noise on turtle migrations is deemed to be of **low** significance without mitigation and **VERY LOW** with mitigation.

*Reproductive success*
Following the emergence of hatchlings on the beaches of northern KwaZulu-Natal between January and March, they maintain mostly a pelagic existence offshore in the Agulhas Current. As hatchlings are weak swimmers they are more vulnerable to collision with the towed equipment and to direct seismic noise impacts from the airguns, which may stun them and render them more vulnerable to predation. The proposed survey area is located in deep waters of the Agulhas Current and hatchling survival may thus be affected.

The effect of seismic surveys on recruitment success is considered to be of high intensity but will vary with the distance offshore and timing of the specific survey. If recruitment success is affected, this could impact population size beyond the short-term to the medium-term. However, the likely low encounter rates would result in the impact of seismic noise or potential collision on hatchling survival to be of **low** significance without mitigation and **VERY LOW** with mitigation.

*Masking of environmental sounds and communication*
Breeding adults of sea turtles undertake large migrations between distant foraging areas and their nesting sites on the beaches of northern KwaZulu-Natal during the summer months October to March, with peak nesting during December and January. Although it is speculated that turtles may use acoustic cues for navigation during migrations, information on turtle communication and the effect of seismic noise is lacking. However, their low abundance in the survey area during the proposed scheduling of the survey (November to March) would suggest that the significance of this potential impact (should it occur) would be **INSIGNIFICANT**.

*Indirect impacts due to effects on predators or prey*
The diets of the three common South African turtle species are remarkably diverse. As the majority of the proposed survey area is located in deep waters away from any shallow water habitats known to be important for turtle feeding, destruction or adverse modification of critical habitat would thus be insignificant, and the effects of seismic surveys on the feeding behaviour of turtles is thus expected to be **VERY LOW** both with and without mitigation.

<u>Mitigation</u>
Recommendations to mitigate the potential impacts on turtles are the same as recommended for seabirds (refer to Section 5.2.4). In addition, the following is recommended:

- The onboard Observer or MMO should record incidence of turtles and their responses to seismic shooting, including position, distance from the vessel, swimming speed and direction and obvious changes in behaviour (e.g. startle responses or changes in surfacing/diving frequencies, breathing patterns, etc.). It is important that the identification and behaviour of the animals are recorded accurately along with sound levels. Observers or MMOs should therefore have experience in identification and differentiation of marine species, as well as observation techniques. The observer should also record (1) all “soft-starts” and pre-firing observation regimes, (2) incidence of feeding behaviour of predators within the hydrophone streamers, and (3) sightings of any injured or dead protected species, regardless of whether the injury or death was caused by the seismic vessel itself. If the injury or death was caused by a collision with the seismic vessel, the date and location (coordinates) of the strike and the species or a description of the animal should be recorded;

- Seismic shooting must be terminated when obvious negative changes to turtle behaviour is observed, if animals are observed within 500 m of the operating airgun and appear to be approaching the firing airgun or there is mortality or injuries to turtles as a direct result of the survey; and
- ‘Turtle-friendly’ tail buoys should be used by the survey contractor or existing tail buoys should be fitted with either exclusion or deflector 'turtle guards'.

**Table 5.14: Impact of seismic noise on turtles.**

| | Extent | Duration | Intensity | Probability | Significance | Confidence |
|---|---|---|---|---|---|---|
| Physiological injury from seismic noise or collision and entanglement | | | | | | |
| **Without mitigation** | Local | Short-term | High | Probable to Highly probable | **Low** | Medium |
| **With mitigation** | Local | Short-term | Low | Probable | **VERY LOW** | Medium |
| Behavioural avoidance of seismic survey areas | | | | | | |
| **Without mitigation** | Local | Short-term | High | Highly probable | **Low** | High |
| **With mitigation** | Local | Short-term | Low | Probable | **VERY LOW** | High |
| Reproductive success | | | | | | |
| **Without mitigation** | Local | Medium-term | High | Improbable | **Low** | High |
| **With mitigation** | Local | Short-term | Low | Improbable | **VERY LOW** | High |
| Masking sounds and communication | | | | | | |
| **Without mitigation** | Local | Short-term | Very Low | Improbable | **Insignificant** | Low |
| **With mitigation** | Local | Short-term | Very Low | Improbable | **INSIGNIFICANT** | Low |
| Indirect impacts | | | | | | |
| **Without mitigation** | Local | Short-term | Low | Improbable | **Very Low** | Low |
| **With mitigation** | Local | Short-term | Low | Improbable | **VERY LOW** | Low |

#### 5.2.1.6 POTENTIAL IMPACTS ON SEALS

Description of impact

Review of the available literature suggests that potential impacts of seismic pulses on Cape fur seals could include physiological injury, behavioural avoidance of seismic survey areas, masking of environmental sounds and underwater communication and indirect impacts due to effects on predators or prey.

Assessment

The Cape fur seal is the only seal species that has breeding colonies along the South Coast. Seal colonies in the vicinity of the proposed survey area are located at Seal Island in Mossel Bay, on the northern shore of the Robberg Peninsula in Plettenberg Bay and at Black Rocks (Bird Island group) in Algoa Bay. As seals are known to forage up to 120 nautical miles (~220 km) offshore, the proposed survey area potentially falls within the foraging range of seals from the nearby colonies, particularly in the Algoa Bay area. Therefore, there is a likelihood of the survey encountering seals.

*Physiological injury and mortality*
The potential for physiological injury to seals from seismic noise is expected to be low as it is assumed that highly mobile creatures such as fur seals would avoid severe sound sources at levels below those at which discomfort occurs, although Cape fur seals have been recorded to approach operational seismic survey gear. Their tendency to swim at or near the surface would expose them to reduced sound levels when in close proximity to an operating airgun array.

The potential impact of physiological injury to seals as a result of seismic noise is therefore deemed to be of medium intensity and would be limited to the survey area, although injury could extend beyond the survey duration. The significance of the impact without mitigation is **VERY LOW** with and without mitigation.

*Behavioural avoidance of seismic survey areas*
Although partial avoidance (to less than 250 m) of operating airguns has been recorded for some seal species, Cape fur seals appear to be relatively tolerant to loud noise pulses and, despite an initial startle reaction, individuals quickly revert back to normal behaviour.

The potential avoidance of seismic survey areas is thus considered to be of low to medium intensity and limited to the survey areas and duration. The potential impact of seal behaviour in response to seismic surveys is considered to be of **VERY LOW** significance with or without mitigation.

*Masking of environmental sounds and communication*
The fact that seals have acute underwater directional hearing suggests that sound is used in orientating underwater. True seals have been shown to use underwater vocalisation in both orientation and communication. The use of underwater sounds for environmental interpretation and communication by Cape fur seals is unknown, although masking is likely to be limited by the low duty cycle of seismic pulses (one pulse every 10 to 15 seconds). The impacts of masking are considered **VERY LOW** with and without mitigation.

*Indirect impacts due to effects on predators or prey.*
The assessment of indirect effects of seismic surveys on Cape fur seals is limited by the complexity of trophic pathways in the marine environment and depends on the diet make-up of the species (and the flexibility of the diet) and the effect of seismic surveys on the diet species. The broad ranges of fish prey species (in relation to the avoidance patterns of seismic surveys of such prey species) and the extended foraging ranges of Cape fur seals suggest that indirect impacts due to effects on predators or prey would be **VERY LOW** with and without mitigation.

<u>Mitigation</u>
Recommendations to mitigate the potential impacts on seals are similar to that recommended for turtles (refer to Section 5.2.5), except that:

- "soft-start" procedures should be allowed to commence, if after a period of 30 minutes seals are still within 500 m of the airguns; and
- airgun firing should only be terminated temporarily if any obvious negative changes to seal behaviour is observed in close proximity to firing airguns or there is any obvious mortality or injuries to seals as a direct result of the survey.

**Table 5.15: Impact of seismic noise on seals.**

| | Extent | Duration | Intensity | Probability | Significance | Confidence |
|---|---|---|---|---|---|---|
| Physiological injury | | | | | | |
| **Without mitigation** | Local | Short-term | Medium | Probable | **Very Low** | Medium |
| **With mitigation** | Local | Short-term | Low | Probable | **VERY LOW** | Medium |
| Behavioural avoidance of seismic survey areas | | | | | | |
| **Without mitigation** | Local | Short-term | Low to Medium | Probable | **Very Low** | High |
| **With mitigation** | Local | Short-term | Low | Probable | **VERY LOW** | High |
| Masking sounds and communication | | | | | | |
| **Without mitigation** | Local | Short-term | Low | Probable | **Very Low** | Medium |
| **With mitigation** | Local | Short-term | Low | Probable | **VERY LOW** | Medium |
| Indirect impacts | | | | | | |
| **Without mitigation** | Local | Short-term | Low | Probable | **Very Low** | High |
| **With mitigation** | Local | Short-term | Low | Probable | **VERY LOW** | High |

#### 5.2.1.7 POTENTIAL IMPACT ON CETACEANS (WHALES AND DOLPHINS)

Description of impact

Review of the available literature suggests that potential impacts of seismic pulses on cetaceans (whales and dolphins) could include physiological injury, behavioural avoidance of seismic survey areas, masking of environmental sounds and communication, and indirect impacts due to effects on predators or prey. Given the slow speed (about 4 to 6 knots) of the vessel while towing the seismic array, whip strikes are unlikely. Entanglement in gear is, however, possible.

Assessment

A wide diversity of cetaceans (whales and dolphins) occur off the South Coast of South Africa. The terms “whales” and “dolphins” relate to the size of cetacean species, but the group can best be divided into odontocete (toothed whales and dolphins) that are resident or migratory and mysticete (baleen whales) that are largely migratory. Marked differences occur in the hearing of odontocete cetaceans and mysticete cetaceans, with mysticete hearing centred at below 1 kHz, while odontocete hearing is centred at frequencies of between 10 and 100 kHz.

The distribution of whales and dolphins on the South Coast can largely be split into those associated with the continental shelf and those that occur in deep, oceanic waters. Species from both environments may, however, be found associated with the shelf (200 m to 1 000 m), making this 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 thousands of kilometres. The most common species within the proposed survey area (in terms of likely encounter rate not total population sizes) are likely to be the common bottlenose dolphin, long finned pilot whale, southern right whale and humpback whale.

Impacts on mysticete cetaceans and odontocete cetaceans are summarised in Tables 5.16 and 5.17, respectively.

*Physiological injury*

Physiological injury to cetaceans can result from exposure to high sound levels through a number of avenues, including trauma to both auditory and non-auditory tissues as shifts of hearing threshold (as permanent (PTS) or temporary threshold shifts (TTS)), direct tissue damage, acoustically induced decompression sickness or other non-auditory physiological effects.

There is little information available on the levels of noise that would result in physiological injury to whales and dolphins. No PTS have been recorded in cetaceans. TTS have been induced in captive dolphin species at received levels higher than 190 dB, although it should be noted that the limited duration of seismic survey pulses would limit the onset of TTS to far higher levels.

Available information suggests that the animal would need to be in close proximity to operating airguns to suffer physiological injury, and being highly mobile it is assumed that they would avoid sound sources at distances well beyond those at which injury is likely to occur. Deep-diving cetacean species (e.g. sperm whale) may, however, be more susceptible to acoustic injury, particularly in the case of seafloor-focussed seismic surveys, where the downward focussed impulses could trap deep diving cetaceans within the survey pulse, as escaping towards the surface would result in exposure to higher sound level pulses.

The majority of baleen whales migrate to the southern African subcontinent to breed during winter months. Humpback whales are reported to reach the coast in the vicinity of Knysna on their northern migrations around April, continuing through to September/October when the southern migration begins and continues through to December. Southern right whales arrive in coastal waters on the South Coast in June, building up to a maximum in September/October and departing again in December. The proposed survey areas thus lies within the migration paths of humpback whales, but offshore of areas frequented by southern right whales. As the survey is proposed for the summer months (November to March) encounters with migrating whales should be minimal, although some humpbacks on their return journey in November/December may still be encountered. However, the survey is likely to frequently encounter resident odontocetes such as common dolphins and pilot whales which are present year-round, and may encounter sperm whales in offshore areas.

The impact of potential physiological injury to both mysticetes (mainly humpback whales in November/December) and resident odontocetes as a result of high-amplitude seismic sounds is deemed to be of high intensity, but would be limited to the immediate vicinity of operating airguns within the survey area. The impact is therefore considered to be of **medium** significance before mitigation and **VERY LOW** significance with mitigation.

*Behavioural avoidance of seismic survey areas*

Mysticete cetaceans appear to avoid impulsive sounds of received levels greater than 150 to 180 dB, while subtle behavioural responses have been noted at levels of above 120 dB. Although behavioural avoidance of seismic noise by baleen whales is highly likely, such avoidance is generally considered of minimal impact in relation to the distances of migrations of the majority of mysticete cetaceans.

Of greater concern than general avoidance of migrating whales is avoidance of critical breeding habitats or areas where mating, calving or nursing occurs. Displacement from critical habitat is particularly important if the sound source is located at an optimal feeding or breeding ground or areas where mating, calving or nursing occurs. It is likely that the proposed survey area overlaps with migration routes of both humpback and southern right whales to and from their breeding grounds. The humpback whale has its winter breeding concentrations on the East Coast of Africa from northern KwaZulu-Natal northwards and, therefore, over 1 000 km to the north-east of the northern boundary of the proposed survey area. Southern right whales, however, currently have their most significant winter concentrations on the South Coast of South African between Port Elizabeth and Cape Town. The nearshore areas of the De Hoop MPA and St Sebastian Bay at Cape Infanta ranks as probably the most important nursery area for southern right whales in the world, containing 70 to 80% of the cow-calf pairs on the South African coast. The proposed survey area, which is mostly located beyond the 200 m isobaths and 100 km offshore at its closest point, therefore, does not overlap with such known areas. However, the paucity of fine scale data from offshore waters on the distribution and seasonal occurrence of most cetacean species prevents prediction where such critical habitat might be with any certainty.

The potential impact of behavioural avoidance of the seismic survey area by mysticete cetaceans is considered to be of high intensity across the survey area and for the duration of the survey. Considering the distribution ranges of most species of cetaceans, the impact of behavioural avoidance by mysticete cetaceans is thus considered to range from **low** (southern right) to **medium** (humpback) before mitigation and **VERY LOW** (southern right) to **LOW** (humpback) after mitigation.

There is very limited information on the response of odontocete cetaceans to seismic surveys. No seasonal patterns of abundance are known for odontocetes occupying the proposed survey area and there is less evidence of avoidance of seismic surveys by toothed whales (including dolphins). Of the smaller odontocetes, the common bottlenose dolphin offshore and humpback dolphins are known to be resident on the shelf and offshore and are likely to be frequently encountered in the survey area. Similarly, the long-finned pilot whale, which is usually associated with the shelf edge, is likely to be commonly encountered. False killer whales, killer whales and the offshore form of the bottlenose dolphin are also likely to be encountered with some regularity in deeper waters. A number of other toothed whale species have a more pelagic distribution and are likely to be encountered further offshore. The overall significance of the potential impact will therefore vary between species, and consequently ranges between **low** and **very low** before mitigation and **VERY LOW** with mitigation.

*Masking of environmental sounds and communication*
Mysticete cetaceans appear to vocalise almost exclusively within the frequency range of the maximum energy of seismic survey noise, while odontocete cetaceans vocalise at frequencies higher than these. Since noise in the mid-frequency range can travel far, masking of communication sounds produced by whistling dolphins and blackfish[2] is likely. In the migratory baleen whale species, vocalisation increases once they reach the breeding grounds and on the return journey in November / December when accompanied by calves. However, masking of communication signals is likely to be limited by the low duty cycle of seismic pulses (one firing impulse every 10 to 15 seconds). Consequently the intensity of impact on mysticetes is likely to be low over the survey area and of short duration, but high in the case of odontocetes. Whereas for mysticetes the significance is rated as **VERY LOW,** both with and without mitigation, for odontocetes it is rated as **low** without mitigation and **VERY LOW** with mitigation.

*Indirect impacts due to effects on predators or prey.*
The majority of mysticete cetaceans would undertake little feeding within breeding ground waters and rely on blubber reserves for the migrations from the feeding grounds. Therefore, the significance of indirect effects on their food source is **VERY LOW**.

The assessment of indirect effects of seismic surveys on resident odontocete cetaceans is limited by the complexity of trophic pathways in the marine environment and depends on the diet make-up of the species (and their flexibility in their diet) and the effect of seismic surveys on the diet species. However, it is expected that both fish and cephalopod prey of toothed whales and dolphins may be affected over limited areas. The

[2] The term blackfish refers to the delphinids: Melon-headed whale, Killer whale, Pygmy Killer Whale, False Killer Whale, Long-finned Pilot Whale and Short-finned Pilot Whale.

broad ranges of prey species (in relation to the avoidance patterns of seismic surveys of such prey species) suggest that indirect impacts due to effects on prey would be **VERY LOW** before and after mitigation.

Mitigation

Recommendations to mitigate potential impacts on cetaceans are similar to that recommended for turtles (refer to Section 5.2.6). In addition, the following is recommended:

- The seismic survey should, as far as possible, be planned to avoid cetacean migration periods from their southern feeding grounds into low latitude waters (June to November). In addition, surveying should ideally avoid December when humpback whales may still be moving through the area on their return migrations. Should surveying during November and December be unavoidable, Passive Acoustic Monitoring (PAM) technology, which detects animals through their vocalisations, must be implemented 24 hours a day. For all other periods, PAM technology must be used during seismic surveys at night and during daytime adverse weather conditions and thick fog;
- "Soft-start" procedures must only commence once it has been confirmed (visually during the day[3] and using PAM technology and night-vision/infra-red binoculars at night) that there is no large cetacean activity within 500 m of the vessel for a 30-minute period[4]. In the case of small cetaceans (particularly dolphins), which are common in inshore waters and often attracted to survey vessels, "soft start" procedures should, if possible, only commence once it has been confirmed that there is no small cetacean activity within 500 m of the airguns. However, if after a period of 30 minutes small cetaceans are still within 500 m of the airguns, the normal "soft start" procedure should be allowed to commence;
- The use of the lowest practicable airgun volume should be defined by the operator and enforced; and
- Marine mammal incidence data and seismic source output data arising from the survey should be made available, if requested, to the Marine Mammal Institute, Department of Environmental Affairs: Branch Oceans and Coasts, Department of Agriculture, Forestry and Fisheries (DAFF) and PASA for analyses of survey impacts in local waters.

**Table 5.16: Impact of seismic noise on mysticete cetaceans (baleen whales).**

| | Extent | Duration | Intensity | Probability | Significance | Confidence |
|---|---|---|---|---|---|---|
| Physiological injury | | | | | | |
| **Without mitigation** | Local | Short-term | High | Probable | **Medium** | Medium |
| **With mitigation** | Local | Short-term | Low to Medium | Probable | **LOW** | Medium |
| Behavioural avoidance | | | | | | |
| **Without mitigation** | Local | Short-term | High | Probable | **Low to Medium** | High |
| **With mitigation** | Local | Short-term | Low | Probable | **VERY LOW TO LOW** | High |
| Masking sounds and communication | | | | | | |
| **Without mitigation** | Local | Short-term | Low | Probable | **Very Low** | Medium |
| **With mitigation** | Local | Short-term | Low | Probable | **VERY LOW** | Medium |
| Indirect impacts | | | | | | |
| **Without mitigation** | Local | Short-term | Very Low | Probable | **Very Low** | High |
| **With mitigation** | Local | Short-term | Very Low | Probable | **VERY LOW** | High |

[3] Note: should surveying in the sensitive cetacean periods be unavoidable, PAM technology must be used, in addition to the visual watches by the MMO, during the day.

[4] Note: once it has been confirmed that there is no cetacean activity within 500 m of the vessel and soft-start procedures have commenced, monitoring must continue, but there is no need to monitor using night-vision/infra-red binoculars at night.

**Table 5.17: Impact of seismic noise on odontocete cetaceans (toothed whales and dolphins).**

| | Extent | Duration | Intensity | Probability | Significance | Confidence |
|---|---|---|---|---|---|---|
| Physiological injury | | | | | | |
| **Without mitigation** | Local | Short-term | High | Probable | **Medium** | Medium |
| **With mitigation** | Local | Short-term | Low to Medium | Probable | **LOW** | Medium |
| Behavioural avoidance | | | | | | |
| **Without mitigation** | Local | Short-term | Medium to High | Probable | **Very Low to Low** | High |
| **With mitigation** | Local | Short-term | Low to Medium | Probable | **VERY LOW** | High |
| Masking sounds and communication | | | | | | |
| **Without mitigation** | Local | Short-term | High | Probable | **Low** | Medium |
| **With mitigation** | Local | Short-term | Low | Probable | **VERY LOW** | Medium |
| Indirect impacts | | | | | | |
| **Without mitigation** | Local | Short-term | Low | Probable | **Very Low** | Medium |
| **With mitigation** | Local | Short-term | Low | Probable | **VERY LOW** | Medium |

## 5.2.2 IMPACTS FROM DROP CORE SAMPLING

### 5.2.2.1 SEDIMENT REMOVAL

Description of impact

During sampling activities sediment cores would be removed from the seabed. Benthic fauna typically inhabit the top 20 to 30 cm of sediment. Therefore, the cores would eliminate any benthic infaunal and epifaunal biota in the core footprints, resulting in a loss of some benthic biodiversity.

Assessment

The proposed project would result in the removal of up to 200 core samples. Assuming a core diameter of 100 mm, each drop core sample would remove a surface area of ~0.008 $m^2$. At a maximum length of 9 m, each drop-core sample would result in the removal of 0.072 $m^3$ of sediment per sample at maximum penetration. If 200 cores are taken, a total cumulative area of 1.6 $m^2$ would be impacted and a maximum of 14.4 $m^3$ sediment removed from a 76 060 $km^2$ sea area under. Any change in sediment composition is thus expected to be minimal and would not affect recovery. In addition, considering the available area of similar habitat on the Agulhas Bank and off the edge of the continental shelf, this reduction in benthic biodiversity can be considered negligible.

Impacts on the offshore benthos as a result of sediment removal are considered to be of high intensity at an extremely local scale (i.e. confined to the core footprints). Full recovery is expected to take place within 1 to 5 years (i.e. short term), as the excavations would be refilled through sediment influx and recolonisation would occur through recruitment and immigration from adjacent areas. Therefore, this impact is rated as being **INSIGNIFICANT** (see Table 5.18).

Mitigation

No mitigation measures are possible.

#### 5.2.2.2 PHYSICAL CRUSHING OF BENTHIC BIOTA

Description of impact

Some disturbance or loss of adjacent benthic biota can be expected as a result of the placement on the seabed of the trigger weight. Epifauna and infauna beneath the footprint of the weight may be smothered or crushed resulting in a reduction in benthic biodiversity. Crushing is likely to primarily affect soft-bodied species as some molluscs and crustaceans may be robust enough to survive.

Assessment

Although some sampling activities may occur within potential benthic protection priority areas (Southwest Indian Seamounts and Browns Bank fall within the survey area - see Figure 4.7), a very small surface area would be impacted at any one sampling site. Although the impacts would be of medium to high intensity, it would be highly localised and short-term as recolonisation would occur rapidly from adjacent undisturbed sediments. The potential impact is consequently deemed to be **INSIGNIFICANT** (see Table 5.18).

Mitigation

No mitigation measures are possible.

**Table 5.18: Impact of drop core sampling on benthic fauna.**

| | Extent | Duration | Intensity | Probability | Significance | Confidence |
|---|---|---|---|---|---|---|
| **Without mitigation** | Local (highly) | Short-term | Medium to High | Definite | **Insignificant** | High |
| **With mitigation** | Local (highly) | Short-term | Medium to High | Definite | **INSIGNIFICANT** | High |

## 5.3 IMPACT ON OTHER USERS OF THE SEA

### 5.3.1 POTENTIAL IMPACT ON FISHING INDUSTRY

#### 5.3.1.1 POTENTIAL IMPACT ON FISHING SECTORS

Description of impact

The acquisition of high quality data requires that the position of the survey vessels is accurately known and that they travel in uninterrupted lines. For this reason the survey vessel, together with its towed arrays / source, is considered to be restricted in its ability to manoeuvre and requires that vessels engaged in fishing shall, so far as possible, keep out of the way of such vessels. Furthermore, a survey vessel falls under the definition of an “offshore installation” and as such it is protected by a 500 m safety zone. In addition to the statutory 500 m safety zone, seismic contractor would request a safe operational limit (that is greater than the 500 m safety zone) that it would like other vessels to stay beyond.

The presence of the survey vessel with the associated 500 m safety zone and proposed safe operational limits could interfere with fishing in the area. The impact on the fishing industry includes the likely disruption to fishing operations and temporary loss of access to fishing grounds in the proposed survey areas over the survey period. The proposed seismic survey could potentially impact the following fishing sectors:

- Demersal trawl;
- Small pelagic purse-seine;
- Demersal long-line (hake- and shark-directed);
- Pelagic long-line (tuna- and shark-directed);
- Traditional line fish;
- South Coast rock lobster;

- Squid jig; and
- Mid-water trawl.

Assessment

*Demersal trawl*

The demersal trawl fishery, which primarily targets the bottom-dwelling (demersal) species of hake, is South Africa's most valuable sector. Within the proposed survey area trawling occurs west of 27°E longitude inshore of the 1 000 m isobath (see Figure 4.11). Trawling grounds extend across the western portion of the proposed survey area (west of 22°E), inshore of the 1 000 m isobaths (see Figure 4.11). Approximately 4 510 $km^2$ of trawling grounds coincide with the proposed survey area which is equivalent to approximately 6.4 % of the total ground available to the fishery. Over the period 2006 to 2010, 7.8 % of the total effort of the demersal trawl fishery was conducted within the proposed survey area at an average of 2 740 trawls per year.

The demersal trawl fishery is active year-round and it is highly likely that trawl activity would be encountered within the proposed survey area. The potential impact on the demersal trawl sector is considered to be local and of medium intensity over the short-term. This impact is assessed to be of **VERY LOW** significance with and without mitigation (see Table 5.18).

*Small pelagic purse-seine*

The small pelagic fishery is the largest South African fishery by volume and the second most important in terms of value. Annual landings have fluctuated between 300 000 and 600 000 tons over the last decade, with landings of 312 000 tons recorded for 2009. The two main targeted species are sardine and anchovy, with associated by-catch of round herring (red-eye) and juvenile horse mackerel.

The pelagic purse-seine fishery operates predominantly on the West and South Coast up to a distance of 50 nautical miles offshore, usually inshore of the 100 m isobaths (see Figure 4.13). The fishery thus operates well inshore of the proposed survey area and no impact is expected.

*Demersal long-line*

The demersal long-line fishery is split into two fishing sectors, namely the hake long-line and the shark long-line sector.

Demersal hake long-line vessels operate in well-defined areas extending along the shelf break from Port Nolloth to Port Elizabeth (see Figure 4.15). Fishing activity would be expected to occur within the survey area along and inshore of the 500 m depth contour. Long-line grounds coincide with approximately 2 304 $km^2$ of the proposed survey area, which is estimated to be 3.9 % of the total grounds fished by the demersal hake long-line fishery. An annual average of 1 million hooks were set and 215 tons of hake (whole, gutted) were caught in the area over the period 2002 to 2008, corresponding to 2.6 % of the overall national effort and 2.8 % of the total landings, respectively. During hauling operations a demersal long-line vessel would be severely restricted in manoeuvrability. Therefore, direct communication with the fishing industry prior to and during surveying would be required to reduce risks to both the proposed survey and fishing operations. The impact on the demersal hake long-line fishery is considered to be local and of medium intensity over the short-term. This impact is assessed to be of **VERY LOW** significance with and without mitigation (see Table 5.19).

The shark long-line fishery operates inshore of the 100 m isobath. The proposed survey area lies beyond the 200 m isobaths and thus would not coincide with the demersal shark-directed longline fishing grounds. No impact is thus expected.

*Large pelagic long-line*

The target species within the South African pelagic long-line sector are yellowfin tuna, bigeye tuna, swordfish and shark species (primarily mako shark). Pelagic long-line effort for tuna extends along and offshore of the 500 m isobath, whilst pelagic shark species are targeted primarily along the 200 m isobath. Grounds are extensive within the proposed survey area (see Figures 4.17 and 4.18).

Within the South African and foreign-flagged fleet combined, approximately 8.1 % of the total national effort is conducted within the proposed survey area annually (approximately 387 000 hooks) and 19.8 % of the total national catch is taken by this fishery (approximately 289 tons of targeted species).

The potential impact on the large pelagic long-line fishery is considered to be regional and of high intensity over the short-term. This impact is assessed to be of **MEDIUM** significance with and without mitigation (see Table 5.19).

*Traditional line fish (recreational and commercial)*

The South African commercial line fishery is the country's third most important fishery in terms of total tons landed and economic value. The traditional line fishery is based on approximately 35 species. Different assemblages of species are targeted according to the region in which they are being fished and include tuna species, sparidae, serranidae, caragidae, scombridae and sciaenidae.

The fishery is widespread from Port Nolloth on the West Coast to Cape Vidal on the East Coast. In the vicinity of the proposed survey area, vessels are restricted to water depths of approximately 100 m due to the fast-flowing Agulhas current (see Figure 4.19). As such the fishery does not coincide with the proposed survey area and is not expected to be impacted by seismic operations.

*South Coast rock lobster*

The South Coast rock lobster occurs on the continental shelf of the South Coast between depths of 50 m and 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 (see Figure 4.20). The fishery is restricted by the Agulhas Current from operating far offshore.

The proposed survey area coincides with approximately 278 km$^2$ of South Coast rock lobster fishing grounds on the Agulhas Bank. Within the proposed survey area an average of 93 500 traps were set per annum between 2001 and 2008. This is approximately 3.4 % of the total effort conducted within South African water by the fishery. During this time the catch of rock lobster taken from the area amounted to 13.3 tons (tail) which is 3.6 % of the total catch taken by the fishery.

The potential impact of the proposed surveys on the South Coast rock lobster fishery is assessed to be local and of medium intensity in the short-term. This potential impact is considered to be of **VERY LOW** significance before and after mitigation (see Table 5.19).

*Squid jig*

Chokka squid 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 4.22). The fishery is seasonal, with most effort conducted between November and March. The grounds for the squid fishery lie well inshore of the proposed survey area and, therefore, no impact is expected.

*Mid-water trawl*

The mid-water trawl fishery targets adult horse mackerel which aggregate in highest concentration on the Agulhas Bank. Fishing grounds are condensed into three areas on the shelf edge of the South and East coasts ranging in depth from 100 m to 400 m, namely: (1) between 22ºE and 23ºE at a distance of approximately 70 nm offshore from Mossel Bay; (2) between 24ºE to 27ºE at a distance of approximately 30 nm offshore; and (3) south of the Agulhas Bank between 21°E and 22°E.

Mid-water trawling grounds to the South of the Agulhas Bank coincide with the proposed survey area, inshore of the 500 m isobaths between 21°E and 22.5°E (see Figure 4.22). Approximately 1 291 $km^2$ of the fishing grounds coincide with the proposed survey area which is equivalent to approximately 7.8 % of the total ground available to the fishery. Between 2000 and 2008, 1.7 % of the total effort of the fishery was conducted within the proposed survey area at an average of approximately 22 trawls per year. An annual average of approximately 1.6 % (339 tons) of the total catch (all species landed) was taken within this area.

The potential impact of the proposed survey on the mid-water trawl sector is assessed to be local and of medium intensity in the short-term. This potential impact is considered to be of **VERY LOW** significance before and after mitigation (see Table 5.19).

<u>Mitigation</u>

The mitigation measures listed below are unlikely to reduce the significance of potential impacts, but they would minimise disruptions to survey and fishing operations.

- Prior to the commencement of the seismic survey, the fishing industry / associations (including South African Deep-sea Trawling Industry Association, South East Coast Inshore Fishery Association, Small Hake Quota Holders Association, South African Tuna Longline Association, Hake Longline Association, South Coast Rock Lobster Association, Blue Continent Products, South African Squid Management Industry Association, South African Marine Linefish Association and the Small Pelagic Sea Management Association) and other key stakeholders (including DAFF, Port Captains, South African Maritime Safety Authority (SAMSA) and South African Navy Hydrographic office) should be consulted and informed of the proposed seismic survey and the likely implications for the various fishing sectors in the area. This would involve pre-survey notification of navigational co-ordinates of the survey areas, timing and duration of proposed activities and likely implications for the fishing industry;
- Total E&P must request, in writing, the South African Navy Hydrographic office to release Radio Navigation Warnings and Notices to Mariners throughout the seismic survey period. The Notice to Mariners should give notice of (1) the co-ordinates of the proposed survey areas, (2) an indication of the proposed survey timeframes and day-to-day location of the survey vessel, and (3) an indication of the 500 m safety zones and the proposed safe operational limits of the survey vessel. These Notices to Mariners should be distributed timeously to fishing companies and directly onto vessels where possible;
- An experienced onboard Independent Observer must be appointed to act as a fisheries and MMO. The observer should provide a fisheries facilitation role to identify and communicate with fishing vessels in the area to reduce the risk of gear interaction between fishing and survey activities. The Observer should be familiar with fisheries operational in the area, as well as with environmental monitoring protocols relating to marine fauna. The Observer should:
  - report on vessel activity daily;
  - advise on actions to be taken in the event of encountering fishing gear; and
  - set up a daily electronic reporting routine to keep key stakeholders informed of survey activity and progress and fisheries and environmental issues.
- The survey vessel should be accompanied by a chase boat with staff familiar with the fisheries expected in the area; and
- In order to minimise disruption to survey time and fishing operations the following specific mitigation measures are recommended for the different fishing sectors:
  - Demersal and mid-water trawlers: Identify trawling vessels and notify them that the survey may move into trawling areas;

> Small pelagic purse seine: Identify active vessels and establish communications with known operators for the duration of the survey;
> Large pelagic long-lines: Establish communications with the known operators if drifting buoys (with radar responders) are sighted;
> Demersal long-lines: Identify gear (marked at each end by a surface buoy) and establish communication with skippers on the position of set gear; and
> Squid jig: Identify active vessels and set up ongoing communications with operators for the duration of the survey.

**Table 5.19: Assessment of the potential impact on fishing activities in the proposed survey area.**

| | Extent | Duration | Intensity | Probability | Significance | Confidence |
|---|---|---|---|---|---|---|
| Demersal trawl | | | | | | |
| **Without mitigation** | Local | Short-term | Medium | Highly probable | **Very Low** | High |
| **With mitigation** | Local | Short-term | Medium | Highly probable | **VERY LOW** | High |
| Demersal long-line (hake-directed) | | | | | | |
| **Without mitigation** | Local | Short-term | Medium | Highly probable | **Very Low** | High |
| **With mitigation** | Local | Short-term | Medium | Highly probable | **VERY LOW** | High |
| Large pelagic long-line (tuna-directed) | | | | | | |
| **Without mitigation** | Regional | Short-term | High | Highly probable | **Medium** | High |
| **With mitigation** | Regional | Short-term | High | Highly probable | **MEDIUM** | High |
| South Coast rock lobster | | | | | | |
| **Without mitigation** | Local | Short-term | Medium | Probable | **Very Low** | High |
| **With mitigation** | Local | Short-term | Medium | Probable | **VERY LOW** | High |
| Mid-water trawl | | | | | | |
| **Without mitigation** | Local | Short-term | Medium | Highly probable | **Very Low** | High |
| **With mitigation** | Locall | Short-term | Medium | Highly probable | **VERY LOW** | High |

#### 5.3.1.2 POTENTIAL IMPACT ON FISHERIES RESEARCH

Description of impact

Fisheries research on small pelagic and demersal fish resources are undertaken by DAFF off the South African coastline on a bi-annual basis in order to set the annual Total Allowable Catch. The presence of the seismic vessel, and associated 500 m safety zone and proposed safe operational limits, could interfere with this research.

Assessment

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. Trawl positions are randomly selected to cover specific depth strata that range from coast to the 1 000 m bathycontour. The South Coast surveys usually take place in May and September, lasting one month each. The survey vessel *FRS Africana* is the dedicated research vessel used to conduct both surveys. A similar gear configuration is used to that of commercial demersal trawlers. However, nets are towed for a shorter duration of generally 30 minutes per tow.

Two further acoustic surveys are undertaken on the small pelagic species in order to assess their biomass during November and April. During the surveys the survey vessel travels pre-determined transects (perpendicular to bathycontours) running from the coast out to approximately the 200 m bathycontour. The survey is designed to cover an area extensive area from the Orange River on the West Coast to Port Alfred on the South Coast.

The timings of the demersal and acoustic surveys are not flexible, due to restrictions with availability of the research vessel, as well as scientific requirements. Since the proposed seismic survey is anticipated to commence during the summer of 2013/2014 and would take two to three months to complete, there is a possibility that these demersal and acoustic surveys could coincide with the proposed seismic survey resulting in possible impacts to both the research surveys and exploration programme. The impact of the proposed seismic survey on the fishery research is considered to be regional and of medium intensity in the short-term. The overall significance of this impact is expected to be **LOW** both with and without mitigation (see Table 5.20).

Mitigation

The most effective means of mitigation would be to ensure that the proposed seismic survey do not coincide with the research surveys. It is recommended that prior to the commencement of the seismic survey, Total E&P and the managers of the research survey programmes, Deon Durholtz (DeonD@nda.agric.za) and Janet Coetzee (JanetC@nda.agric.za) of DAFF, discuss their respective survey and survey programmes and the possibility of altering the exploration programme in order to minimise or avoid disruptions to both parties.

**Table 5.20: Assessment of the potential impact on fishing research in the proposed survey area.**

| | Extent | Duration | Intensity | Probability | Significance | Confidence |
|---|---|---|---|---|---|---|
| **Without mitigation** | Regional | Short-term | Medium | Probable | **Low** | High |
| **With mitigation** | Regional | Short-term | Medium | Probable | **LOW** | High |

## 5.3.2 POTENTIAL IMPACT ON MARINE TRANSPORT ROUTES

Description of impact

The acquisition of high quality data requires that the position of the survey vessel is accurately known and that it travel in uninterrupted lines. For this reason the survey vessel, together with its towed arrays / source, is considered to be restricted in its ability to manoeuvre and under COLREGS, 1972 (Part A, Rule 10) requires that power-driven and sailing vessels give way to a vessel restricted in its ability to manoeuvre. Vessels engaged in fishing are also required to, so far as possible, keep out of the way of the seismic survey operation. Furthermore, a survey vessel falls under the definition of an “offshore installation” and as such it is protected by a 500 m safety zone. In addition to the statutory 500 m safety zone, the seismic contractor would request a safe operational limit (that is greater than the 500 m safety zone) that it would like other vessels to stay beyond. The presence of the seismic vessel could thus interfere with shipping in the area.

Assessment

A large number of vessels navigate along the South Coast on their way around the southern African subcontinent (see Figure 4.25). The majority of this vessel traffic, including commercial and fishing vessels, remains relatively close inshore and is, therefore, expected to pass inshore of the proposed survey area (see safe shipping routes around the coast of South Africa in Figure 4.26). 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. Important commercial harbours include Mossel Bay and Port Elizabeth.

Although the safety zone around the seismic vessel would be relatively small all vessels would be prohibited from entering this area. The displacement of shipping would be limited to within the extreme near vicinity of the seismic vessel. Although survey vessels are protected by a 500 m safety zone, there could be some interaction with marine traffic during surveying, resulting in disruptions and/or delays. This is normally mitigated by a notice to mariners and regular communication through daily notifications.

The potential impact on shipping traffic in the proposed seismic survey area is considered to be regional, of high intensity in the short-term. The significance of this potential impact is therefore assessed to be **medium** without mitigation and **LOW** with mitigation (see Table 5.21).

Mitigation

Recommendations to mitigate the potential impacts on marine transport routes are similar to that recommended for fishing (refer to Section 5.3.1). In addition, the following is recommended:

- The seismic and support vessels must be certified for seaworthiness through an appropriate internationally recognised marine certification programme (e.g. Lloyds Register, Det Norske Veritas). The certification, as well as existing safety standards, requires that safety precautions would be taken to minimise the possibility of an offshore accident;
- Collision prevention equipment on the vessels should include radar, multi-frequency radio, foghorns, etc. Additional precautions include: the chase boat with staff familiar with the fisheries expected in the area, the existence of an internationally agreed safety zone around the survey vessel, cautionary notices to mariners and access to current weather service information. The vessel is required to fly standard flags, lights (three all-round lights in a vertical line, with the highest and lowest lights being red and the middle light being white) or shapes (three shapes in a vertical line, with the highest and lowest lights being balls and the middle light being a diamond) to indicate that it is engaged in towing surveys and is restricted in manoeuvrability, and must be fully illuminated during twilight and night; and
- Report any emergencies to SAMSA.

**Table 5.21: Assessment of interference with marine transport routes.**

| | Extent | Duration | Intensity | Probability | Significance | Confidence |
|---|---|---|---|---|---|---|
| **Without mitigation** | Regional | Short-term | Medium | Probable | **Low** | Medium |
| **With mitigation** | Regional | Short-term | Low | Probable | **VERY LOW** | Medium |

### 5.3.3 POTENTIAL IMPACT ON MARINE PROSPECTING, MINING, EXPLORATION AND PRODUCTION ACTIVITIES

Description of impact

The presence of the survey vessel with the associated 500 m safety zone and proposed safe operational limits could interfere with other prospecting, mining, exploration and production activities in the area.

Assessment

*Prospecting and mining*

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. The validity of these permits could not be confirmed with a great deal of certainty, but the Department of Mineral Resources indicated that they may no longer be valid. These areas are located well inshore of the proposed area.

Manganese nodules enriched with valuable metals occur in water depths of over 3 000 m on the west, south and east coasts of South Africa (see Figure 4.27). The proposed survey area does overlap with these areas.

The potential impact on prospecting and mining is considered to be localised and of very low intensity in the short-term. The significance of this potential impact is thus assessed to be **INSIGNIFICANT** with and without mitigation (see Table 5.22).

*Exploration and production*

Although the proposed seismic survey would be limited to an “approved” survey area, the vessel would need to exit the proposed survey area during line changes, which may, although unlikely, have an impact on other exploration right holders and associated exploration activities.

There are currently no production related activities within the proposed survey area. The closest production related activities are located in Block 9 on the South Coast, well to the north of the proposed survey area. Thus, the proposed survey is unlikely to affect any production related activities.

The potential impact on exploration activities, although unlikely, is considered to be localised, of low to medium intensity in the short-term. The significance of this impact is assessed to be **VERY LOW** with and without mitigation (see Table 5.22).

<u>Mitigation</u>

- Total E&P should engage timeously with other exploration / production right holders in order to discuss the scheduling of the proposed survey in relation to current / proposed exploration activities. This would involve pre-survey notification of navigational co-ordinates of the survey area, timing and duration of proposed activities; and
- Any dispute arising should be referred to the Department of Mineral Resources or PASA for resolution.

**Table 5.22: Impact on marine prospecting, mining, exploration and production activities.**

| | Extent | Duration | Intensity | Probability | Significance | Confidence |
|---|---|---|---|---|---|---|
| Prospecting and mining | | | | | | |
| **Without mitigation** | Local | Short-term | Very Low | Improbable | **Insignificant** | Medium |
| **With mitigation** | Local | Short-term | Very Low | Improbable | **INSIGNIFICANT** | Medium |
| Exploration and production | | | | | | |
| **Without mitigation** | Local | Short-term | Low to Medium | Improbable | **Very Low** | High |
| **With mitigation** | Local | Short-term | Low | Improbable | **VERY LOW** | High |

# 6. CONCLUSIONS AND RECOMMENDATIONS

Total E&P is proposing to explore for oil and gas reserves in the deep offshore area of the South Coast of South Africa roughly between Cape Agulhas and Cape St. Francis, referred to as the Outeniqua South Area. Exploration activities would include a 2D seismic survey, a sonar bathymetric survey and drop core sampling. Although survey commencement would ultimately depend on a permit award date, it is anticipated that the seismic survey would commence during the last quarter of 2013 and would take in the order of two to three months to complete (between November 2013 and March 2014). Following analysis of the 2D seismic data, a sonar bathymetry survey and drop core sampling would be undertaken. These activities are proposed to take place from November 2014, with an estimated duration of 30 to 45 days.

In order to undertake the proposed exploration activities Total E&P lodged an application for an Exploration Right with the Petroleum Agency of South Africa (PASA) in terms of Section 74 of the Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA). PASA accepted the application on 28 June 2012. A requirement of obtaining an Exploration Right is that an EMP has to be compiled in terms of Section 39 of the MPRDA and I&APs must be notified and consulted. Total E&P appointed CCA to compile an EMP to meet the relevant requirements of the MPRDA and the Regulations thereto.

Specialists were appointed to address the two key issues, namely the effect on the fishing industry and effects on marine fauna. The findings of the specialist studies and other relevant information have been integrated and synthesised into this EMP.

This chapter summarises the key findings of the study and presents mitigation measures that should be implemented if the proposed survey goes ahead.

## 6.1 CONCLUSIONS

A summary of the assessment of potential environmental impacts associated with the proposed exploration activities is provided in Table 6.1.

In summary, the majority of the impacts would be of short-term duration and limited to the immediate survey area. As a result, the majority of the impacts associated with the exploration activities are considered to be of **INSIGNIFICANT** to **LOW** significance after mitigation.

The two key issues identified in this study relate to:

- The potential impact on marine mammals (physiological injury and behavioural avoidance) as a result of seismic noise; and
- The potential impact on the fishing industry (vessel interaction, disruption to fishing operations and reduced catch) due to the presence of the survey vessel with its associated safety zone, potential fish avoidance of the survey area and changes in feeding behaviour.

Although most of the impacts on cetaceans are assessed to have **VERY LOW to LOW** significance with mitigation, the impact could be of much higher significance due to the limited understanding of how short-term effects of seismic surveys relate to longer term impacts. For example, if a sound source displaces a species from an important breeding area for a prolonged period, impacts at the population level could be more significant. In order to mitigate the potential impact on cetaceans it is recommended that the proposed exploration activities be planned, as far as possible, to avoid cetacean migration and breeding periods from June to November (inclusive). In addition, surveying should ideally avoid December when humpback whales may still be moving through the area on their return migrations. Should surveying in the sensitive cetacean periods be unavoidable, PAM technology, which detects animals through their vocalisations, must be implemented 24 hours a day. Various other measures are recommended to further mitigate the potential impact on cetaceans, e.g. “soft-starts”, temporary termination of survey, etc. It should, however, be noted that if the survey activities are undertaken when more whales are likely to be present in the area, there could be increased downtime due to the temporary termination of survey activities.

The potential impact on the fishing industry ranges from **VERY LOW** (demersal trawl, hake demersal long-line, mid-water trawl and South Coast rock lobster) to **MEDIUM** (pelagic long-line) significance with and without mitigation. However, if fish avoid the survey area and / or change their feeding behaviour it could have a more significant impact on the fishing industry. Research has, however, shown that behavioural effects are generally short-term with duration of the effect being less than or equal to the duration of exposure, although these vary between species and individuals, and are dependent on the properties of the received sound. Similarly, if there was any interaction between the seismic survey vessel and a fishery the significance of the impact could be higher. Thus it is important that Total E&P engage timeously with the fishing industry prior to and during the survey. Regular communication with fishing vessels in the vicinity during surveying would minimise the potential disruption to fishing operations and risk of gear entanglements.

As the proposed survey area is located beyond the 200 m depth contour, it would not coincide with the small pelagic purse-seine, shark-directed demersal long-line, traditional line or squid jig fishing grounds. No impact on these fishing sectors is thus expected.

**Table 6.1: Summary of the significance of potential impacts of the proposed exploration activities in the Outeniqua South Area off the South Coast of South Africa.**

| Potential impact | | Significance | |
|---|---|---|---|
| | | Without mitigation | With mitigation |
| ***Normal seismic / support vessels and helicopter operation:*** | | | |
| Emissions to the atmosphere | | VL | **VL** |
| Deck drainage into the sea | | VL | **VL** |
| Machinery space drainage into the sea | | VL | **VL** |
| Sewage effluent into the sea | | VL | **VL** |
| Galley waste disposal into the sea | | VL | **VL** |
| Solid waste disposal into the sea | | Insignificant | **INSIGNIFICANT** |
| Noise from seismic and support vessel operation | | VL | **VL** |
| Noise from helicopter operation | | L-M | **VL** |
| ***Impact of seismic noise on marine fauna:*** | | | |
| Plankton | | VL | **VL** |
| Invertebrates | Physiological injury | VL | **VL** |
| | Behavioural avoidance | VL | **VL** |
| Fish | Physiological injury | L | **VL** |
| | Behavioural avoidance | L | **VL** |
| | Spawning and reproductive sucess | L | **VL** |
| | Masking sound and communication | VL | **VL** |
| | Indirect impacts | VL | **VL** |
| Non-diving seabirds | Physiological injury | Insignificant | **INSIGNIFICANT** |
| | Behavioural avoidance | Insignificant | **INSIGNIFICANT** |
| Diving seabirds | Physiological injury | L | **VL** |
| | Behavioural avoidance | L | **VL** |
| | Indirect impacts | VL | **VL** |

| Potential impact | | Significance | |
|---|---|---|---|
| | | Without mitigation | With mitigation |
| Turtles | Physiological injury | L | **VL** |
| | Behavioural avoidance | L | **VL** |
| | Reproductive success | L | **VL** |
| | Masking sound and communication | Insignificant | **INSIGNIFICANT** |
| | Indirect impacts | VL | **VL** |
| Seals | Physiological injury | VL | **VL** |
| | Behavioural avoidance | VL | **VL** |
| | Masking sound and communication | VL | **VL** |
| | Indirect impacts | VL | **VL** |
| Mysticetes Cetaceans | Physiological injury | M | **L** |
| | Behavioural avoidance | L-M | **VL-L** |
| | Masking sound and communication | VL | **VL** |
| | Indirect impacts | VL | **VL** |
| Odontocetes Cetaceans | Physiological injury | M | **L** |
| | Behavioural avoidance | VL-L | **VL** |
| | Masking sound and communication | L | **VL** |
| | Indirect impacts | VL | **VL** |
| ***Impacts from drop core sampling on benthic biota:*** | | | |
| Sediment removal | | Insignificant | **INSIGNIFICANT** |
| Physical crushing of benthic biota | | Insignificant | **INSIGNIFICANT** |
| ***Impact on other users of the sea:*** | | | |
| Fishing industry | Demersal trawl | VL | **VL** |
| | Demersal long-line (hake) | VL | **VL** |
| | Large pelagic long-line (tuna) | M | **M** |
| | South Coast rock lobster | VL | **VL** |
| | Mid-water trawl | VL | **VL** |
| | Fisheries research | L | **L** |
| Marine transport routes | | L | **VL** |
| Marine prospecting, mining, exploration and production | Prospecting and mining | Insignificant | **INSIGNIFICANT** |
| | Exploration and production | VL | **VL** |
| H=High M=Medium L=Low VL=Very low | | | All impacts are negative |

## 6.2 RECOMMENDATIONS

### 6.2.1 COMPLIANCE WITH ACTION PLAN, PROCEDURES AND MARPOL STANDARDS

All phases of the proposed project (including pre-establishment phase, establishment phase, operational phase, and decommissioning and closure phase) must comply with the Action Plan and Procedures presented in Chapter 7. In addition, the seismic and support vessels must ensure compliance with the MARPOL 73/78 standards.

### 6.2.2 SURVEY TIMING AND SCHEDULING

The seismic survey should, as far as possible, be planned to avoid cetacean migration periods from their southern feeding grounds into low latitude waters from June to November (inclusive). In addition, surveying should ideally avoid December when humpback whales may still be moving through the area on their return migrations. If surveying during November and December cannot be avoided all other mitigation measures must be stringently enforced and additional mitigation measures must be implemented (see Section 6.2.3.1 below).

It is further recommended that the survey programme be scheduled, as far as possible, to avoid operating within key spawning areas within the proposed survey area (see Figure 4.8) in November and December.

### 6.2.3 SEISMIC SURVEY PROCEDURES

#### 6.2.3.1 PAM technology

Should surveying in the sensitive cetacean periods be unavoidable, PAM technology, which detects animals through their vocalisations, must be implemented 24-hours a day. For all other periods, PAM technology must be used during seismic surveys at night and during daytime adverse weather conditions and thick fog.

If there is a technical problem with PAM during surveying, visual watches must be maintained by the MMO during the day and night-vision/infra-red binoculars must be used at night while PAM is being repaired.

#### 6.2.3.2 "Soft-start" procedures and airgun firing

All initiations of seismic surveys must be carried out as "soft-starts" for a minimum of 20 minutes. This requires that the sound source be ramped from low to full power rather than initiated at full power, thus allowing a flight response by marine fauna to outside the zone of injury or avoidance. Where possible, "soft-starts" should be planned so that they commence within daylight hours.

"Soft-start" procedures must only commence once it has been confirmed (visually during the day[1] and using PAM technology and night-vision/infra-red binoculars at night) that there is no seabird (diving), seal, turtle or cetacean activity within 500 m of the vessel[2]. For cetaceans, the period of confirmation should be for at least 30 minutes prior to the commencement of the "soft-start" procedures, so that deep or long diving species can be detected. However, in the case of seals and small cetaceans (particularly dolphins), which are common in inshore waters and often attracted to survey vessels, the normal "soft-start" procedures should be allowed to commence, if after a period of 30 minutes seals and small cetaceans are still within 500 m of the airguns.

"Soft-start" procedures must also be implemented after breaks in airgun firing (for whatever reason) of longer than 20 minutes. Breaks of shorter than 20 minutes should be followed by a "soft-start" of similar duration.

The use of the lowest practicable airgun volume, as defined by the operator, should be defined and enforced.

During surveying, airgun firing should be terminated when:

- obvious negative changes to turtle, seal and cetacean behaviour is observed;
- turtles or cetaceans are observed within 500 m of the operating airgun and appear to be approaching the firing airgun; or

[1] Note: should surveying in the sensitive cetacean periods be unavoidable, PAM technology must be used, in addition to the visual watches by the MMO, during the day.

[2] Note: once it has been confirmed that there is no seabird (diving), seal, turtle or cetacean activity within 500 m of the vessel and soft-start procedures have commenced, monitoring must continue, but there is no need to monitor using night-vision/infra-red binoculars at night.

- there is mortality or injuries to seabirds, turtles, seals or cetaceans as a direct result of the survey.

A log of all termination decisions must be kept (for inclusion in both daily and "close-out" reports).

#### 6.2.3.3 Line changes

During night-time line changes, low level warning airgun discharges should be fired at regular intervals in order to keep animals away from the survey operation while the vessel is repositioned.

#### 6.2.3.4 Independent Observer or MMO and PAM Operator

An onboard Independent Observer or MMO must be appointed for the duration of the seismic survey to act as a fisheries and marine mammal observer. The Observer or MMO should be familiar with fisheries operational in the area and must have experience in seabird, turtle, seal and other marine mammal identification and observation techniques. The duties of the Observer or MMO would be to:

<u>Marine fauna:</u>
- Observe and record responses of marine fauna to the seismic survey, including seabird, turtle, seal and cetacean incidence and behaviour and any mortality of marine fauna as a result of the surveys. Data captured should include species identification, position (latitude/longitude), distance from the vessel, swimming speed and direction (if applicable) and any obvious changes in behaviour (e.g. startle responses or changes in surfacing/diving frequencies, breathing patterns) as a result of the survey activities;
- Record airgun activities, including sound levels, "soft-start" procedures and pre-firing regimes;
- Request the temporary termination of a seismic survey, as appropriate. It is important that Observers or MMOs have a full understanding of the financial implications of terminating firing, and that such decisions are made confidently and expediently;

<u>Fishing and other users of the sea:</u>
- Provide back-up onboard facilitation with the fishing industry and other users of the sea. This would include communication with fishing and shipping / sailing vessels in the area in order to reduce the risk of interaction between the proposed surveys and other existing or proposed activities. The Observer would need to identify fishing vessels active in the area and associated fishing gear;
- Daily electronic reporting on vessel activity and recording of any communication and/or interaction should also be undertaken in order to keep key stakeholders informed of survey activity and progress;

<u>Other:</u>
- Record meteorological conditions;
- Monitor compliance with international marine pollution regulations (MARPOL 73/78 standards); and
- Prepare daily reports of all observations. These reports should be forwarded to the key stakeholders.

A PAM operator must be appointed if surveying during the sensitive cetacean periods. For all other periods, a PAM operator would be required during seismic surveys at night and during daytime adverse weather conditions and thick fog. The duties of the PAM Operator would be to:
- Confirm that there is no marine mammal activity within 500 m of the vessel prior to commencing with the "soft-start" procedures;
- Record species identification, position (latitude/longitude) and distance from the vessel, where possible;
- Record airgun activities, including sound levels, "soft-start" procedures and pre-firing regimes; and

- Request the temporary termination of the seismic survey, as appropriate.

All data recorded by MMOs and PAM Operator should form part of the survey “close-out” report.

### 6.2.4 HELICOPTER OPERATIONS

Mitigation relating to helicopter operations includes:

- Flight paths must be pre-planned to ensure that no flying occurs over bird and seabird colonies, coastal reserves or marine islands. Important areas in the vicinity of the proposed survey area include: Algoa Bay islands (St Croix Island, Jaheel Island, Bird Island, Black Rocks, Seal Island, Stag Island and Brenton Rocks), Dyer Island, Cape Recife, Seal Island (Mossel Bay) and Robberg Peninsula (Plettenberg Bay);
- Extensive coastal flights (parallel to the coast within 1 nautical mile of the shore) should be avoided. There is a restriction of coastal flights (parallel to the coast within 1 nautical mile of the shore) on the South Coast between the months of June and November to avoid Southern Right whale breeding areas;
- Aircraft may not approach to within 300 m of whales in terms of the Marine Living Resources Act, 1998;
- The operator must comply with the Seabirds and Seals Protection Act, 1973, which prohibits the wilful disturbance of seals on the coast or on offshore islands;
- The contractor should comply fully with aviation and authority guidelines and rules; and
- All pilots must be briefed on ecological risks associated with flying at a low level parallel to the coast.

### 6.2.5 OTHER MITIGATION MEASURES

Other mitigation measures that should also be implemented during the survey in order to ensure that any potential impacts are minimised include the following:

*Equipment*

- ‘Turtle-friendly’ tail buoys should be used by the survey contractor or existing tail buoys should be fitted with either exclusion or deflector 'turtle guards';

Vessel safety

- The survey vessels must be certified for seaworthiness through an appropriate internationally recognised marine certification programme (e.g. Lloyds Register, Det Norske Veritas). The certification, as well as existing safety standards, requires that safety precautions would be taken to minimise the possibility of an offshore accident;
- Collision prevention equipment should include radar, multi-frequency radio, foghorns, etc. Additional precautions include: the chase boat with staff familiar with the fisheries expected in the area, the existence of an internationally agreed 500 m safety zone around the survey vessel, cautionary notices to mariners, and access to current weather service information;
- The vessels are required to fly standard flags, lights (three all-round lights in a vertical line, with the highest and lowest lights being red and the middle light being white) or shapes (three shapes in a vertical line, with the highest and lowest lights being balls and the middle light being a diamond) to indicate that they are engaged in towing surveys and are restricted in manoeuvrability, and must be fully illuminated during twilight and night;
- Report any emergency situation to SAMSA;

Vessel lighting

- Lighting on board survey vessels should be reduced to the minimum safety levels to minimise stranding of pelagic seabirds on the survey vessel at night. All stranded seabirds must be retrieved and released according to appropriate guidelines;

Emissions, discharges into the sea and solid waste

- Ensure adequate maintenance of diesel motors and generators to minimise the volume of soot and unburned diesel released to the atmosphere;
- Ensure adequate maintenance of all hydraulic systems and frequent inspection of hydraulic hoses;
- Undertake training and awareness of crew members of the need for thorough cleaning up of any spillages immediately after they occur, as this would minimise the volume of contaminants washing off decks;
- Use of low toxicity, biodegradable detergents during deck cleaning to further minimise the potential impact of deck drainage on the marine environment;
- Collect deck drainage in oily water catchment systems;
- Discharge effluent (e.g. sewage and galley waste as per MARPOL requirements) into the sea as far as possible from the coast;
- Initiate an onboard waste minimisation system;
- Ensure onboard solid waste storage is secure;
- Ensure that contractors co-operate with the relevant local authority to ensure that solid and hazardous waste disposal is carried out in accordance with the appropriate laws and ordinances;

Communication with key stakeholders

- Total E&P should engage timeously with the fishing industry, DAFF[3] and other exploration right holders and applicants to discuss the scheduling of the proposed survey in relation to current or planned activities in order to reduce the risk of delay to or interference with the proposed survey. Any dispute arising in this regard should be referred to the Department of Mineral Resources or PASA for resolution;
- Communication channels should be set up with the fishing industry / associations (including South African Deep-sea Trawling Industry Association, South East Coast Inshore Fishery Association, Small Hake Quota Holders Association, South African Tuna Longline Association, Hake Longline Association, South Coast Rock Lobster Association, Blue Continent Products, South African Squid Management Industry Association, South African Marine Linefish Association and the Small Pelagic Sea Management Association) and other key stakeholders (including DAFF, Port Captains, South African Maritime Safety Authority (SAMSA) and South African Navy Hydrographic office). This would involve pre-survey notification of navigational co-ordinates of the survey areas, timing and duration of proposed activities and likely implications for the fishing industry and other vessels;
- Total E&P must request, in writing, the South African Navy Hydrographic office to release Radio Navigation Warnings and Notices to Mariners throughout the seismic survey period. The Notice to Mariners should give notice of (1) the co-ordinates of the proposed survey areas, (2) an indication of the proposed survey timeframes and day-to-day location of the survey vessel, and (3) an indication of the 500 m safety zones and the proposed safe operational limits of the survey vessel. These notices should be distributed timeously to fishing companies and directly onto vessels where possible;
- Ensure ongoing notification throughout the duration of the survey with the submission of daily reports (via email) indicating the vessel's location to key stakeholders; and
- Marine mammal incidence data and data arising from the survey should be made available, if requested, to the Marine Mammal Institute, Department of Environmental Affairs: Branch Oceans and Coasts, DAFF and PASA.

[3] Managers of the DAFF research survey programmes include Deon Durholtz (DeonD@nda.agric.za) and Janet Coetzee (JanetC@nda.agric.za).

# 7. ACTION PLAN AND PROCEDURES

The Action Plan and Procedures compiled for the proposed exploration activities off the South Coast of South Africa is set out in Table 7.1. Specific issues are addressed under each of the five project life cycle phases listed below:

7.1 Pre-Establishment Phase
- 7.1.1 Pre-survey planning
- 7.1.2 Preparation for emergencies
- 7.1.3 Financial provision
- 7.1.4 Approval of EMP

7.2 Establishment Phase
- 7.2.1 Compliance with the EMP
- 7.2.2 Notifying other users of the sea
- 7.2.3 Appoint an independent observer or MMO and PAM operator

7.3 Operational Phase
- 7.3.1 Adherence to the EMP and Environmental awareness
- 7.3.2 Communication with other users of the sea and resource managers
- 7.3.3 Prevention of emergencies
- 7.3.4 Dealing with emergencies including major oil spills
- 7.3.5 Pollution control and waste management
- 7.3.6 Exclusion of other marine users from access to the operational area for safety reasons
- 7.3.7 Equipment loss
- 7.3.8 Use of helicopters
- 7.3.9 Oil bunkering/refuelling at sea
- 7.3.10 Acoustic emissions from airguns

7.4 Decommissioning and Closure Phase
- 7.4.1 Survey vessel to leave area
- 7.4.2 Informing relevant parties of survey completion
- 7.4.3 Final waste disposal

7.5 Monitoring, Compliance Auditing and the Submission of Information Phase
- 7.5.1 Performance assessment / monitoring activities and effects
- 7.5.2 Compile seismic survey “close-out” report/s

**Acronyms used in the table are:** DAFF – Department of Agriculture, Forestry and Fisheries; DEA - Department of Environmental Affairs; DEA: BOC- Department of Environmental Affairs: Branch Oceans and Coasts; DWA - Department of Water Affairs; IAGC - International Association of Geophysical Contractors; ISO - International Standards Organisation; SAMSA - South African Maritime Safety Authority; SAN - South African Navy.

The fundamental elements of this management programme are to be implemented at all times, as and when appropriate.

**Table 7.1: Action Plan and Procedures for the proposed exploration activities in the Outeniqua South Area off the South Coast of South Africa.**

| PROJECT PHASE AND ACTIVITIES: | ENVIRONMENTAL OBJECTIVES: | AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE EMP REPORT OBJECTIVES (SEISMIC SURVEYS): | ✓ | RESPONSI-BILITY: | TIMING: | REQUIREMENT FOR "CLOSE-OUT" REPORT: |
|---|---|---|---|---|---|---|
| **7.1 PRE-ESTABLISHMENT PHASE** | | | | | | |
| **7.1.1 PRE-SURVEY PLANNING** | *Accommodation of needs for environmental monitoring and liaison with fishing and other industries* | In order to minimise disruption to the survey and other users of the sea:<br>• Total E&P is to engage timeously with the fishing industry, DAFF and other exploration right holders and applicants to discuss the scheduling of the proposed survey in relation to current or planned activities in order to reduce the risk of delay to or interference with the proposed survey. Any dispute arising in this regard should be referred to the Department of Mineral Resources or PASA for resolution.<br>• Establish communication channels and communicate with fishing industry and oil/gas and mining industries, as well as other vessels, regarding (1) safety zone around the seismic survey vessel, and (2) the timing of the seismic survey in order to minimise disruption to the survey and other activities in the area.<br>• Make provision for placing an Independent Observer/Marine Mammal Observer (MMO) on board the seismic vessel. The Observer or MMO must, where possible, have experience in seabird, turtle and marine mammal identification and observation techniques. | | Total E&P | Prior to commencement of operations | Provide records of meetings held and copies of all correspondence<br><br>MMO's report |
| | *Minimise impact on cetaceans and turtles* | • Seismic survey should, as far as possible, be planned to avoid cetacean migration periods from their southern feeding grounds into low latitude waters from June to November (inclusive). In addition, surveying should ideally avoid December when humpback whales may still be moving through the area on their return migrations.<br>• The survey programme should be scheduled, as far as possible, to avoid operating within key spawning areas within the proposed survey area (see Figure 4.8 in EMP) in November and December.<br>• Should surveying in November and December be unavoidable, PAM technology, which detects animals through their vocalisations, must be implemented 24 hours a day. For all other periods, PAM technology must be used during seismic surveys at night and during daytime adverse weather conditions and thick fog. If there is a technical problem with PAM during surveying, visual watches must be maintained by the MMO during the day and night-vision/infra-red binoculars must be used at night while PAM is being repaired.<br>• Use 'turtle-friendly' tail buoys. Alternatively, the existing tail buoys should be fitted with either exclusion or deflector 'turtle guards'. | | Total E&P | Prior to commencement of operation | PAM operator's report |

| PROJECT PHASE AND ACTIVITIES: | ENVIRONMENTAL OBJECTIVES: | AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE EMP REPORT OBJECTIVES (SEISMIC SURVEYS): | ✓ | RESPONSI-BILITY: | TIMING: | REQUIREMENT FOR "CLOSE-OUT" REPORT: |
|---|---|---|---|---|---|---|
| **7.1.2 PREPARATION FOR EMERGENCIES** | *Preparation for any emergency that could result in an environmental impact* | Ensure the following emergency plans, equipment and personnel are in place to deal with all emergencies:<br>• Total E&P's Emergency Procedures document and Medical Emergency Response Plan.<br>• Helicopter Operator Emergency Response Plan.<br>• South African Search and Rescue (SASAR) Manual.<br>• Onboard oil spill plan (SOPEP Manual) as required by MARPOL. Note that in case of a major oil spill, emergency responses and/or Oil Pollution Contingency Plan(s) should refer to the coastal oil spill contingency plan(s) of the DEA:BOC<br>In addition to the above, ensure that:<br>• There is adequate protection and indemnity insurance cover for oil pollution incidents.<br>• There is a record of the vessel's seaworthiness certificate and/or classification stamp. | | Total E&P | Prior to commencement of operation | Confirm compliance and justify and omissions |
| **7.1.3 FINANCIAL PROVISION** | *Compliance with legislative requirements* | Ensure that financial provision is in place to execute the requirements of the EMP. | | Total E&P | Prior to commencement of operations | Confirm that financial provision for EMP has been put in place |
| **7.1.4 APPROVAL OF EMP** | *Compliance with legislative requirements* | Ensure that the EMP has been approved by PASA. | | Total E&P | Prior to commencement of operations | Provide Minister's approval letter |
| **7.2 ESTABLISHMENT PHASE** | | | | | | |
| **7.2.1 COMPLIANCE WITH EMP** | *Operator and contractor to commit to adherence to EMP* | Ensure that a copy of the approved EMP is supplied to all Contractors and is on board the seismic and support vessels during the operation.<br>Ensure procedures and systems for compliance are in place.<br>Appropriately inform the vessel's personnel of the purpose and requirements of the EMP.<br>Ensure correct equipment and personnel are available to meet the requirements of the EMP.<br>Ensure responsibilities are allocated to personnel.<br>TOTAL E&P to commit organisation and contractor to meet the requirements of the EMP. | | Total E&P | Prior to commencement of operation | Ensure that a copy of the EMP report is provided to the vessel and that an acknowledgment of receipt form is signed |

| PROJECT PHASE AND ACTIVITIES: | ENVIRONMENTAL OBJECTIVES: | AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE EMP REPORT OBJECTIVES (SEISMIC SURVEYS): | ✓ | RESPONSI-BILITY: | TIMING: | REQUIREMENT FOR "CLOSE-OUT" REPORT: |
|---|---|---|---|---|---|---|
| **7.2.2 NOTIFYING OTHER USERS OF THE SEA** | *Ensure that other users are aware of the seismic survey* | Total E&P must notify key stakeholders of the navigational co-ordinates of the seismic survey and keep them updated on the seismic survey programme. The following stakeholders shall be notified:<br>• Fishing industry and associations (including South African Deep-sea Trawling Industry Association, South East Coast Inshore Fishery Association, Small Hake Quota Holders Association, South African Tuna Longline Association, Hake Longline Association, South Coast Rock Lobster Association, Blue Continent Products, South African Squid Management Industry Association, South African Marine Linefish Association and the Small Pelagic Sea Management Association).<br>• Overlapping and neighbouring users with delineated boundaries in the oil / gas and mining industries.<br>• SAN Hydrographic Office (Silvermine).<br>• Government departments with jurisdiction over marine activities, particularly DAFF, DEA:BOC and PASA.<br>• SAMSA and local Port Captains.<br>Total E&P must request, in writing, the SAN Hydrographic Office (Silvermine) to release Radio Navigation Warnings and Notices to Mariners throughout the seismic survey period. The Notice to Mariners should give notice of (1) seismic survey co-ordinates, (2) 500 m safety zone around seismic vessel, (3) the timing of the seismic survey, and (4) day-to-day location of the seismic vessel. | | Total E&P | 7 days prior to start | Confirm that notices were sent to relevant parties<br>Provide copy of standard notice and list of those to whom it was sent |
| **7.2.3 APPOINT AN INDEPENDENT OBSERVER OR MMO AND PAM OPERATOR** | *Ensure impacts associated with the construction phase are kept to a minimum* | Appoint an independent observer / MMO for the duration of the survey.<br>Appoint a PAM operator when surveying during the sensitive cetacean periods, as well as when surveying at night and during daytime adverse weather conditions and thick fog. | | Total E&P | Prior to commencement of operations | MMO's and PAM operator's report |
| **7.3 OPERATIONAL PHASE** | | | | | | |
| **7.3.1 ADHERENCE TO THE EMP AND ENVIRONMENTAL AWARENESS** | *Operate in an environmentally responsible manner* | Comply fully with the EMP (compliance would mean that all activities were undertaken successfully and details recorded and included in the "close-out" report/s).<br>Subscribe to the principles of an internationally acceptable Environmental Management System onboard the vessels. This includes environmental awareness training, waste management and environmental monitoring, record keeping and continuous improvement.<br>The seismic survey should comply with the "Environmental Guidelines for Worldwide Geophysical Operations" issued by the International Association of Geophysical Contractors (IAGC). | | Total E&P | Throughout programme | Provide copies of records |

| PROJECT PHASE AND ACTIVITIES: | ENVIRONMENTAL OBJECTIVES: | AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE EMP REPORT OBJECTIVES (SEISMIC SURVEYS): | ✓ | RESPONSI-BILITY: | TIMING: | REQUIREMENT FOR "CLOSE-OUT" REPORT: |
|---|---|---|---|---|---|---|
| **7.3.2 CONTINUE TO COMMUNICATE WITH OTHER USERS OF THE SEA AND RESOURCE MANAGERS** | *Promote co-operation and successful multiple use of the sea, including promotion of safe navigation* | Through normal communication channels, Radio Navigation Warnings and Notices to Mariners, keep interested and affected parties (see Section 7.2.2) updated on the seismic survey programme. | | Total E&P or independent observer / MMO | During operations as required | Provide copies of written notices and list of those to whom it was sent |
| | | Keep constant watch for approaching vessels during the survey and warn by radio and standby vessel, if required. | | Total E&P and independent observer | | Provide copies of records |
| | | Take steps to share information and co-operate with other marine users and resource managers in the marine environment generally, to their mutual benefit. | | Total E&P | During and on completion of the survey | |
| **7.3.3 PREVENTION OF EMERGENCIES** | *Minimise the chance of emergency and subsequent damage to the environment occurring* | Prevent collisions by ensuring that the seismic and support vessels display correct signals by day and lights by night (including twilight), by visual radar watch and standby vessel(s). The vessels are required to fly standard flags, lights (three all-round lights in a vertical line, with the highest and lowest lights being red and the middle light being white) or shapes (three shapes in a vertical line, with the highest and lowest lights being balls and the middle light being a diamond) to indicate that they are engaged in towing surveys and are restricted in manoeuvrability.<br><br>The law also requires equipment and training to ensure the safety and survival of the crew in the event of an accident.<br><br>Service equipment regularly and practice weekly emergency response plans, etc. (refer to Mine Health and Safety Act and regulations). | | Total E&P | Throughout operation | |
| **7.3.4 DEALING WITH EMERGENCIES INCLUDING MAJOR OIL SPILLS (owing to collision, vessel break-up, refuelling etc.)** | *Minimise damage to the environment by implementing response procedures efficiently* | Adhere to obligations regarding other vessels in distress.<br><br>Implement emergency plans in Section 7.1.2.<br><br>Notify SAMSA about wrecked vessels (safety and pollution) and the Department of Finance (salvage, customs, royalties). Give location details to SAN Hydrographer.<br><br>In the event of an oil spill immediately implement emergency plans (refer to Section 7.1.2) and notify (a) the Principal Officer of the nearest SAMSA office, (b) the DEA's Chief Directorate of Marine & Coastal Pollution Management in Cape Town and (c) Smit Amandla Marine. Information that should be supplied when reporting a spill includes:<br>• Name and contact details of person reporting the incident;<br>• The type and circumstances of incident, ship type, port of registry, nearest agent representing the ships company; | | Total E&P | In event of spill | Record of all spills (Spill Record Book), including spill reports; emergency exercise reports; audit reports.<br>Incident log |

| PROJECT PHASE AND ACTIVITIES: | ENVIRONMENTAL OBJECTIVES: | AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE EMP REPORT OBJECTIVES (SEISMIC SURVEYS): | ✓ | RESPONSI-BILITY: | TIMING: | REQUIREMENT FOR "CLOSE-OUT" REPORT: |
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| | | • Date and time of spill;<br>• Location (co-ordinates), source and cause of pollution;<br>• Type and estimated quantity of oil spilled and the potential and probability of further pollution;<br>• Weather and sea conditions; and<br>• Action taken or intended to respond to the incident.<br>Where diesel, which evaporates relatively quickly, has been spilled, the water should be agitated or mixed using a propeller boat/dinghy to aid dispersal and evaporation.<br>Dispersants should not be used without authorisation of DEA. Dispersants should not be used:<br>• On diesel or light fuel oil.<br>• On heavy fuel oil.<br>• On slicks > 0.5 cm thick.<br>• On any oil spills within 5 nautical miles off-shore or in depths less than 30 metres.<br>• In areas far offshore where there is little likelihood of oil reaching the shore.<br>Dispersants are most effective:<br>• On fresh crude oils; under turbulent sea conditions (as effective use of dispersants requires mixing).<br>• When applied within 12 hours or at a maximum of 24 hours.<br>The volume of dispersant should not exceed 20-30% of the oil volume. | | | | |
| **7.3.5 POLLUTION CONTROL AND WASTE MANAGEMENT of products disposed of: into the air (exhausts, CFCs and incinerators), to sea (sewage, food, oils), to land (used oils etc, metals, plastics, glass, etc.)** | *Minimise pollution, and maximise recycling by implementing and maintain pollution control and waste management procedures at all times* | Comply with legal requirements for waste management and pollution control (for air and water quality levels at sea) and employ "good housekeeping" and monitoring practices.<br>• General waste: Initiate a waste minimisation system. No disposal overboard.<br>• Galley (food) waste: Dispose overboard after macerating according to MARPOL standard (less than 25 mm size) – prohibited if distance to nearest land is < 3 nautical miles. Disposal overboard without macerating – vessel must be 12 nautical miles from coast.<br>• Medical waste: Seal in aseptic containers for appropriate disposal onshore.<br>• Metal: Send to shore for recycling or disposal.<br>• Other waste: Send remaining waste to a licensed waste site. Ensure waste disposal is carried out in accordance with appropriate laws and | | Total E&P | Throughout operations | Provide summary of waste record book / schedule and receipts<br><br>Report occurrence of minor oil spills and destination of wastes |

| PROJECT PHASE AND ACTIVITIES: | ENVIRONMENTAL OBJECTIVES: | AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE EMP REPORT OBJECTIVES (SEISMIC SURVEYS): | ✓ | RESPONSI-BILITY: | TIMING: | REQUIREMENT FOR "CLOSE-OUT" REPORT: |
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| | | ordinances.<br>• Waste oil: Return used oil to a port with a registered facility for processing or disposal.<br>• Wastewater: Comply with MARPOL.<br>• Minor oil spill: Use oil absorbent.<br>• Emissions to the atmosphere: Properly tune and maintain all engines, motors, generators and all auxiliary power to contain the minimum of soot and unburned diesel.<br>• Deck drainage: Deck drainage should be collected in oily water separator systems. Ensure that weather decks are kept free of spillage. Mop up any spills immediately with biodegradable low toxicity detergents. Ensure compliance with MARPOL standard.<br>• Machinery space drainage: Drilling unit and supply vessels must comply with international agreed standards regulated under MARPOL.<br>• Sewage - use approved treatment plants to the MARPOL standard.<br><br>Ensure all crew is trained in spill management.<br><br>Ensure that a waste disposal contractor disposes of waste returned to port at a licensed landfill site. | | | | |
| **7.3.6 EXCLUSION OF OTHER MARINE USERS FROM ACCESS TO THE OPERATIONAL AREA FOR SAFETY REASONS (shipping, including fishing vessels)** | *Minimise disruption to other legitimate users of the sea by respecting their rights.* | Co-operate with other legitimate users of the sea to minimise disruption to other marine activities and marine fauna. | | Total E&P | Throughout operations | |
| | | Use effective communication channels (refer to Section 7.3.2) to inform all other potential users about the survey location, timing, priority of passage safety, 500 m exclusion zone and general safety distances. | | Total E&P | Throughout operations | Confirm that notices were sent to relevant parties<br><br>Provide copy of standard notice and list of those to whom it was sent<br><br>Record any incidents outside of normal occurrence |

| PROJECT PHASE AND ACTIVITIES: | ENVIRONMENTAL OBJECTIVES: | AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE EMP REPORT OBJECTIVES (SEISMIC SURVEYS): | ✓ | RESPONSI-BILITY: | TIMING: | REQUIREMENT FOR "CLOSE-OUT" REPORT: |
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| **7.3.7 EQUIPMENT LOSS** | *Minimise hazards left on the seabed or floating in the water column, and inform relevant parties* | Keep a record of lost equipment and all items lost overboard and not recovered.<br><br>When any items that constitute a seafloor or navigational hazard are lost on the seabed, or in the sea, complete a standard form / record sheet, which records the date and cause of loss, details of equipment type, etc.<br><br>Pass information to PASA and SAMSA. Notify SAN Hydrographer, relevant fishing associations. SAN Hydrographer will send out Notice to Mariners with this information. | | Total E&P | Throughout operation | Provide a list of lost equipment and a copy of record sheet |
| **7.3.8 USE OF HELICOPTERS for crew changes, servicing, etc.** | *Minimise disturbance / damage to marine and coastal fauna.* | Establish, with pilots, flight paths that do not over-pass Ramsar sites, islands, coastal reserves, bird and seal breeding or bird breeding colonies / sanctuaries on the coast (minimum altitudes of 600 m above ground level over nature conservation areas). Important areas in the vicinity of the proposed survey area include: Dyer Island, Cape Recife, Seal Island (Mossel Bay) and Robberg Peninsula (Plettenberg Bay).<br><br>Extensive coastal flights (parallel to the coast within 1 nautical mile of the shore) should also be avoided. There is a restriction of coastal flights (parallel to the coast within 1 nautical mile of the shore) on the South Coast between the months of June and November to avoid southern right whale breeding areas.<br><br>Comply with the Marine Living Resources Act, 1998 which prohibits aircrafts approaching within 300 m of whales.<br><br>Comply with the Seabirds and Seals Protection Act, 1973, which prohibits the wilful disturbance of seals on the coast or on offshore islands.<br><br>Report any deviations from set flight plans.<br><br>Brief all pilots on the ecological risks associated with flying at a low level parallel to the coast.<br><br>Comply with aviation and authority guidelines and rules. | | Total E&P and Helicopter contractor | As required | Submit copy of set flight path.<br><br>Report deviations from set flight paths. |
| **7.3.9 OIL BUNKERING / REFUELLING AT SEA** | *Minimise disturbance / damage to marine life.* | No discharge of any oil whatsoever is permitted within 50 nautical miles of the coast.<br><br>Transfer of oil at sea is not permitted within the economic zone (i.e. 200 miles from the coast) without the permission of the Minister.<br><br>Submit an application in terms of Regulation 14 to the Principal Officer at the port nearest to where the transfer is to take place.<br><br>Inform SAMSA of location, supplier and timing, 5 days prior to refuelling at sea. | | Vessel Captain | As required, 5 days prior to refuelling | Confirm that a notice was sent to SAMSA |

| PROJECT PHASE AND ACTIVITIES: | ENVIRONMENTAL OBJECTIVES: | AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE EMP REPORT OBJECTIVES (SEISMIC SURVEYS): | ✓ | RESPONSI-BILITY: | TIMING: | REQUIREMENT FOR "CLOSE-OUT" REPORT: |
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| **7.3.10 ACOUSTIC EMISSIONS FROM AIRGUNS** | *Reduce disturbance of marine fauna, particularly cetaceans (whales and dolphins), seals, seabirds (particularly gannets and penguins) and turtles.* | PAM technology must be used should surveying in the sensitive cetacean periods be unavoidable (see Section 7.1.1). For all other periods, PAM technology must be used during seismic surveys at night or during adverse weather conditions and thick fog.<br><br>All initiations of seismic surveys must be carried out as "soft-starts" for a minimum of 20 minutes. This requires that the sound source be ramped from low to full power rather than initiated at full power, thus allowing a flight response by marine fauna to outside the zone of injury or avoidance. Where possible, "soft-starts" should be planned so that they commence within daylight hours.<br><br>"Soft-start" procedures must only commence once it has been confirmed (visually during the day[1] and using PAM technology and night-vision/infra-red binoculars at night) that there is no seabird (diving), seal, turtle or cetacean activity within 500 m of the vessel[2]. For cetaceans, the period of confirmation should be for at least 30 minutes prior to the commencement of the "soft-start" procedures, so that deep or long diving species can be detected. However, in the case of seals and small cetaceans (particularly dolphins), which are common in inshore waters and often attracted to survey vessels, the normal "soft-start" procedures should be allowed to commence, if after a period of 30 minutes seals and small cetaceans are still within 500 m of the airguns.<br><br>"Soft-start" procedures must also be implemented after breaks in airgun firing (for whatever reason) of longer than 20 minutes. Breaks of shorter than 20 minutes should be followed by a "soft-start" of similar duration.<br><br>The use of the lowest practicable airgun volume, as defined by the operator, should be defined and enforced.<br><br>During night-time line changes, low level warning airgun discharges should be fired at regular intervals in order to keep animals away from the survey operation while the vessel is repositioned.<br><br>During surveying, airgun firing should be terminated when:<br>• obvious negative changes to turtle, seal and cetacean behaviour is | | Total E&P and MMO / PAM operator | Prior to and during seismic surveys | Provide copies of completed marine fauna observation forms and seismic activity logs showing "soft start" commencement. |

[1] Note: should surveying in the sensitive cetacean periods be unavoidable, PAM technology must be used, in addition to the visual watches by the MMO, during the day.
[2] Note: once it has been confirmed that there is no seabird (diving), seal, turtle or cetacean activity within 500 m of the vessel and soft-start procedures have commenced, monitoring must continue, but there is no need to monitor using night-vision/infra-red binoculars at night.

| PROJECT PHASE AND ACTIVITIES: | ENVIRONMENTAL OBJECTIVES: | AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE EMP REPORT OBJECTIVES (SEISMIC SURVEYS): | ✓ | RESPONSI-BILITY: | TIMING: | REQUIREMENT FOR "CLOSE-OUT" REPORT: |
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| | | observed;<br>• turtles or cetaceans are observed within 500 m of the operating airgun and appear to be approaching the firing airgun; or<br>• there is mortality or injuries to seabirds, turtles, seals or cetaceans as a direct result of the survey.<br><br>A log of all termination decisions must be kept (for inclusion in both daily and "close-out" reports). | | | | |
| Note 1: In terms of the Marine Living Resources Act, 1998 (18 of 1998):<br>• No person may approach within 300 metres of a whale by vessel, aircraft or other means;<br>• A vessel approached by a whale is required to distance itself at 300 m from the whale;<br>• A vessel may not proceed directly through a school of dolphins or porpoises; and<br>• No person shall attempt to feed, harass, disturb or kill great white sharks, dolphins, seals or turtles. | | | | | | |
| **7.4 DECOMMISSIONING AND CLOSURE PHASE** | | | | | | |
| **7.4.1 SURVEY VESSEL TO LEAVE AREA** | *Leave survey area as it was prior to survey* | Ensure that all deployed equipment is retrieved. | | Total E&P | | On completion of survey |
| **7.4.2 INFORM RELEVANT PARTIES OF SURVEY COMPLETION** | *Ensure that relevant parties are aware that the seismic campaign is complete* | Inform all key stakeholders (refer to Section 7.2.2) that the vessels are off location. | | Total E&P or independent observer / MMO | Within two weeks after completion of survey | Copies of notification documentation required. |
| **7.4.3 FINAL WASTE DISPOSAL** | *Minimise pollution and ensure correct disposal of waste* | Dispose all waste retained onboard at a licensed waste site using a licensed waste disposal contractor. | | Total E&P | When vessel is in port | Receipt required from contractor |
| **7.5 MONITORING, COMPLIANCE AUDITING AND THE SUBMISSION OF INFORMATION PHASE** | | | | | | |
| **7.5.1 PERFORMANCE ASSESSMENT / MONITORING ACTIVITIES AND EFFECTS** | *Implement the ongoing monitoring programmes (in conjunction with government if required)* | Compile monitoring programme and EMP Performance Assessments and submit to PASA.<br><br>Undertake appropriate monitoring (as per specific topics) and track performance against objectives and targets. Document all activities and results for internal and external auditing.<br><br>MMO to record / monitor the following:<br>• Responses of marine fauna to seismic shooting, including seabird, turtle, seal and cetacean incidence and behaviour and any mortality of marine fauna as a result of the seismic survey. Data captured should include | | Total E&P / Independent Observer / MMO / PAM Operator | Daily throughout operations<br><br>The frequency of performance assessments shall be as recommended by PASA | Provide all recorded information (e.g. MMO and PAM report) |

| PROJECT PHASE AND ACTIVITIES: | ENVIRONMENTAL OBJECTIVES: | AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE EMP REPORT OBJECTIVES (SEISMIC SURVEYS): | ✓ | RESPONSI-BILITY: | TIMING: | REQUIREMENT FOR "CLOSE-OUT" REPORT: |
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| | | species identification, position (latitude/longitude), distance from the vessel, swimming speed and direction (if applicable) and any obvious changes in behaviour (e.g. startle responses or changes in surfacing/diving frequencies, breathing patterns) as a result of the seismic activities;<br>• Airgun activities, including sound levels, "soft-start" procedures and pre-firing regimes;<br>• Meteorological conditions;<br>• Interaction and communication with other vessels;<br>• A log of all termination decisions; and<br>• Compliance with international marine pollution regulations (MARPOL 73/78 standards).<br><br>PAM Operator to record / monitor the following:<br>• Presence of marine mammal activity within 500 m of the vessel prior to commencing with the "soft-start" procedures;<br>• Species, position (latitude/longitude) and distance from the vessel, where possible; and<br>• Airgun activities, including sound levels, "soft-start" procedures and pre-firing regimes.<br><br>MMO and PAM Operator to prepare daily reports of all observations. These reports should be forwarded to the necessary authorities and key stakeholders on a daily. In addition, marine mammal incidence data and seismic source output data arising from the survey should be made available, if requested, to the Marine Mammal Institute, DEA: BOC, DAFF and PASA for analyses of survey impacts in local waters. | | | | |
| **7.5.2 COMPILE SEISMIC SURVEY "CLOSE-OUT" REPORT/S** | *Ensure corrective action and compliance and contribute towards improvement of EMP implementation* | Compile a seismic survey "Close-out" Report at the end of the seismic survey.<br><br>"Close–out" Report must be based on requirements of the monitoring and EMP Performance Assessment.<br><br>Provide information / records as indicated in the "Close-out" Report column of the EMP within 90 days of the seismic survey. In addition, information relating to percentage of daylight airgun firing time and frequency of airgun shutdowns must be included in the "Close out" Report.<br><br>Provide a copy of report to PASA. | | Total E&P | On completion of seismic survey | |

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# APPENDIX 1

# PUBLIC PARTICIPATION SUMMARY REPORT

# ENVIRONMENTAL MANAGEMENT PLAN FOR A PROPOSED 2D SEISMIC SURVEY, SONAR BATHYMETRY AND DROP CORE SAMPLING IN THE OUTENIQUA SOUTH AREA OFF THE SOUTH COAST OF SOUTH AFRICA

# PUBLIC PARTICIPATION SUMMARY REPORT

Prepared for:

**Petroleum Agency South Africa**

On behalf of:

**Total E and P South Africa (Pty) Ltd**

Prepared by:

**CCA Environmental (Pty) Ltd**

TOT01OBE/PPSR OCTOBER 2012

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**ANNEXURES**

# 1. INTRODUCTION

Total E and P South Africa (Pty) Ltd (Total E&P) is proposing to undertake a two-dimensional (2D) seismic survey, a sonar bathymetry survey and drop core sampling to investigate oil and gas reserves in the Outeniqua South Area off the South Coast of South Africa.

This report summarises the public participation process undertaken as part of the Environmental Management Plan (EMP) process, to record comments from Interested and Affected Parties (I&APs) and provide responses thereto.

# 2. PUBLIC PARTICIPATION PROCESS

The public participation process undertaken to date includes the following steps:

- A preliminary I&AP database was compiled of authorities (local and regional), Non-Governmental Organisations, Community-based Organisations and other key stakeholders (including the fishing industry, overlapping and neighbouring users with delineated boundaries in the oil/gas and mining industries). This database was compiled using databases of previous studies in the area and responses to the newspaper advertisements. To date, 161 people have been registered on the I&AP database (see Annexure 1);
- A Background Information Document (BID) was prepared and distributed to all identified I&APs for a 21-day comment period from 01 October 2012 to 23 October 2012. The purpose of the BID was to convey information on the proposed project to I&APs and allowed them the opportunity to comment on the proposed project. To simplify the commenting process, a Response Form was included with the BID. Copies of the notification letter, BID and Response Form (including proof of distribution) are included in Annexure 2; and
- Advertisements announcing the proposed project and the availability of the BID were placed in four regional newspapers on 02 October 2012 (see Annexure 3), including: Cape Times (Western Cape), Die Burger (Western Cape), Die Burger (Eastern Cape) and The Herald (Eastern Cape).

# 3. COMMENTS RECEIVED

A list of the 11 I&APs that submitted written comments / response forms during the BID comment period are presented in Table 1.

Copies of all written submissions received are provided in Annexure 4. Comments are presented and responded to in an Issues and Response Trail in Section 4. No importance should be given to the order in which the categories are presented.

**Table 1: Interested and affected parties that submitted comments on the Background Information Document.**

| Submitted by: | Method, date received: |
|---|---|
| 1. Dave Murray, Smit Amandla Marine (Pty) Ltd | Response Form and email, received on 02 Oct 2012 |
| 2. Thabo Mokonenyane | Email, received on 02 Oct 2012 |
| 3. Deanne Wilson | Email, received on 02 Oct 2012 |
| 4. Suleiman Salie, Chairman - FishSA | Email, received on 03 Oct 2012 |
| 5. Roy Bross, South African Deep-sea Trawling Industry Association | Email, received on 03 Oct 2012 |
| 6. Moses Jawula | Email, received on 03 Oct 2012 and Response Form received on 22 Oct 2012 |
| 7. Guy Odell, Fugro Survey (Middle East) Ltd. | Response Form and email, received on 04 Oct 2012 |
| 8. George Sieraha, Greater Cape Town Civic Alliance | Email, received on 05 Oct 2012 |
| 9. Jessica Courtoreille, PetroSA | Email, received on 08 Oct 2012 |
| 10. Steve Cameron-Dow, Fresh Tuna Exporters Association | Response Form and email, received on 15 Oct 2012 |
| 11. Western Cape Government: Department of Environmental Affairs and Development Planning (DEA&DP) | Letter, received 23 Oct 2012 |

# 4. ISSUES AND RESPONSE TRAIL

The comments presented in the table below were received in response to the BID and advertisements. The comments have been categorised as follows:

1. Fishing;
2. Public Participation Process.

= Letter/Fax/Response Form; = E-mail

| NO. | ISSUE | NAME | METHOD | COMMENT | RESPONSE |
|---|---|---|---|---|---|
| 1. | Fishing | | | | |
| 1.1 | Impact on fishing activities | Suleiman Salie (FishSA) | received 12 Sept 2012 | Mr Salie indicated that FishSA represented the following commercial fisheries: South African Deep-Sea Trawl Industry Association (Hake), South African Pelagic Fishing Industry Association (Pilchards & Sardines), South Coast Rock Lobster Industry Association, West Coast Rock Lobster Association, South African Mid-water Trawling Association (Horse Mackerel), South African Tuna Association, South African Squid Management Industrial Association, South East Coast Fishing Industry Association (Inshore Hake and Sole trawl fishery), Fresh Tuna Exporters Association and South African Hake Longline Association.<br><br>He noted their concerns regarding the possible conflict with fishing activities and possible negative impact on fish resources. | Specialists were appointed to address the potential impacts on the fishing industry in the vicinity of the proposed survey, including the possible conflict with fishing activities and negative impact on fish resources. The findings of the specialist assessments are summarised in Chapters 5 and 6 of the EMP.<br><br>With regards to fishing activities, the specialist fisheries assessment found that the potential impact on the fishing industry ranges from VERY LOW (demersal trawl, hake demersal long-line, mid-water trawl and South Coast rock lobster) to MEDIUM (pelagic long-line) significance with and without mitigation. As the proposed survey area is located beyond the 200 m depth contour, it would not coincide with the small pelagic purse-seine, shark-directed demersal long-line, traditional line or squid jig fishing grounds and no impact on these fishing sectors is thus expected (refer to the Fisheries Assessment in Appendix 3.1 for further details).<br><br>The potential impacts on fish resources are presented in detail in the Marine Fauna Assessment in Appendix 3.2 of the EMP. In short, the assessment found that as the proposed survey |

| NO. | ISSUE | NAME | METHOD | COMMENT | RESPONSE |
|---|---|---|---|---|---|
| | | | | | would be located more than 100 km offshore in water depths in excess of 200 m, the received noise by demersal species (who are more susceptible to physiological injury from seismic noise) at the seabed would be within the far-field range, and outside of distances at which physiological injury or avoidance would be expected. In addition, given the high mobility of most fish that occur offshore of the 200 m isobath, particularly the highly migratory pelagic species likely to be encountered in deeper water, it is assumed that the majority of fish species would avoid seismic noise at levels below those where physiological injury or mortality would result. As there are various seamounts and important fishing banks in the survey area, the likelihood of encountering feeding aggregations of large pelagic species is high. The duration of the impact would, however, be limited to the short-term. The potential physiological impact on demersal and deep-water reef species would, however, be insignificant as they would only be affected in the far-field range.<br><br>Behavioural responses such as avoidance of seismic survey areas and changes in feeding behaviours of some fish to seismic sounds have been documented. Behavioural effects are generally short-term, however, with duration of the effect being less than or equal to the duration of exposure, although these vary between species and individuals, and are dependent on the properties of the received sound. The potential impact would, however, be of short-term duration and limited to the survey area.<br><br>Fish populations can be further impacted if behavioural responses result in deflection from migration paths or disturbance of spawning. Considering the wide range over |

| NO. | ISSUE | NAME | METHOD | COMMENT | RESPONSE |
|---|---|---|---|---|---|
| | | | | | which the potentially affected species occur, the relatively short duration of the proposed survey and that the migration routes do not constitute narrow restricted paths, reproductive success of fish species is not expected to be significantly impacted if the recommended mitigation measures are implemented. |
| 1.2 | Impact on the fishing industry | Roy Bross (South African Deep-sea Trawling Industry Association) | received 03 Oct 2012 | We object that in as much as these surveys interact with the trawl footprint, the desired exclusion zones are excessive having regard to commercial bottom trawlers also being vessels with limited manoeuvrability while engaged in fishing. In brief, we would have to contend with exclusion zones of about 400 $km^2$ moving at a rate of about 200 $km^2$ per hour. An already serious situation would be exacerbated by the aforementioned surveys taking place on some of our best fishing grounds.<br><br>Mr Bross also made reference to other surveys currently proposed along the West Coast by PetroSA and Anadarko. | The recommended exclusion zone is not a legal requirement, only a request in order to avoid damage to both the seismic and fishing gear. However, there is a legal exclusion zone of 500 m around the seismic array.<br><br>The demersal trawl grounds cover approximately 4 510 $km^2$ of the proposed survey area, which is equivalent to 6.4 % of the total ground available to the demersal trawl fishery. Approximately 7.8% of the total effort was undertaken in the proposed survey area over the period 2006 to 2010.<br><br>Although the proposed survey area would overlap with important fishing grounds, surveying in these areas would be of very short duration and the potential impact on the demersal trawl fishery was rated as of very low significance.<br><br>The potential impacts on the different fishing industries active in the area have been assessed and appropriate mitigation measures have been recommended as part of a Fisheries Assessment (see Appendix 3.1 of the EMP). The findings of the Fisheries Assessment are summarised in Section 5.3.1 of the EMP.<br><br>The concerns regarding the number of different surveys proposed along the South African coast are acknowledged. The South African offshore area is vast and the cumulative impacts of these surveys would ultimately depend on where the surveys are undertaken. The current proposed Total E&P |

| NO. | ISSUE | NAME | METHOD | COMMENT | RESPONSE |
|---|---|---|---|---|---|
| | | | | | survey would be undertaken beyond the 200 m isobaths and is only proposed to commence during the summer months of 2013/2014. To our knowledge, no other survey activities have yet been proposed during that period in the vicinity of the Total E&P licence area. |
| 1.3 | Impact on highly migrating fish species (Tuna) | Steven Cameron-Dow (Fresh Tuna Exporters Association) | received 15 Oct 2012 | As has previously been stated, we are extremely concerned regarding the effect on highly migrating fish species such as Tuna. Although our tuna pole vessels do not fish in this particular area, we are of the opinion that Yellowfin Tuna that reaches our areas will cross paths with the survey area. As there is no scientific proof that seismic surveys do or do not affect Tuna, we unfortunately will only find out after the fact. Our greater concern is for the number of surveys taking place around our coast at the same time. | Depending on their location, large pelagic species such as Tuna are expected to keep clear of the survey area when they hear the sound. In many of the large pelagic species the swim-bladders are either underdeveloped or absent, and the risk of physiological injury through damage of this organ is therefore lower. The effects of the sounds on demersal species would be in the far-field and, thus, not of high intensity and outside the range at which avoidance would be expected.<br>It is acknowledged that if fish avoid the survey area and / or change their feeding behaviour it could have a more significant impact on the fishing industry. Research has, however, shown that behavioural effects are generally short-term with duration of the effect being less than or equal to the duration of exposure, although these vary between species and individuals, and are dependent on the properties of the received sound (see Response 1.1 and the Marine Fauna Assessment in Appendix 3.2 for more detail).<br>The cumulative impact of surveys along the South African coast is addressed in Response 1.2. |
| 2. | Public participation process | | | | |
| 2.1 | I&AP registration | Dave Murray (Smit Amandla Marine) | received 03 Oct 2012 | Asked to be registered as an I&AP and had no comment | Dave Murray (Smit Amandla Marine) has been registered as an I&AP on the project database (see Annexure 1 of this report). |

| NO. | ISSUE | NAME | METHOD | COMMENT | RESPONSE |
|---|---|---|---|---|---|
| 2.2 | I&AP registration | Thabo Mokonenyane | received 03 Oct 2012 | Asked to be registered as an I&AP and to participate in the study. | Thabo Mokonenyane has been registered as an I&AP on the project database (see Annexure 1 of this report) and was also sent a copy of the BID and Response Form. |
| 2.3 | I&AP registration | Deanne Wilson | received 03 Oct 2012 | Asked to be registered as an I&AP. | Deanne Wilson has been registered as an I&AP on the project database (see Annexure 1 of this report) and was also sent a copy of the BID and Response Form. |
| 2.4 | I&AP registration | Moses Jawula | and received 03 and 22 Oct 2012 | Asked to be registered as an I&AP. | Moses Jawula has been registered as an I&AP on the project database (see Annexure 1 of this report) and was also sent a copy of the BID and Response Form. |
| 2.5 | I&AP registration | Guy Odell (Fugro Survey (Middle East) Ltd.) | received 04 Oct 2012 | Asked to be registered as an I&AP. | Guy Odell (Fugro Survey Ltd.) has been registered as an I&AP on the project database (see Annexure 1 of this report). |
| 2.6 | I&AP registration | George Sieraha (Greater Cape Town Civic Alliance) | received 05 Oct 2012 | Please register the Greater Cape Town Civic Alliance as an I&AP. | The Greater Cape Town Civic Alliance has been registered as an I&AP on the project database (see Annexure 1 of this report). |
| 2.7 | I&AP registration | Jessica Courtoreille (PetroSA) | received 08 Oct 2012 | Asked for confirmation of registration as an I&AP. | PetroSA is a registered I&AP on the project database (see Annexure 1 of this report). |
| 2.8 | Authority comment | DEA&DP | received 23 Oct 2012 | DEAD&P acknowledged receipt of the Background Information Document and indicated that the information was being considered. | This correspondence is noted. |

## ANNEXURE 1

## I&AP DATABASE

**()**

**CP du Plessis ()**
P O Box 201 GREAT BRAK RIVER 6525
Work 044 620 4115

**Mr I McLachlan (Ian)**
11 Orchard Way PINELANDS 7405
Cell 082 307 4536 Home 021 531 2712 Email ian.mclach@gmail.com
NOTE: Add to all oil and gas project databases.

**Mr T Mokonenyane (Thabo)**
Cell 082 292 2081 Email thabo.mokonenyane@gmail.com

**Wilson (Deanne)**
Email deawilson@polka.co.za

**Afrishore Shipping (Pty) Ltd**

**Ms S Schmidt (Shirley)**
Afrishore Shipping (Pty) Ltd
P O Box 751 MOSSEL BAY 6500
Work 044 691 3218 Fax 044 690 7884 Email shirley@afrishore.co.za

**Ms E van Aswegen (Elmar)**
Afrishore Shipping (Pty) Ltd
P O Box 751 MOSSEL BAY 6500
Work 044 691 3218 Fax 044 690 7884 Cell 084 827 1149 Email elmar@afrishore.co.za
NOTE: company do not exist anymore,(Krew Maritime )

**Anadarko Petroleum Corporation**

**Mr M Ranoszek (Marek)**
General Manager Anadarko Petroleum Corporation
P O Box 7980 ROGGEBAAI 8012
Work 021 425 5012/3 Fax 021 425 5588 Cell 082 467 3227 Email ranoszem@pioneernrc.com
NOTE: 21st Floor, 1 Thibault Square, Long Street, Cape Town, no longer with Pioneer

**Aquatic Protection Group**

**Mr C Viljoen (Craig)**
Chairperson Aquatic Protection Group
P O Box 1633 MOSSEL BAY 6500
Fax 044 690 5066 Cell 082 665 3770
NOTE: 9 Bayview Street MOSSEL BAY 6506

**Association of Small Hake Industries**

**Mr A Kaye (Andrew)**
Chairman Association of Small Hake Industries
P O Box 6259 ROGGEBAAI 8012
Work 021 421 2472 Fax 021 425 2716 Email andrew@kaytrad.co.za
NOTE: Hake Longline Assocition

**Bhana Coastal/Compass Trawling**

**Mr L Bhana (Lynweth)**
Bhana Coastal/Compass Trawling
13 Robbe Street De Bakke MOSSEL BAY 6506
Work 044 690 7239 Cell 073 219 8105 Email lynweth@polka.co.za

**Blue Continent Products (Pty) Ltd**

**Mr P Rocher (Pierre)**
Managing Director Blue Continent Products (Pty) Ltd
P O Box 56 PAARDEN EILAND 7420
Work 021 508 9600 Fax 021 511 9632 Email procher@bluecon.co.za

**BMC Visserye**

**Mr Brown (Basil)**
BMC Visserye
121 Marlin Street, Ext. 23 MOSSEL BAY 6506
Fax 044 693 2657 Cell 083 548 9146

**Bowman Gilfillan**

**Ms M Adderley (Megan)**
Associate Bowman Gilfillan
P O Box 248 CAPE TOWN 8000
Work 021 480 7800 Fax 021 424 1688 Cell 082 806 6002 Email m.adderley@bowman.co.za

**Mr N Tunbridge (Noel)**
Attorney: Executive Consultant Bowman Gilfillan
P O Box 248 CAPE TOWN 8000
Work 021 480 7932 Fax 021 480 7918 Email n.tunbridge@bowman.co.za
NOTE: SA Reserve Bank Building, 60 St Georges's Mall, Cape Town

**Cacadu District Municipality**

**Ms K Kekana (Khunjuzwa)**
Executive Mayor Cacadu District Municipality
P O Box 318 PORT ELIZABETH 6006
Work 041 508 7111 Fax 041 508 7000

**Capricorn Fisheries Monitoring cc (CAPFISH)**

**Mr D Japp (Dave)**
Director Capricorn Fisheries Monitoring cc (CAPFISH)
P O Box 50035 WATERFRONT 8002
Work 021 425 2161 Fax 021 425 1994 Cell 082 788 6737 Home 021 780 1101 Email jappy@iafrica.com
NOTE: Home tel = also fax. Physical address: Unit 15 Foregate Square, Table Bay Boulevard, Cape Town.

**Ms S Wilkinson (Sarah)**
Capricorn Fisheries Monitoring cc (CAPFISH)
P O Box 50035 WATERFRONT 8002
Work 021 425 6226 Fax 021 425 1994 Cell 073 173 0417 Email sarah@capfish.co.za

**Centre for Dolphin Studies**

**Dr V Cockcroft (V)**
Centre for Dolphin Studies
P O Box 1856 PLETTENBERG BAY 6600
Fax 044 533 6185 Cell 083 655 6902 Email cdswhale@worldonline.co.za

**CNR International (South Africa) Limited**

**Mr D Forfar (David)**
CNR International (South Africa) Limited
St Magnus House Guild Street ABERDEEN AB11 6NJ U K
Work +440 1224 30360 Email David.Forfar@cnrinternational.com

**Mr R Truter (Ruari)**
Senior Drilling Engineer CNR International (South Africa) Limited
St Magnus House Guild Street ABERDEEN AB 116 NJ U.K.
Work +4401224 303193 Cell +4407789 516039 Email ruari.truter@cnrinternational.com
NOTE: Switchboard: +44 0 1224 303600

**CNR International (UK) Ltd**

**Mr D Spooner (David)**
CNR International (UK) Ltd
St Magnus House Guild Street ABERDEEN AB 116NJ UK
Work +44 01224 30319 Email david.spooner@cnrinternational.com
NOTE: Switchboard +44 01224 303600

**Da Nova Forum**

**Mr O Rebolini (Orazio)**
Da Nova Forum
23 Ryk Tulbagh Street MOSSEL BAY 6500
Work 044 691 1551

**Department of Agriculture, Forestry and Fisheries**

**Dr J Augustyn (Johan)**
Chief Director: Marine Resource Management Department of Agriculture, Forestry and Fisheries
Private Bag X2 ROGGEBAAI 8012
Work 021 402 3102 Fax 021 419 3639 Cell 082 829 3911 Email JohannAU@daff.gov.za
NOTE: Ground floor, Foretrust Building, Marin Hammerschlag way, Foreshore.secretary 021 402 3103

**Department of Agriculture, Forestry and Fisheries**

**Mr A Munro (Arno)**
Communication Officer Department of Agriculture, Forestry and Fisheries
Private Bag X1 MOSSEL BAY 6500
Work 044 691 9066 Fax 044 691 9066 Cell 083 667 2100 Email arnom@daff.gov.za
NOTE: Bartolomeu Dias museum Complex, Mossel Bay

**Dr K Prochazka (Kim)**
Department of Agriculture, Forestry and Fisheries
Private Bag X2 ROGGEBAAI
Work (021) 402 3546 Email kimp@daff.gov.za

**Mr P Sims (Peter)**
The Regional Officer: Fisheries Branch Department of Agriculture, Forestry and Fisheries
PO Box 58 MOSSEL BAY 6500
Work 044 690 3500 Fax 044 690 3041 Cell 082 772 0174 Email petersm@daff.gov.za
NOTE: 86 Bland Street, Vincent Building, First Floor Room 3/4, Mossel Bay, 6500 petesims@mweb.co.za

**Department of Energy**

**Ms N Magubane (Nelly)**
Deputy DG: Energy Planning & Hydrocarbons Department of Energy
Private Bag X19 ARCADIA 0007
Work 012 444 4062 Fax 012 341 7713
NOTE: letter returned, 1 Nov11, replaced mr R Crompton

**Department of Environmental Affairs**

**Dr A Boyd (Alan)**
Oceans and Coasts Conservation Department of Environmental Affairs
Shed 2, East Pier Road V&A Waterfront CAPE TOWN 8012
Work 021 819 2470 Cell 083 421 3965 Email ajboyd@environment.gov.za

**Dr L Hutchings (Larry)**
Chief Specialist Scientist Department of Environmental Affairs
Private Bag X2 ROGGEBAAI 8012
Work 021 402 3109 Fax 0866 152 567 Cell 082 829 3900 Email lhutchin@deat.gov.za
NOTE: Oceans & Coasts

**Mr M Meyer (Mike)**
Department of Environmental Affairs
Private bag X2 ROGGEBAAI 8012
Work 021 402 3173 Email Mmeyer@environment.gov.za
NOTE: Second Floor Foretrust House, Marinhammerschlagweg, Foreshore, Cape Town

**Mr D Mthembu (Dumisani)**
Director: Environmental Impact Evaluation Department of Environmental Affairs
Private Bag X447 PRETORIA 0001
Work 012 310 3230 Fax 012 320 7539
NOTE: Physical Addres: Fedsure Building, 315 Pretorius Street, Pretoria 0002

**Dr R Omar (Razeena)**
Chief Director: Integrated Coastal Management Department of Environmental Affairs
PO Box 52126 CAPE TOWN 8002
Work 021 819 2432/0 Email romar@environment.gov.za
NOTE: Physical address: 2 East Pier Shed, East Pier Road, V&A Waterfront, Cape Town. Oceans & Coasts Bran

**Department of Mineral and Resources**

**()**
The Regional Department of Mineral and Resources
Private Bag X9 ROGGEBAAI 8012

**Mr H Gumede (Henry)**
Chief Director: Hydrocarbons Department of Mineral and Resources
Private Bag X59 PRETORIA 0001

**Department of Water Affairs**

**Dr W Roets (Wietsche)**
Department of Water Affairs
Cell 082 414 0064 Email roetsw@dwa.gov.za
NOTE: Has left DEA&DP - now with Water Affairs

**Dolphin Action & Protection Group**

**Ms N Rice (Nan)**
Secretary Dolphin Action & Protection Group
P O Box 22227 FISH HOEK 7974
Fax 021 782 6223 Home 021 782 5845 Email mwdapg@mweb.co.za

**Eastern Cape Parks and Tourism Agecy**

**Ms A Sontsele (Asanda)**
Environmental Planner Eastern Cape Parks and Tourism Agecy
Work 043 705 4400 Fax 086 310 3891 Email Asanda.Sontsele@ecpta.co.za

**Eden District Municipality**

**Mr P van Rensburg (Piet)**
Eden District Municipality
P O Box 582 MOSSEL BAY 6500
Work 044 693 0006
NOTE: cnr Marlin & Sampson Streets, Extension 23, Mossel Bay 6506

**Eyethu Fishing (Pty) Ltd**

**Mr D Nel ()**
Eyethu Fishing (Pty) Ltd
PO Box 1531 PORT ELIZABETH 6000
Work 041 585 5683 Fax 041 585 5682

**Fish SA**

**Mr S Salie (Suleiman)**
Chairman Fish SA
PO Box 2066 CAPE TOWN 8000
Work 021 425 2727 Fax 021 419 0785 Cell 082 455 1211 Email suleimans@bluecon.co.za
NOTE: deepsea@iafrica.com Harbour Place, Foreshore

**Fisheries Consultant**

**Mr B Flanagan (Brian)**
Fisheries Consultant
P O Box 50132 WATERFRONT 8002
Work 021 421 3990 Fax 021 421 3992 Email ruwekus@mweb.co.za

**Fishing Industry News**

**Ms T Chandler (Tracy)**
Fishing Industry News
P O Box 705 RONDEBOSCH 7701
Work 021 659 2640 Cell 072 993 9585 Email trachandler@telkomsa.net

**Forest Exploration International (SA) (Pty)Ltd**

**Mr J Langhus (John)**
Forest Exploration International (SA) (Pty)Ltd
Suite 1B, Nautica The Waterclub, Beach Road GRANGER BAY 8005
Work 021 401 4140 Fax 021 401 4198 Cell 083 412 9876 Email jllanghus@forestoil.co.za
NOTE: no longer works for OPASA,

**Fransmanshoek Conservancy**

**Mr W Meyer (Wayne)**
Fransmanshoek Conservancy
P O Box 765 MOSSEL BAY 6500
Cell 082 084 2791 Email waynemeyer7@yahoo.co.uk
NOTE: ranger@fransmanshoek.co.za

**Fresh Tuna Exporters Association**

**Mr S Cameron-Dow (Steve)**
Chairman Fresh Tuna Exporters Association
PO Box 26973 HOUT BAY 7872
Work 021 790 5113 Fax 021 790 5113 Email stevecd@rsaweb.co.za
NOTE: Also longfin@iafrica.com

**Ms c de Kock (Carol)**
Fresh Tuna Exporters Association
Email longfin@iafrica.com

**Fugro Survey (Middle East) Ltd.**

**Captain G Odell (Guy)**
Business Development Manager - Subsea Services Fugro Survey (Middle East) Ltd.
PO Box 43088 ABU DHABI U.A.E.
Work +971 2 5547810 Fax +971 2 554 7811 Email g.odell@fugro-uae.com

**GAC Shipping (SA) (Pty) Ltd**

**Mr H Venter (Herman)**
Operations Manager GAC Shipping (SA) (Pty) Ltd
P O Box 2369 CAPE TOWN 8000
Work 021 419 8574 Fax 021 419 4438 Cell 083 631 1855 Email southafrica@gacworld.com
NOTE: dale hart no longer with the company

**Great Brak River Museum**

**()**
Chairman Great Brak River Museum
PO Box 20 GREAT BRAK RIVER 6525
Work (044) 620 3338 Fax (044) 620 3176 Email greatbrakmuseum@gmail.com
NOTE: Chairman 2011: Rene de Kock

**Greater Cape Town Civic Alliance**

**Mr G Sieraha (George)**
Greater Cape Town Civic Alliance
PO Box 31010 GRASSY PARK 7888
Cell 082 490 7628 Email gsieraha@gmail.com

**Hanil Import & Export**

**Mr B J Jung ()**
Hanil Import & Export
Unit 19, 22 Section Street PAARDEN EILAND 7405
Work 021 511 0347 Fax 021 511 5401 Email jung@telkomsa.net

**Harbourside Trade cc.**

**()**
Harbourside Trade cc.
13 Marlin Sreet Ext. 13 MOSSELBAY 6500

**Heritage Western Cape**

**()**
Senior Heritage Officer Heritage Western Cape
Private Bag X9067 CAPE TOWN 8000
Work 021 483 9685
NOTE: Secretary's tel: (021) 483 9696 Protea Assurance Building, Greenmarket Square, CT 8001

**Irvin & Johnson Limited**

**Mr R Human (Riaan)**
The Branch Manager Irvin & Johnson Limited
P O Box 384 MOSSEL BAY 6500
Work 044 691 2023 Fax 044 691 1748 Cell 082 658 2958 Email riaanh@ij.co.za
NOTE: he has left the company

**Mr B Leask (Butch)**
Irvin & Johnson Limited
Private Bag X5 WATERFRONT 8002
Work 021 402 9988 Fax 021 402 9800

**Ms R Welby-Cooke (Renee)**
Irvin & Johnson Limited
PO Box 384 MOSSEL BAY 6510
Work 044 601 8802 Fax 044 691 1748 Email renec@ij.co.za
NOTE: SE Coast Inshore Fishin Association

**Japan Marine**

**Mr C Kotze (Chris)**
Managing Director Japan Marine
P O Box 7894 ROGGEBAAI 8012
Work 021 418 8880 Fax 021 418 8805 Email ckotze@jmss.co.za

**Jolinoli Arts Foundation**

**Mr N Philander (Noel)**
Jolinoli Arts Foundation
P O Box 2876 MOSSEL BAY 6500
Work 044 693 2554 Cell 073 201 0480 Email noelphilander@gmail.com

**Kannaland Local Municipality**

**Mr M Hoogbaard (Morne)**
Municipal Manager Kannaland Local Municipality
P O Box 30 LADISMIT 6655
Work 028 551 1023 Fax 086 619 8671 Email morne@kannaland.co.za

**Lusitania Trawling Services**

**Mr L De Freitas (Louie)**
Lusitania Trawling Services
P O Box 1078 PORT ELIZABETH 6056
Work 041 586 2296 Fax 041 586 0997 Cell 082 658 1580 Email salome@lst.co.za

**Mr M Mendonca (Mario)**
Lusitania Trawling Services
P O Box 7365 ROGGEBAAI 8012
Work 021 402 4200 Fax 021 418 2657 Email mario@lusitaniafishing.co.za

**Mr L Shaer (Lionel)**
Lusitania Trawling Services
P O Box 7365 ROGGEBAAI 8012
Work 021 402 4200 Fax 021 418 2657 Cell 082 658 5018 Email lshaer@lusitaniafishing.co.za

**Mr R Ventura (Rui)**
Lusitania Trawling Services
P O Box 7365 ROGGEBAAI 8012
Work 021 421 6466 Fax 021 418 2657 Email rventura@bluecon.co.za
NOTE: Also represents: South African Deep-sea Trawling Industry Association

**Mammal Institute / Iziko Museum**

**Dr P Best (Peter)**
Mammal Institute / Iziko Museum
P O Box 61 CAPE TOWN 8000
Work 021 481 3800 Email pbest@iziko.org.za

**Mossel Bay Environmental Partnership**

**Ms B Boer (Beverley)**
Mossel Bay Environmental Partnership
PO Box 2818 MOSSEL BAY 6500
Work 044 690 4694 Cell 082 439 5718 Email beverley@envirob.co.za
NOTE: ECO for Mossgas Voorbaai site

**Ms T Schonken (Tonia)**
Chairman MEP Mossel Bay Environmental Partnership
P O Box 732 HARTENBOS 6520
Work 044 695 0647
NOTE: also chairman for the Hartenbos Bayview Resident association

**C Schutte ()**
Mossel Bay Environmental Partnership
P O Box 25 MOSSEL BAY 6500

**Mossel Bay Heritage Society**

**()**
Chairman Mossel Bay Heritage Society
P O Box 774 MOSSEL BAY 6500
Work 044 691 3621
NOTE: Chairman 2009: Pieter Viljoen V/Chair 2011 Rene de Kock

**Mossel Bay Municipality**

**Clr PA du Plessis ()**
Councillor Mossel Bay Municipality
PO Box 25 MOSSEL BAY 6500
Work 044 6065140 Email flipcecelia@telkomsa.net
NOTE: PO Box 10597, DANA BAY, 6510

**Alderlady M Ferreira ()**
Executive Mayor Mossel Bay Municipality
PO Box 25 MOSSEL BAY 6500
Work 044 691 0404 Email mayor@mosselbaymun.co.za

**Clr J Gerber ()**
Councillor Mossel Bay Municipality
P O Box 25 MOSSEL BAY 6500
Work 044 620 3089 Email gansie@telkomsa.net

**Clr H Levendal ()**
Executive Deputy Mayor Mossel Bay Municipality
PO Box 25 MOSSEL BAY 6500
Work 044 606 5140 Email hleveldal@mosselbaymun.co.za

**Alderman NJ Lodewyks ()**
Speaker Mossel Bay Municipality
PO Box 25 MOSSEL BAY 6500
Work 044 606 5140 Email speaker@mosselbaymun.co.za

**Clr S Moodie ()**
Councillor Mossel Bay Municipality
PO Box 25 MOSSEL BAY 6500
Work 044 606 5140
NOTE: 76 Nicolaai Crescent, Ext 23, Mossel Bay, 6506

**Clr E Scheepers ()**
Councillor Mossel Bay Municipality
PO Box 25 MOSSEL BAY 6500
Work 044 606 5140 Email escheepers@mosselbaymun.co.za

**Cllr KH Smit ()**
Councillor Mossel Bay Municipality
PO Box 25 MOSSEL BAY 6500
Work 044 620 2445 Email ksmit@mosselbay.gov.za

**Clr J van der Merwe (Jim)**
Councillor Mossel Bay Municipality
PO Box 25 MOSSEL BAY 6500
Work 044 6065140 Email jvmerwe@mosselbay.gov.za

**Mr J A van Zyl (Johan)**
Mossel Bay Municipality
P O Box 25 MOSSEL BAY 6500
Cell 082 922 9340 Email jvanzyl@mosselbaymun.co.za

**G Viljoen ()**
Mossel Bay Municipality
Private Bag X29 MOSSEL BAY 6500
Work 044 606 5200 Fax 044 693 4513 Cell 082 990 1270 Email
gnviljoen@mosselbaymun.gov.za

**Mr N Zietsman (Neels)**
Mossel Bay Municipality
101 Marsh Street MOSSEL BAY 6506
Work 044 606 5000 Fax 044 691 2920

**NAFCOC**

**Mr N August (Numachole)**
NAFCOC
P O Box 426 MOSSEL BAY 6500
Work 044 693 0353 Fax 044 693 0353 Cell 083 740 7568
NOTE: 19 Nichaba Kwanonqaba MOSSEL BAY 6506

**NAFCOC**

**Mnr S Grootboom ()**
NAFCOC
Moonegstraat 101 MOSSEL BAY 6506
Work 044 693 9088

**Mr B Maxam (Buyani)**
NAFCOC
P O Box 426 MOSSEL BAY 6500
Fax 044 693 0353 Cell 083 4273210
NOTE: 19 Nichaba Kwanonqaba MOSSEL BAY 6506. He has passed on.

**National Ports Authority**

**Captain A Bergstedt (Ashley)**
National Ports Authority
P O Box 1942 MOSSEL BAY 6500
Work 044 604 6271 Fax 044 604 6232 Cell 083 620 6908 Email tamarathomas@npa.co.za
NOTE: other email: tamarat@npa.co.za

**Ms P Madikizela (Primrose)**
Environmental Manager National Ports Authority
P O Box 162 PORT ELIZABETH 6000
Work 041 507 1700 Fax 041 585 2930 Email primrose.madikizela@transnet.net

**Ms S Malope (Sandra)**
Environmental Manager National Ports Authority
P O Box 1924 MOSSEL BAY 6500
Work 044 604 6245 Fax 044 604 6232 Email mmantsha.malope@transnet.net

**Mr M Plaatjies (Mogamat)**
National Ports Authority
P O Box 162 PORT ELIZABETH 6000
Work 041 507 1900 Fax 041 585 2938 Email mogamatp@npa.co.za

**Mr W Roux (Willem)**
National Ports Authority
P O Box 1942 MOSSEL BAY 6500
Work 044 604 6272 Fax 044 604 6231 Email willem.roux@transnet.net

**N Sewnath (Naresh)**
Captain National Ports Authority
P O Box 1942 MOSSEL BAY 6500
Work 0866 487797 Cell 083 307 1228 Email naresh.sewnath@transnet.net
NOTE: 55 Bland Street Mossel Bay 6506

**Captain N Sewnath ()**
Harbour Master National Ports Authority
P O Box 1942 MOSSEL BAY 6500
Work 044 604 6271 Fax 044 604 6232 Cell 083 307 1228 Email naresh.sewnath@transnet.net
NOTE: 55 Bland Street Mossel Bay 6506; 0866487797

**Newsbase Limited**

**Mr E Reed (Edward)**
Senior Editor Newsbase Limited
Centrum House, 108-114 Dundas Street EDENBURGH EH3 5DQ
Work +44 131 2083622 Fax +44 131 4787001 Email edreed@newsbase.com

**Oceana Group Limited**

**Mr M Copeland (Mike)**
Operations Manager Oceana Group Limited
Oceana Fishing P O Box 7206 ROGGEBAAI 8012
Work 021 417 5600 Fax 021 417 5601 Email mcopeland@ob.co.za
NOTE: also represent SA Inshore Fishing Industry Association

**Offshore Petroleum Association of South Africa**

**Ms A Futter (Alison)**
Offshore Petroleum Association of South Africa
c/o PetroSA, 151 Frans Conradie Drive PAROW 7500
Work 021 929 3112 Fax 021 929 9097 Cell 079 493 3933 Email alison.futter@petrosa.co.za

**Our Hope Our Future Enterprise Pty Ltd**

**Mr M Jawula (Moses)**
Our Hope Our Future Enterprise Pty Ltd
PO Box 540 KENTON ON SEA 6191
Fax 086 656 5979 Cell 082 622 2580 Email moses.jawula@gmail.com

**Petroleum Agency SA**

**Ms J Du Toit (Jo)**
Manager: E&P Assets Petroleum Agency SA
P O Box 5111 TYGERVALLEY 7536
Work 021 938 3545 Fax 021 938 3520 Cell 082 829 6903 Email dutoitj@petroleumagencysa.com
NOTE: physical address: Tygerpoort Building, 7 Mispel Road, Bellville 7530

**Mr S Mills (Stephen)**
Commercial Manager Petroleum Agency SA
P O Box 5111 TYGERVALLEY 7536
Work 021 938 3500 Fax 021 938 3520 Email millss@petroleumagencysa.com
NOTE: physical address: Tygerpoort Building, 7 Mispel Road, Bellville 7530

**Ms P Ngesi (Phumla)**
Manager: Environmental Compliance Petroleum Agency SA
P O Box 5111 TYGERVALLEY 7536
Work 021 938 3570 Fax 021 910 0811 Email ngesip@petroleumagencysa.com

**Mr N Nwendamutswu (Nthangeni)**
Environmental Compliance Manager Petroleum Agency SA
P O Box 5111 TYGERVALLEY 7536
Work 021 938 3500 Fax 021 938 3520 Email nwendamutswun@petroleumagencysa.com
NOTE: Physical Address: Tygerpoort Building, 7 Mispel Road, Bellville 7530 (HE HAS LEFT PASA)

**Mr D van der Spuy (Dave)**
Manager: Resource Evaluation Petroleum Agency SA
P O Box 5111 TYGERVALLEY 7536
Work 021 938 3500 Fax 021 938 3520 Email vanderspuyd@petroleumagencysa.com
NOTE: physical address: Tygerpoort Building, 7 Mispel Road, Bellville 7530

**PetroSA (Pty) Ltd**

**Mr S Borean (Sandro)**
Project Engineer PetroSA (Pty) Ltd
Private Bag X5 PAROW 7499
Work 021 929 3000 Fax 021 929 3144 Cell 083 461 6617 Email sandro.borean@petrosa.co.za

**Ms J Courtoreille (Jessica)**
PetroSA (Pty) Ltd
Private Bag X5 PAROW 7955
Work 021 929 3216 Fax 021 929 3018 Cell 083 253 6614 Email jessica.courtoreille@petrosa.co.za
NOTE: 151 Frans Conradie Drive, Parow 7500

**Mr F Herbst (Faan)**
PetroSA (Pty) Ltd
Private Bag X14 MOSSEL BAY 6500
Work 044 601 2746 Fax 044 601 2038 Email faan.herbst@petrosa.co.za
NOTE: senior to Eileen Green

**Mr T Mofana (Tsepo)**
PetroSA (Pty) Ltd
Private Bag X5 PAROW 7499
Cell 0833621996 Email tsepo.mofana@petrosa.co.za
NOTE: no one knows him. Email returned

**Premier Fishing (SA) (Pty) Ltd**

**Mr M Debesai (Michael)**
Operations Manager Premier Fishing (SA) (Pty) Ltd
P O Box 181 CAPE TOWN 8000
Work 021 419 0124 Fax 021 419 0731 Email michaeld@premfish.co.za
NOTE: member of south coast rock lobster association. Mike van den Heever no longer with the company June

**Risar Fishing**

**Mr R de Maine (Redah)**
Risar Fishing
P O Box 22650 PORT ELIZABETH 6000
Work 041 586 0220 Fax 041 586 0266 Cell 082 855 1457 Email redahdemainef@msn.com

**S A Marine Predator Lab/Rhodes University**

**Mr E Gennari (Enrico)**
S A Marine Predator Lab/Rhodes University
Private Bag X1 MOSSEL BAY 6500
Work 044 690 5799 Cell 076 215 3360 Email enrico@sampla.org

**SA Squid Management Industrial Association**

**Mr E van Niekerk (Eugene)**
Chairperson SA Squid Management Industrial Association
P O Box 2008 North End PORT ELIZABETH 6070
Email sasmia@webec.co.za
NOTE: Mr Tucker no longer Chairman of the above organisation. Chairman is Mr Eugene van Niekerk.

**SANCO Mossel Bay**

**Mr E Polisi (Ernest)**
SANCO Mossel Bay
48 Matheza Street KWA-NONQABA 6506
Cell 078 3761805

**Mr B Swartbooi (Bongani)**
SANCO Mossel Bay
22 Cedile Street KWA-NONQABA 6506
Cell 0782623835 Email bsmnyama@gmail.com

**Sea Harvest Corporation Ltd**

**Mr R Hall (Russell)**
Fleet Operations Manager Sea Harvest Corporation Ltd
P O Box 52 SALDANHA 7395
Work 022 701 4120 Fax 022 714 3555 Cell 083 255 3577 Email russellh@seaharvest.co.za

**Mr JBH Scholte (Jan)**
Sea Harvest Corporation Ltd
P O Box 761 CAPE TOWN 8000
Work 021 417 7900 Fax 021 425 4845 Cell 082 561 9609 Email jans@seaharvest.co.za
NOTE: 021 557 5471, Physical address: 7th floor, Fleetway House, Martin Hammerschlag Way, Foreshore

**Sea Vuna Fishing Company (Pty) Ltd**

**Mr A Hendricks (Andrew)**
Sea Vuna Fishing Company (Pty) Ltd
P O Box 147 MOSSEL BAY 6500
Work 044 691 2814 Fax 044 691 3163 Email irvine@seaharvest.co.za
NOTE: Inshore Fishing Company. Send mail c/o Ravona Bruinders. AH collects when in Mbay.

**Mr K Maritz (Kobus)**
Sea Vuna Fishing Company (Pty) Ltd
Quay No. 5 Mossel Bay Harbour MOSSEL BAY 6506
Work 044 691 2814 Cell 082 561 9848 Email kobusm@seaharvest.co.za
NOTE: Also represents: South East Coast Inshore Fishing Association

**Selecta Sea Products (Pty) Ltd**

**Mr T Reddell (Tim)**
Selecta Sea Products (Pty) Ltd
P O Box 414 CAPE TOWN 8000
Work 021 372 1100 Email tim@selectafish.co.za
NOTE: Lanzerac Road, Phillipi, Cape Town 7785

**Shark Longline Association**

**Mr H Gomez (Horatio)**
Chairman Shark Longline Association
20 Woodhead Drive EDGEMEAD 7441
Work 021 425 2161 Fax 021 589 739

**SMIT Amandla Marine (Pty) Ltd**

**Mr G Barker (Guy)**
SMIT Amandla Marine (Pty) Ltd
13 Industry Road Voorbaai MOSSEL BAY 6506
Cell 083 254 8609 Email g.barker@smit.com
NOTE: guybarker@mweb.co.za

**Mr D de Wet (Durandt)**
Senior Diving Supervisor SMIT Amandla Marine (Pty) Ltd
P O Box 2214 MOSSEL BAY 6500
Work 044 695 0390 Fax 044 695 0391 Cell 083 409 4809 Email d.d.wet@smit.com

**Mr D Murray (Dave)**
SMIT Amandla Marine (Pty) Ltd
P O Box 1339 CAPE TOWN 8000
Work 021 507 5777 Fax 021 507 5885 Email d.murray@smit.com

**South African Navy Hydrographic Office**

**Lieutenant I Coetzer (Irene)**
South African Navy Hydrographic Office
Private Bag X1 TOKAI 7966
Work 021 787 2408 Fax 021 787 2233 Email hydrosan@iafrica.com

**Mr M Nelson (Malcolm)**
South African Navy Hydrographic Office
Private Bag X1 TOKAI 7966
Work 021 787 2408 Fax 021 787 2233 Email hydrosan@iafrica.com

**Commander TJ van Niekerk (TJ)**
South African Navy Hydrographic Office
Private Bag X1 TOKAI 7966
Work 021 787 2408 Fax 021 787 2228 Email hydrosan@iafrica.com
NOTE: please email only

**South African Petroleum Industry Association**

**Mr A Tshifularo (Avhapfani)**
Managing Director South African Petroleum Industry Association
P O Box 783482 SANDTON 2146
Work 011 783 7664
NOTE: Mr McClelland Retired

**South African Commercial Fisherman**

**Ms C Attwood (Clair)**
South African Commercial Fisherman
P O Box 705 RONDEBOSCH 7701
Email cattwood@mweb.co.za
NOTE: Send info via email.

**South African Deep Sea Trawling Industry Ass.**

**Mr R Bross (Roy)**
The Secretary South African Deep Sea Trawling Industry Ass.
P O Box 2066 CAPE TOWN 8000
Work 021 425 2727 Fax 021 425 4734 Email deepsea@iafrica.com
NOTE: Note: Send corr. via email

**Mr J Pope (John)**
South African Deep Sea Trawling Industry Ass.
P O Box 6636 ROGGEBAAI 8012
Work 021 419 4424 Fax 021 419 5724 Email jpope@marpro.co.za

**South African Heritage Resources Agency**

**Mr S Berry (Shawn)**
South African Heritage Resources Agency
PO Box 2771 CAPE TOWN 8000
Work (021) 465 2198 Fax (021) 465 5789 Email sberry@wc.sahra.org.za

**South African Heritage Resources Agency (SAHRA)**

**Dr M Galimberti (Mariagrazia)**
Archaeology, Palaeontology & Meteorite Unit South African Heritage Resources Agency (SAHRA)
PO Box 4637 CAPE TOWN 8000
Work 021 462 4502 Fax 021 462 4509 Email mgalimberti@sahra.org.za
NOTE: 111 Harrington St, CAPE TOWN, 8000

**South African Inshore Fishing Industry Association**

**Mr D de Villiers (Dan)**
South African Inshore Fishing Industry Association
P O Box 2066 CAPE TOWN 8000
Work 021 425 2727 Fax 021 425 4734 Email dan@new.co.za
NOTE: safish@new.co.za - SA Pelagic Fishing Industry Association

**South African Maritime Safety Authority (SAMSA)**

**Mr B Colenutt (Brian)**
South African Maritime Safety Authority (SAMSA)
P O Box 3914 North End PORT ELIZABETH 6056
Work 041 585 0051 Fax 041 582 1213 Email bcolenutt@samsa.org.za

**Mr D Colly (Dave)**
Western Regional Manager South African Maritime Safety Authority (SAMSA)
Private Bag X7025 ROGGEBAAI 8012
Work 021 421 6170 Email dcolly@samsa.org.za
NOTE: 2 Long Street, 19th Floor, Cape Town, 8001

**Mr D Manley (Dave)**
Principle Officer South African Maritime Safety Authority (SAMSA)
P O Box 4 MOSSEL BAY 6500
Work 044 690 4201 Fax 044 691 1206 Email dmanley@samsa.org.za
NOTE: Room 109, Plaza Aquada, 55 marsh Street, Mossel Bay 6506

**Captain S Modak ()**
South African Maritime Safety Authority (SAMSA)
Private Bag X7025 ROGGEBAAI 8012
Work 021 421 6170 Fax 021 419 0730 Email smodak@samsa.org.za
NOTE: no longer with the company

**Captain P Van Gysen ()**
South African Maritime Safety Authority (SAMSA)
Private Bag X7025 ROGGEBAAI 8012
Work 021 421 6170 Fax 021 419 0730 Email pvangysen@samsa.org.za
NOTE: no longer with the company

**South African Oil & Gas Alliance**

**Mr W Blyth (Warwick)**
Director South African Oil & Gas Alliance
P O Box 6142 ROGGEBAAI 8012
Work 021 425 8840 Fax 021 421 7928 Cell 083 647 9917 Email wblyth@offshoreafrica.co.za
NOTE: Mr Schwabe no longer with the company

**South African Sports Anglers Confederation**

**Mr J Pledger (John)**
South African Sports Anglers Confederation
Work (011) 794 6950 Cell 083 648 2561 Email jpledger@iafrica.com
NOTE: Also represents: South African Consolidated Recreational Anglers Association

**South African Squid Management Industrial Ass**

**Mr D Moodley (Dino)**
South African Squid Management Industrial Ass
PO Box 22276 PORT ELIZABETH 6000
Work (041) 585 1652 Fax (041) 585 8605 Email sasmia@webec.co.za

**South African Squid Management Industrial Ass.**

**Dr E van Niekerk (Eugene)**
South African Squid Management Industrial Ass.
P O Box 13130 Suite 196 HUMEWOOD 6013
Work 041 582 1615 Email aqfishing@mweb.co.za

**South African Tuna Longline Association**

**Mr R Ball (Richard)**
Secretary South African Tuna Longline Association
P O Box 3277 CAPE TOWN 8000
Email rball@iafrica.com

**South Coast Rock Lobster Association**

**Mr S Bhana (Shaun)**
South Coast Rock Lobster Association
P O Box 181 CAPE TOWN 8000
Work 021 419 0124 Fax 021 419 0731 Email shaunb@premfish.co.za
NOTE: Dean Stacey left the company. June 2012

**Suid Kaap Fisheries**

**Mr W Cronje (Willem)**
Suid Kaap Fisheries
P O Box 7 STILBAAI 6674
Work 028 754 2002 Fax 028 754 2002

**Taiwanese Consulate**

**Mr Wu ()**
Taiwanese Consulate
P O Box 1122 CAPE TOWN 8000
Work 021 418 1188 Email ccwu@mofa.gov.tw

**The Herald**

**Mr S Gillham (Shaun)**
The Herald
Email gillhams@timesmedia.co.za
NOTE: Journalist at The Herald

**The Mossel Bay Environmental Partnership**

**Mr M Keet (Mike)**
The Mossel Bay Environmental Partnership
44 Upper Cross Street MOSSEL BAY 6506
Fax 044 691 1887 Cell 083 578 7530 Home 044 691 1887 Email thekeets@telkomsa.net
NOTE: PO Box 2050 Mossel Bay 6500 Chairman of Hartenbos River Forum

**Total E&P South Africa (Pty) Ltd**

**Ms K Azevedo (Karla)**
Senior Counsel - Africa Division Total E&P South Africa (Pty) Ltd
2, Place Jean Millier La Defense 6 PARIS LA DEFENSE 92078 CEDEX
Work +33 01 47443115 Email karla.azevedo@total.com

**Total Exploration and Production South Africa**

**Mr R Lions (Renaud)**
Project Director - Africa Total Exploration and Production South Africa
Tour Couple 07F39 2 Place Jean Miller PARIS LA DEFENSE 6 92078 CEDEX
Work +330147448345 Cell 033609625106 Email renaud.lions@total.com

**TRT Shipping**

**Mr D Jooste (David)**
TRT Shipping
P O Box 7200 ROGGEBAAI 8012
Work 021 440 9200 Fax 021 419 2848 Email djooste@trt.co.za

**Tuna Longline Association/Combined fishing Enterp.**

**Mr D Lucas (Don)**
Tuna Longline Association/Combined fishing Enterp.
P O Box 3277 CAPE TOWN 8000
Work 021 510 7924 Fax 021 696 1327 Cell 083 456 2592 Email don@comfish.co.za
NOTE: 021 511 6590, comfish@mweb.co.za

**Viking Inshore Fishing**

**Mr C Bacon (Craig)**
Viking Inshore Fishing
P O Box 368 MOSSEL BAY 6500
Work 044 691 1600 Fax 044 691 1147 Email craig@vikingfishing.co.za
NOTE: send info via email. He is also the secretary of S.E. Coast Inshore Fishing Association (SECIFA)

**WCG: Department of Cultural Affairs & Sport**

**Mr MP Mrubata (MP)**
WCG: Department of Cultural Affairs & Sport
Private Bag X1 MOSSEL BAY 6500
Work 044 691 1067 Fax 044 691 1915 Email mmrubata@pgwc.gov.za
NOTE: Mr Stoffel Smalberger left the department

**WCG: Department of Env. Affairs & Dev Planning**

**Mr Z Jumat (Zain)**
Directorate: Coastal Management WCG: Department of Env. Affairs & Dev Planning
PO Box 6509 GEORGE 6530
Email zjumat@pgwc.gov.za

**Mr F Naude (Francois)**
Control Environmental Officer WCG: Department of Env. Affairs & Dev Planning
Private Bag 6509 GEORGE 6530
Work 044 805 8600 Fax 021 874 2423 Email fnaude@novell.pgwc.gov.za
NOTE: Chief Directorate: Integrated Environ and Land Management (Region A1) York Park Building 93 York str

**Mr A Oosthuizen (Andre)**
WCG: Department of Env. Affairs & Dev Planning
Private Bag X6509 GEORGE 6530
Work 044 805 8600 Email Aoosthuiz@pgwc.gov.za
NOTE: Physical Add: 4th Floor, York Park Building, York Street

**Mr D Swanepoel (Danie)**
Deputy Director WCG: Department of Env. Affairs & Dev Planning
93 York Park Building St Johns Street GEORGE 6530 RSA
Work 044 805 8600 Email dswanepo@novell.pgwc.gov.za
NOTE: Private Bag X6509

**Wildlife & Environment Society of SA (WESSA)**

**Mr P Dowling (Patrick)**
Wildlife & Environment Society of SA (WESSA)
P O Box 30145 TOKAI 7966
Work 021 701 1397 Fax 021 701 1399 Email patrick@wessa.co.za

**Mr S du Toit (Steve)**
Wildlife & Environment Society of SA (WESSA)
31 Progress Street Dormehlsrif GEORGE 6529
Work 044 874 7097 Email steve@wessa.co.za

**Prof M Finnemore (Martheanne)**
Regional Manager Wildlife & Environment Society of SA (WESSA)
P O Box 12444 CENTRAL HILL 6006
Email martheanne@wessaep.co.za
NOTE: Eastern Province

**Ms L McGibbon (Lorraine)**
Wildlife & Environment Society of SA (WESSA)
31 Progress Street GEORGE 6529
Work 044 870 7038 Email lorraine@wessa.co.za

**World Shipping Agencies**

**Mr N Warner (Nils)**
World Shipping Agencies
P O Box 1573 CAPE TOWN 8000
Work 021 419 7223 Fax 021 418 6068 Email nils.warner@worldshipping.co.za

**WWF South Africa**

**Dr S Petersen (Samantha)**
Manager WWF South Africa
Marine Programme P O Box 23273 CLAREMONT 7735
Work 021 657 6600 Fax 086 535 9433 Email spetersen@wwf.org.za
NOTE: Aaniyah Omardien no longer works for the company July12

**Zululand Oil & Gas Resources (Pty) Ltd**

**Mr EO Sayed (Ebrahim)**
Zululand Oil & Gas Resources (Pty) Ltd
PO Box 21141 ROSHNEE 1936
Email esayed@vodamail.co.za

**161 names listed**

# ANNEXURE 2

# NOTIFICATION LETTER, BID AND RESPONSE FORM

CCA ENVIRONMENTAL

TOT01/Let-01 Oct12

01 October 2012

Dear Sir / Madam

**ENVIRONMENTAL MANAGEMENT PLAN FOR A PROPOSED 2D SEISMIC SURVEY, DROP CORING SAMPLING AND SONAR BATHYMETRY, OUTENIQUA SOUTH AREA, SOUTH COAST, SOUTH AFRICA: NOTICE OF EMP AND PUBLIC PARTICIPATION PROCESS**

This letter and attached Background Information Document (BID) provides information on proposed oil and gas exploration activities in the Outeniqua South area off the South Coast of South Africa.

Total E and P South Africa (Pty) Ltd (Total E&P) has lodged an application for an Exploration Right with the Petroleum Agency of South Africa (PASA) in terms of Section 74 of the Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA) in order to explore for oil and gas reserves in the deep offshore area off the South Coast of South Africa, roughly between Cape Agulhas and Cape St. Francis. At its closest point the survey area is located approximately 90 km offshore. In applying for an Exploration Right, Total E&P is required to comply with Sections 39 and 74 of the MPRDA by submitting an Environmental Management Plan (EMP). In this regard, Total E&P has appointed CCA Environmental (Pty) Ltd (CCA) to prepare an EMP and undertake the associated public participation process in terms of the MPRDA requirements. A BID providing preliminary project details has also been compiled and is enclosed for your information.

If you or your organisation wish to register as an Interested and/or Affected Party and/or wish to raise any issues or concerns regarding the proposed project, please make use of the attached Response Form and forward it to Eloise Costandius of CCA at the contact details below. For comments to be included in the EMP they should be forwarded to CCA **no later than 23 October 2012.**

It should be noted that the EMP will be distributed for a 30-day comment period upon completion.

Yours sincerely

Jonathan Crowther Pr.Sci.Nat., CEAPSA
**CCA ENVIRONMENTAL (PTY) LTD**

Encl.

TOT01OBE/corr/I&APs/let – BID 01Oct12

# ENVIRONMENTAL MANAGEMENT PLAN FOR A PROPOSED 2D SEISMIC SURVEY, DROP CORING SAMPLING AND SONAR BATHYMETRY, OUTENIQUA SOUTH AREA, SOUTH COAST, SOUTH AFRICA

**BACKGROUND INFORMATION DOCUMENT OCTOBER 2012**

## 1. INTRODUCTION

Total E and P South Africa (Pty) Ltd (Total E&P) is proposing to explore for oil and gas reserves in the deep offshore area of the South Coast of South Africa roughly between Cape Agulhas and Cape St. Francis, referred to as the Outeniqua South area (see Figure 1). In this regard, Total E&P lodged an application for an Exploration Right with the Petroleum Agency of South Africa (PASA) in terms of Section 74 of the Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA). PASA accepted the application on 28 June 2012. Exploration activities would include a 2D seismic survey, drop coring sampling and sonar bathymetry. The proposed exploration area covers an area of approximately 76 060 km$^2$ with water depths ranging from 200 m to over 4 000 m.

A requirement of obtaining an Exploration Right is that an Environmental Management Plan (EMP) has to be compiled and submitted to PASA in term of Section 39 of the MPRDA and Interested and/or Affected Parties (I&APs) must be notified and consulted.

Total E&P has appointed CCA Environmental (Pty) Ltd (CCA) to compile an EMP to meet the relevant requirements of the MPRDA.

## 2. PURPOSE OF THIS DOCUMENT

This Background Information Document (BID) serves to:

- Inform Interested and/or Affected Parties (I&APs) that Total E&P has submitted a formal application to PASA for an Exploration Right off the South Coast of South Africa (see Figure 1);
- Provide background information about the proposed project and highlight some key issues regarding the potential environmental impacts of the proposed activities; and
- Provide I&APs with an opportunity to register as I&APs and to raise any issues on the proposed project. This document has been released for 21-day comment / review period from 02 October 2012 to 23 October 2012. The issues raised by I&APs will be included and addressed in the EMP.

## 3. PROJECT DESCRIPTION

### 3.1 2D SEISMIC SURVEY

**Introduction**

Seismic surveys are carried out during marine oil and gas exploration in order to investigate subsea geological formations. During seismic surveys high-level, low frequency sounds are directed towards the seabed from near-surface sound sources towed by a seismic vessel. Signals reflected from geological interfaces below the seafloor are recorded by multiple receivers (or hydrophones) towed in streamers. Analyses of the returned signals allow for interpretation of subsea geological formations.

Seismic surveys are undertaken to collect either 2D or 3D data. For this investigation Total E&P is proposing to undertake a 2D seismic survey, which is typically applied to obtain regional data from widely spaced survey grids (tens of kilometres).

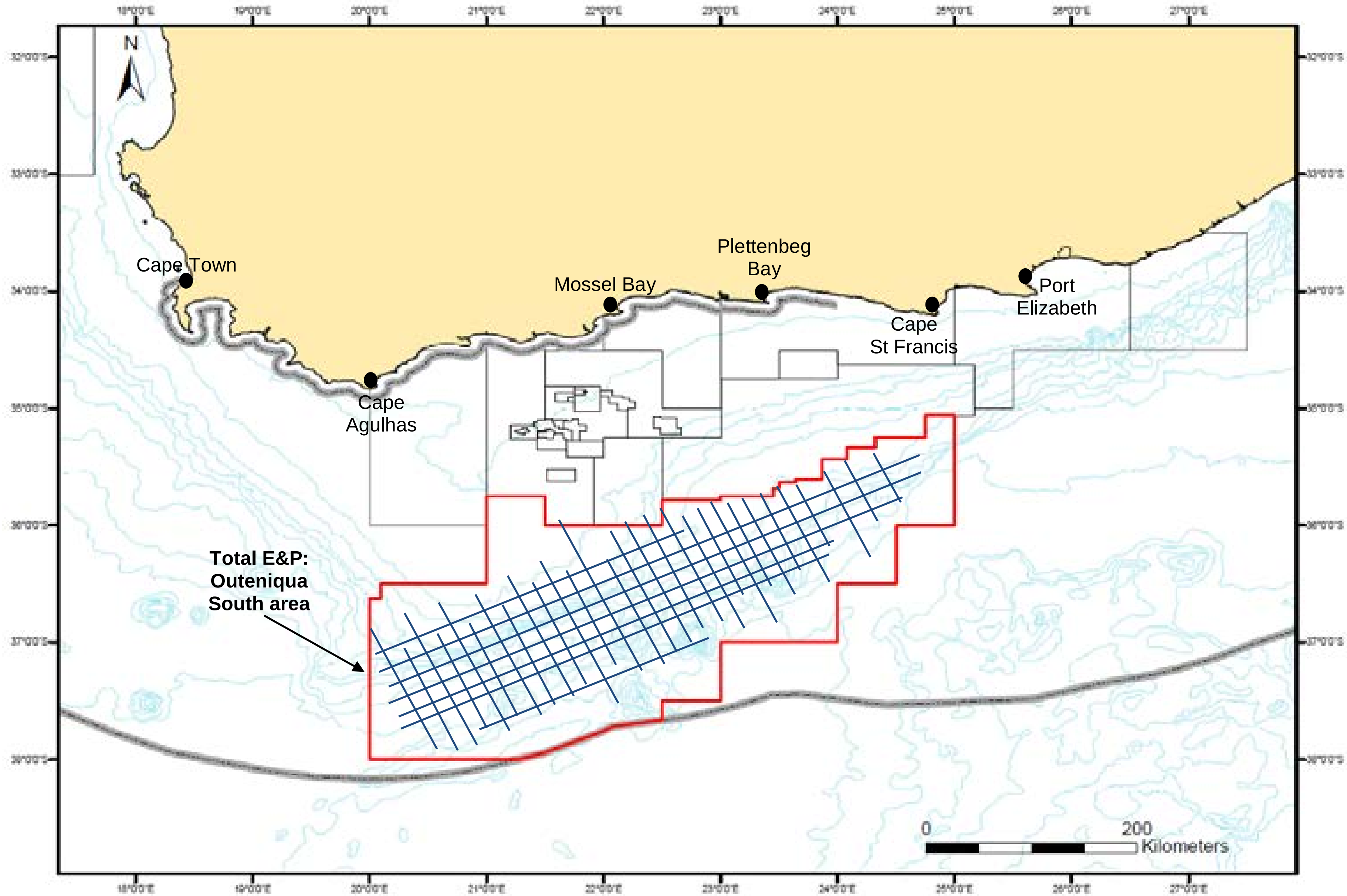


**Figure 1: Location of Total E&P's 2D seismic survey off the South Coast of South Africa, with approximate survey lines indicated.**

**Extent, duration and timing**

The proposed 2D seismic survey would be approximately 7 000 km in length, comprising a number of low density spaced survey lines covering Total E&P's entire licence block area in the Outeniqua South area (see Figure 1). The proposed exploration area is located at a substantial distance offshore. From Cape Agulhas and Cape St. Francis, the block is approximately 180 km and 90 km offshore, respectively. The larger harbours located at Mossel Bay and Port Elizabeth are approximately 150 km north and 130 km north-east of the area, respectively. Although survey commencement would ultimately depend on a permit award date, it is anticipated that the survey would commence during the last quarter of 2013 and would take in the order of two to three months to complete (between November 2013 and March 2014).

**Survey methodology and airgun array**

The seismic vessel would travel along transects of a prescribed grid within the survey area that have been carefully chosen to cross any known or suspected geological structure in the area. During surveying the seismic vessel would travel at a speed of between four and six knots (i.e. 2 to 3 metres per second).

The seismic survey would involve a towed airgun array, which provides the seismic source energy for the profiling process, and a seismic wave detector system, usually known as hydrophone streamer. The sound source or airgun would be situated some 100 m to 200 m behind the vessel at a depth of 5 m to 20 m below the surface. The airgun would be fired at approximately 10 to 20 second intervals. A 2D survey involves a single streamer, which would be up to 12 000 m long. A typical 2D seismic survey configuration and safe operational limits are illustrated in Figure 2.

The sound waves are reflected by boundaries between sediments of different densities and returned signals are recorded by hydrophones mounted inside streamer cables and transmitted to the seismic vessel for electronic processing. A surface tail-buoy with radar reflectors would be connected to the end of each streamer to provide a visible location point for reference.

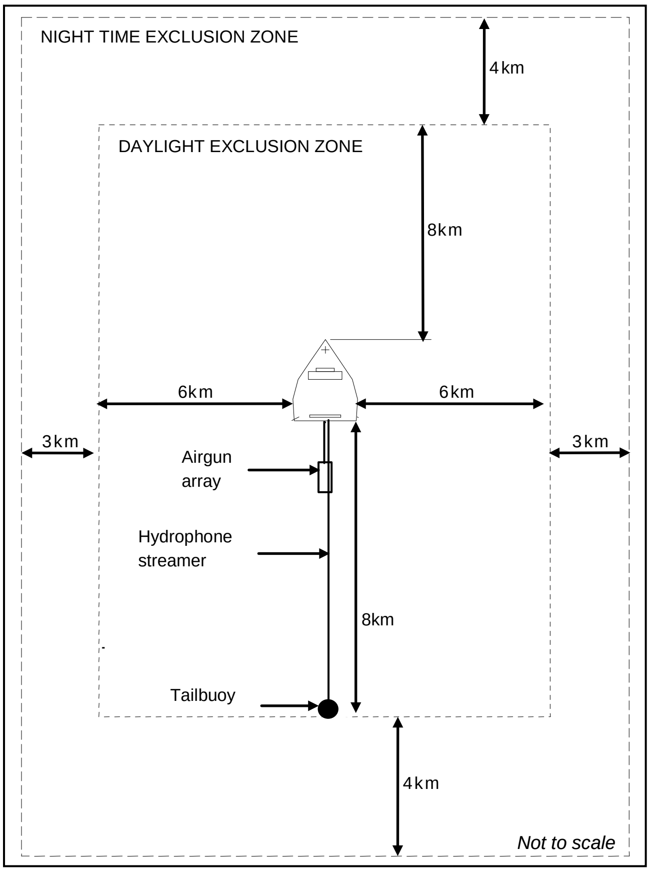


**Figure 2: Typical safe operational limits for 2D seismic survey operations.**

**Sound pressure emission levels**

Airguns are used on an individual basis or in arrays. Arrays of airguns are made up of towed parallel strings of airguns (usually comprised of between 12 and 70 airguns in total). A single airgun could typically produce sound levels of the order of 220-230 dB re 1 mPa @ 1m, while arrays produce sounds typically in the region of 250 dB re 1 mPa @ 1m. The majority of energy produced is in the 0 to 120 Hz bandwidth, although energy at much higher frequencies is also recorded. High-resolution surveys and shallow penetration surveys require relatively high frequencies of 100 to 1000 Hz, while the optimum wavelength for deep seismic work is in the 10 to 80 Hz range.

One of the required characteristics of a seismic shot is that it is of short duration (the main pulse is usually between 5 and 30 milliseconds). The main pulse is followed by a negative pressure reflection from the sea surface of several lower magnitude bubble pulses. Although the peak levels during the shot may be high, the overall energy is limited by the duration of the shot.

**Exclusion zone**

Under the Merchant Shipping Act (No. 57 of 1951), a seismic survey vessel that is engaged in surveying is defined as a "vessel restricted in its ability to manoeuvre" and requires that vessels engaged in fishing shall, so far as possible, keep out of the way of a vessel restricted in her ability to manoeuvre. It should also be noted that under the Marine Traffic Act (No. 2 of 1981), a seismic survey vessel and its array of airguns and hydrophones fall under the definition of an "offshore installation" and as such it is protected by a 500 m safety zone. It is an offence for an unauthorised vessel to enter the safety zone. In addition to a statutory 500 m safety zone, the seismic contractor would request a safe operational limit (that is greater than the 500 m safety zone) that it would like other vessels to stay beyond. Typical safe operational limits for 2D surveys are illustrated in Figure 2. Support vessels are usually commissioned as 'chase' boats to ensure that other vessels adhere to the safe operational limits.

### 3.2 CORE DRILL SAMPLING AND SONAR BATHYMETRY

Based on the outcome of the 2D seismic survey, follow-up drop core sampling and sonar bathymetry would be undertaken. Total E&P is proposing to use a piston coring system to undertake sediment core samples of the seabed surface. Approximately 150 to 200 core samples would be collected across the 2D seismic survey area. This number and the exact location of the core samples would be confirmed following the analysis of the 2D survey results. It is proposed to commence with the core drilling and sonar survey during November 2014.

## 4. KEY ISSUES TO BE INVESTIGATED

The following key issues and potential impacts have been identified in relation to the proposed exploration activities and will be addressed in the EMP:

- Noise effects on marine fauna;
- Effects on the fishing industry, including effects on fish behaviour, fish catches and cessation or displacement of fishing activities;
- Interference with marine recreational facilities and transport routes; and
- Waste discharge to sea and atmosphere.

## 5. YOUR INVITATION TO COMMENT AND PARTICIPATE IN THE PROCESS

If you or your organisation wish to register as an I&AP and/or wish to raise any issues or concerns regarding the proposed project, please make use of the attached Response Form and forward it to Ms Eloise Costandius of CCA at the contact details below. For comments to be included in the EMP they should be forwarded to CCA **no later than 23 October 2012.**

It should be noted that the EMP will also be distributed for a 30-day comment period upon completion.

Eloise Costandius
CCA Environmental
PO Box 10145, Caledon Square, 7905, Cape Town
Tel: (021) 461 1118/9 Fax: (021) 461 1120
E-mail: eloise@ccaenvironmental.co.za

cca
ENVIRONMENTAL

# ENVIRONMENTAL MANAGEMENT PLAN FOR A PROPOSED 2D SEISMIC SURVEY, DROP CORING SAMPLING AND SONAR BATHYMETRY, OUTENIQUA SOUTH AREA, SOUTH COAST, SOUTH AFRICA

## INTERESTED AND AFFECTED PARTY (I&AP) REGISTRATION AND RESPONSE FORM

**Would you or your organisation like to become a registered I&AP and continue to receive information on the proposed project?**

**Yes** ___________ **No** ___________

**Name:**

**Organisation:**

| **Postal address:** | |
|---|---|
| | **Email address:** |
| **Telephone number:** | **Fax number:** |

**Do you or your organisation have any issues or concerns regarding the proposed exploration activities off the South Coast of South Africa?**

**Yes** ___________ **No** ___________

**If yes, please provide details below** (or use extra pages if necessary):

Please forward to:
**CCA ENVIRONMENTAL (PTY) LTD**
Attention: Eloise Costandius
PO Box 10145, Caledon Square, 7905
Tel: (021) 461 1118/9 Fax: (021) 461 1120
Email: eloise@ccaenvironmental.co.za

Comments must reach
CCA Environmental no later than
**23 October 2012**

## Eloise Costandius

**From:** Eloise Costandius <eloise@ccaenvironmental.co.za>
**Sent:** 02 October 2012 11:03 AM
**To:** 'zjumat@pgwc.gov.za'; 'wroets@pgwc.gov.za'; 'willem.roux@transnet.net'; 'wblyth@offshoreafrica.co.za'; 'vanderspuyd@petroleumagencysa.com'; 'tsepo.mofana@petrosa.co.za'; 'trachandler@telkomsa.net'; 'tim@selectafish.co.za'; 'thekeets@telkomsa.net'; 'tamarathomas@npa.co.za'; 'steve@wessa.co.za'; 'spetersen@wwf.org.za'; 'southafrica@gacworld.com'; 'smodak@samsa.org.za'; 'shirley@afrishore.co.za'; 'shaunb@premfish.co.za'; 'sberry@wc.sahra.org.za'; 'sasmia@webec.co.za'; 'sarah@capfish.co.za'; 'sandro.borean@petrosa.co.za'; 'rventura@bluecon.co.za'; 'ruwekus@mweb.co.za'; 'russellh@seaharvest.co.za'; 'ruari.truter@cnrinternational.com'; 'romar@environment.gov.za'; 'renec@ij.co.za'; 'redahdemainef@msn.com'; 'rball@iafrica.com'; 'ranoszem@pioneernrc.com'; 'pvangysen@samsa.org.za'; 'procher@bluecon.co.za'; 'primrose.madikizela@transnet.net'; 'petersm@daff.gov.za'; 'pbest@iziko.org.za'; 'patrick@wessa.co.za'; 'nwendamutswun@petroleumagencysa.com'; 'nils.warner@worldshipping.co.za'; 'ngesip@petroleumagencysa.com'; 'naresh.sewnath@transnet.net'; 'mwdapg@mweb.co.za'; 'mogamatp@npa.co.za'; 'mmrubata@pgwc.gov.za'; 'Mmeyer@environment.gov.za'; 'mmantsha.malope@transnet.net'; 'millss@petroleumagencysa.com'; 'michaeld@premfish.co.za'; 'mgalimberti@sahra.org.za'; 'mcopeland@ob.co.za'; 'mayor@mosselbaymun.co.za'; 'martheanne@wessaep.co.za'; 'mario@lusitaniafishing.co.za'; 'lynweth@polka.co.za'; 'lusiops@intekom.co.za'; 'lshaer@lusitaniafishing.co.za'; 'lorraine@wessa.co.za'; 'longfin@iafrica.com'; 'lhutchin@deat.gov.za'; 'kobusm@seaharvest.co.za'; 'kimp@daff.gov.za'; 'jung@telkomsa.net'; 'jpope@marpro.co.za'; 'jpledger@iafrica.com'; 'JohannAU@daff.gov.za'; 'jessica.courtoreille@petrosa.co.za'; 'jappy@iafrica.com'; 'jans@seaharvest.co.za'; 'irvine@seaharvest.co.za'; 'hydrosan@iafrica.com'; 'g.barker@smit.com'; 'fnaude@novell.pgwc.gov.za'; 'faan.herbst@petrosa.co.za'; 'enrico@sampla.org'; 'elmar@afrishore.co.za'; 'edreed@newsbase.com'; 'dutoitj@petroleumagencysa.com'; 'dswanepo@novell.pgwc.gov.za'; 'don@comfish.co.za'; 'dmanley@samsa.org.za'; 'djooste@trt.co.za'; 'deepsea@iafrica.com'; 'dcolly@samsa.org.za'; 'David.Forfar@cnrinternational.com'; 'dan@new.co.za'; 'd.d.wet@smit.com'; 'craig@vikingfishing.co.za'; 'ckotze@jmss.co.za'; 'ccwu@mofa.gov.tw'; 'cattwood@mweb.co.za'; 'beverley@envirob.co.za'; 'bcolenutt@samsa.org.za'; 'Asanda.Sontsele@ecpta.co.za'; 'arnom@daff.gov.za'; 'aqfishing@mweb.co.za'; 'Aoosthuiz@pgwc.gov.za'; 'andrew@kaytrad.co.za'; 'alison.futter@petrosa.co.za'; 'ajboyd@environment.gov.za'
**Cc:** Jonathan Crowther
**Subject:** Proposed Exploration for Oil and Gas Reserves in the Outeniqua South Area
**Attachments:** Let I&AP - BID 2 October 2012 - Final.pdf

Good day

Please find attached information regarding the Exploration Right application lodged by Total E and P South Africa (Pty) Ltd to explore for oil and gas reserves in the deep offshore area of the South Coast of South Africa – the Outeniqua South area.

Regards

Eloise Costandius


Eloise Costandius Pr.Sci.Nat.
Environmental Scientist

CCA ENVIRONMENTAL (Pty) Ltd • Consulting Services
Unit 35 Roeland Square 30 Drury Lane Cape Town 8001 • PO Box 10145 Caledon Square 7905
Tel + 27 (21) 461 1118/9 • Fax + 27 (21) 461 1120 • eloise@ccaenvironmental.co.za • website: www.ccaenvironmental.co.za
Directors: J Crowther F Fredericks • Associate: J Blood • Reg No 2003/019026/07

# CCA ENVIRONMENTAL (PTY) LTD

## ACKNOWLEDGEMENT FORM
## LETTERS POSTED

| | |
|---|---|
| Project: | ENVIRONMENTAL MANAGEMENT PLAN FOR A PROPOSED 2D SEISMIC SURVEY, DROP CORING SAMPLING AND SONAR BATHYMETRY, OUTENIQUA SOUTH AREA, SOUTH COAST, SOUTH AFRICA; NOTICE OF EMP AND PUBLIC PARTICIPATION PROCESS |
| Letter Reference: | TOT01OHE |
| Number of letters posted: | 11 |
| Date posted: | 2 OCTOBER 2012 |
| Post Office: | Mill Street Post Office, Cape Town |

Signed:

CCA Environmental (Pty) Ltd
Director

2/10/2012
Date

Signed:

Mill Street Post Office

MAILS
Millstreet Post Office
2012 -10- 02
Ph: 021 465 1013

Date

cca
ENVIRONMENTAL

Mr Brown
BMC Visserye
121 Marlin Street, Ext. 23
MOSSEL BAY
6506

Ms K Kekana
Executive Mayor
Cacadu District Municipality
P O Box 315
PORT ELIZABETH
6006

Mr D Mkhembu
Director: Environmental Impact Evaluation
Department of Environmental Affairs
Private Bag X447
PRETORIA
0001

The Regional
Department of Mineral and Resources
Private Bag X9
ROGGEBAAI
8012

Mr P van Rensburg
Eden District Municipality
P O Box 582
MOSSEL BAY
6500

Mr D Nel
Eyethu Fishing (Pty) Ltd
PO Box 1531
PORT ELIZABETH
6000

Harbourside Trade cc.
13 Marlin Street
Ext. 13
MOSSEL BAY
6500

Mr B Leask
Irvin & Johnson Limited
Private Bag X5
WATERFRONT
8002

Ms T Schonken
Chairman MEP
Mossel Bay Environmental Partnership
P O Box 732
HARTENBOS
6520

Mr H Gomez
Chairman
Shark Longline Association
20 Woodhead Drive
EDGEMEAD
7441

Mr A Tshifularo
Managing Director
South African Petroleum Industry Association
P O Box 783482
SANDTON
2146

MAILS
Millstreet Post Office
2012 -10- 02
Ph: 021-465 1013

# ANNEXURE 3

# ADVERTISEMENTS

# TEXT OF ADVERTISEMENTS

## PUBLIC PARTICIPATION PROCESS

### PROPOSED OIL AND GAS EXPLORATION ACTIVITIES IN THE OUTENIQUA SOUTH AREA OFF THE SOUTH COAST OF SOUTH AFRICA

Notice is hereby given in terms of the Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA) and Regulations thereto of the intent to carry out the following activity:

Total E and P South Africa (Pty) Ltd lodged an application for an Exploration Right with the Petroleum Agency of South Africa (PASA) in terms of Section 74 of the MPRDA in order to explore for oil and gas reserves in the deep offshore area of the South Coast of South Africa, roughly between Cape Agulhas and Cape St. Francis - the Outeniqua South area. At its closest point the survey area is located approximately 90 km offshore. Exploration activities would entail a 2D seismic survey of approximately 7 000 km in length, drop core sampling and a sonar bathymetry survey. It is anticipated that the seismic survey would commence during November 2013 and would take between two and three months to complete. The drop core sampling (approximately 150 to 200 cores) and sonar bathymetry survey would depend on seismic survey results and are planned for November 2014.

CCA Environmental (Pty) Ltd (CCA) has been appointed as the independent environmental assessment practitioner to prepare an Environmental Management Plan (EMP) in order to comply with the requirements of the MPRDA.

A Background Information Document (BID), which provides information about the proposed project and highlights some key issues regarding the proposed activity, is available for a 21-day review and comment period from 02 October 2012 to 23 October 2012. Copies of the BID are available on request or on the CCA website (www.ccaenvironmental.co.za).

If you or your organisation would like to register as an interested and affected party (I&AP) and/or wish to participate in the study process, please contact Eloise Costandius of CCA at the contact details below. In addition, any I&APs who would like to submit comments on the BID and/or MPRDA process should do so no later than 23 October 2012.

It should be noted that the EMP will also be distributed for a 30-day comment period.

CCA ENVIRONMENTAL (PTY) LTD
PO Box 10145, Caledon Square, 7905
Tel: 021 461 1118/9; Fax: 021 461 1120
E-mail: eloise@ccaenvironmental.co.za

Date of advertisement: 02 October 2012

## PUBLIEKE DEELNAMEPROSES

### VOORGESTELDE OLIE EN GAS EKSPLORASIE IN DIE OUTENIEKWA SUID AREA LANGS DIE SUIDKUS VAN SUID AFRIKA

Kennis geskied hiermee in terme van die Wet op die Ontwikkeling van Minerale en Petroleumhulpbronne (No. 28 van 2002) (MPRDA) en die bygaande Regulasies van die voorneme om die volgende aktiwiteit te onderneem:

Total E and P South Africa (Edms) Bpk het 'n aansoek om 'n Eksplorasiereg by die Petroleum Agentskap van Suid Afrika (PASA) ingedien in terme van Gedeelte 74 van die MPRDA om te kan verken vir olie en gasreserwes in die diep aflandige area van die Suidkus van Suid Afrika, rofweg tussen Kaap Agulhas en Kaap St Francis – die Outeniekwa Suid area. Die verkenningsarea is ongeveer 90 km aflandig geleë by die naaste punt. Eksplorasie aktiwiteite sal 'n 2D seismiese opname van ongeveer 7 000 km, die neem van seevloerkernmonsters en 'n sonar bathymetriese opname. Die seismiese opname sal tussen twee en drie maande neem om te voltooi en word beplan vir November 2013. Die neem van seevloerkernmonsters (ongeveer 150 tot 200 kernmonsters) en sonar bathymetriese opname sal afhang van die resultate van die seismiese opname en word beplan vir November 2014.

CCA Environmental (Edms) Bpk (CCA) is aangestel as die onafhanklike omgewingskonsultant om die Omgewingsbestuursplan (OBP) wat deur die MPRDA vereis word, saam te stel.

'n Agtergrondinligtingsdokument (AID), wat verdere inligting oor die voorgestelde projek verskaf en van die kern kwessies weergee is vir 'n 21-dae oorsig en kommentaarperiode beskikbaar vanaf 02 Oktober 2012 tot 23 Oktober 2012. Kopieë van die AID is op aanvraag of op die CCA webblad beskikbaar (www.ccaenvironmental.co.za).

Indien u of u organisasie wil registreer as 'n belanghebbende party en/of u wil deelneem aan die proses, skakel asseblief met Eloise Costandius van CCA by die onderstaande kontakbesonderhede. Indien u enige kommentaar wil indien op die AID en/of MPRDA proses moet u dit teen 23 Oktober 2012 indien.

Neem kennis dat die OBP ook vir 'n 30-dae kommentaarperiode beskikbaar gestel sal word.

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Posbus 10145, Caledonplein, 7905
Tel: 021 461 1118/9; Faks: 021 461 1120
E-pos: eloise@ccaenvironmental.co.za

Datum van advertensie: 02 Oktober 2012

# Cwele to begin sentence for drug smuggling

From Page 1

Yesterday's ruling marks the end of the legal challenges available to Cwele as neither she nor Nabolisa raised constitutional challenges during their appeal and therefore could not approach the Constitutional Court.

National Prosecuting Authority (NPA) provincial spokeswoman Natasha Ramkisson said Cwele, who has been out on R100 000 bail since her arrest in February 2010, would have to hand herself over to prison authorities within three days after her attorney has received a copy of the judgment.

"The State advocate received the judgment via fax today (Monday) therefore the defence should receive it in the same manner," said Ramkisson.

Ramkisson said if Cwele did not hand herself in, a warrant for her arrest would be issued and the police would step in.

Nabolisa, who was denied bail in 2010, has been in custody since then.

Cwele's neighbours said yesterday they looked out for her as she had fallen on hard times.

A neighbour, who would not be named, said Cwele lived with her mother and granddaughter. "She always asked me to look after her house when she left. A lot of people trouble her so she does not answer her cellphone. She keeps to herself and goes to church. Her kids visit her sometimes."

Another neighbour said she had bought Cwele food and groceries after she heard that she was struggling financially.

"During Eid, I asked my housekeeper to send over biscuits and juice. Sheryl came and thanked me in the afternoon. She was crying and told me she had not eaten in two days."

The woman said she sympathised with Cwele because she seemed to be in a bad state.

"I felt bad for her because we are neighbours."

Beetge's mother, Marie Swanepoel, who has made it her mission to get her daughter out of jail, said she was delighted by the court's ruling.

"I have been waiting for a long time. She (Cwele) deserves the full 20 years," she said.

In arriving at his harsher 20-year sentence, Judge Mpati had commented that it was through Swanepoel's "courage and determination" that Nabolisa and Cwele had been caught.

According to his spokesman, Brian Dube, State Security Minister Siyabonga Cwele, who divorced Cwele last year, did not want to make any comments.

# Correctional Services flayed after receiving 18th qualified audit

**Michael Mpofu**
Political Bureau

"WE CANNOT continue, after 18 years to have a department with qualifications [in its audit]," the chairman of Parliament's oversight committee on correctional services, Vincent Smith said yesterday.

Smith was referring to the department's latest annual report, in which Auditor-General Terence Nombembe gives it its 18th qualified audit since 1994.

> 'Cannot continue to have a department with qualifications'

Nombembe highlighted a litany of irregular, fruitless and wasteful spending, including R38 million wasted because of the absence of a proper agreement between Correctional Services and the Department of Public Works. Fruitless and wasteful expenditure in the last financial year totalled R71m, with a further R215m under investigation.

The department's annual report showed it paid out more than R902m in claims against it for bodily injury and assault, and that it failed to curb the rate of assaults among inmates.

In his report, Nombembe said 47 percent of performance targets set by the department had not been met.

He also revealed the department had underspent its budget by almost R900m.

Last year's total underspending amounted to R410m.

Nombembe said investigations were under way against employees implicated in fraud, theft, procurement irregularities and subsistence and travel costs fraud. Last year 163 cases were dealt with; 145 disciplinary hearings were finalised, with 141 officials found guilty and four acquitted. Only two resigned, while 15 cases were withdrawn and the contract of another staff member was rescinded.

Nombembe said Correctional Services national commissioner Tom Moyane had failed to:

● Ensure the department maintained effective, efficient and transparent systems of financial and risk management and internal controls.

● See that financial statements presented for auditing were drawn up according to regulations.

● Take "effective and appropriate" steps to collect money due to the department on time as required by Treasury regulations.

● Prevent fruitless and wasteful spending.

● Ensure money owed by the department was always paid within the 30-day period required by Treasury.

● See that staff did not abuse sick leave.

● Implement control systems to protect and maintain assets and prevent theft, losses, wastage and misuse – as required by Treasury regulations.

Committee chairman Smith said Moyane was "ultimately" accountable for the whole department and he would have to be the one to "respond to us [the committee]".

He said the Public Finance Act was clear that "the buck stops with the accounting officer", even though Moyane may not have been directly responsible.

## INQUIRY TEAM HEADS FOR HILLS

# Marikana tragedy site inspection

**Sapa**

RUSTENBERG: A judicial inquiry into the shooting of striking Lonmin platinum workers at Marikana has concluded an inspection of the outcrops where the workers were killed.

Two North West crime scene experts led retired Supreme Court of Appeal Judge Ian Farlam and his team around the area where 34 miners died when police opened fire in August.

Warrant Officer Patrick Thamae pointed out where bodies were found near the main outcrop, where the mineworkers assembled in the days leading up to the shooting on August 16.

A large crowd of observers and advocates representing the different parties followed the judge and the experts as they made their way around the scene.

Thamae pointed out the place where seven bodies were found.

Another five were found next to a kraal, he told the judge.

Judge Farlam asked him to show the commission where barbed wire had been rolled out by police on the day of the shooting.

The commission was then taken a few hundred metres further on, to where a single body had been found "in the road".

Cartridges had been found near the body, Thamae said.

He told the commission a number of R5 rifle and pistol cartridges had been found in areas around the outcrop where police were believed to have been standing at the time of the shooting.

In another area, pistol cartridges and rubber bullets were found.

The other crime scene expert, Captain Apollo Mohlaki, led the commission in inspecting a small outcrop.

He pointed out where bodies had been found.

He also showed the judge the place where traditional weapons recovered from the protesters had been heaped.

Large boulders on the hill were chipped by bullets.

The procession inspected other areas where other bodies and bullet cartridges had been found.

The locations had been marked with yellow paint. Mohlaki pointed out bullet markings and drops of blood on some of the boulders around the small outcrop.

A group of miners, arrested after the shooting and since released on bail, stood watching on the sidelines of the commission's inspection.

They would not talk to the media.

The workers are represented by advocate Dali Mpofu.

> Judge to inspect hostels, shafts and settlements

During the inspection, Mpofu stopped to speak to them. He told Judge Farlam they wanted to point out that three or four helicopters had hovered over the scene on the day of the shooting.

Earlier, the mineworkers undertook an inspection of the scene, independently of the judicial commission of inquiry.

A miner showed Association of Mineworkers and Construction Union (Amcu) leader Joseph Mathunjwa areas where striking mineworkers were shot by the police.

He pointed to an area surrounded by rocks where a body was found, and indicated that the miner had been shot from a helicopter.

Mathunjwa, wearing a white Amcu T-shirt, took photographs and asked questions.

Before the formal inspection started, residents from the nearby informal settlement approached the scene, singing Struggle songs and carrying placards reading "Don't let the police get away with murder".

A group of policemen stood watching.

Thirty-four miners died and 78 were wounded when police opened fire in trying to disperse a large group of wildcat strikers who had gathered near Lonmin's platinum mine at Marikana.

The commission's inspection in loco continues today, with Judge Farlam scheduled to visit the mine hostels and informal settlements near the mine.

The commission is also to inspect shafts and any other areas deemed important to the inquiry.

See Page 8

**TOP TRIO:** Retired Judge Ian Farlam, left, and Pingla Devi Hemraj, SC, and Bantubonke Regent Tokota, SC, arrive for an inspection of the scene where striking Lonmin mineworkers died at Marikana when police opened fire. The judge, assisted by the two advocates, heads the commission of inquiry into the Marikana tragedy, in which scores of miners were also injured. *Picture: DUMISANI SIBEKO*

# AG gives Public Works disclaimer

**Chantall Presence**
Sapa

FINANCIAL chaos continues to dog the Public Works Department, according to Auditor-General (AG) Terence Nombembe; the department was given another disclaimer for the 2011/12 financial year – one of the worst audit opinions possible.

Nombembe said he could not rely on information provided by the department about, among other things, how many properties it owned and leased to sister departments and other state entities, and the accuracy of irregular, fruitless and wasteful expenditure.

"I was unable to obtain sufficient appropriate audit evidence to satisfy myself as to the completeness of irregular expenditure relating to the current year stated at R171 127 000."

The department's financial statements indicated there was over R69 million in fruitless and wasteful expenditure.

Nombembe said he could not rely on this figure either, as the department did not have a system in place to identify this type of spending.

The lease problems at the department continued.

"I was unable to obtain sufficient appropriate audit evidence for operating lease expenditure transactions with an estimated value of R48 513 867," said Nombembe.

On the supply chain management side, the department was faring poorly by contravening Treasury regulations and procuring goods and services of a transaction value higher than R500 000.

Nombembe took aim at officials who played a part in awarding relatives, friends, partners or associates lucrative public works contracts. Some of these officials had not been sanctioned for fraud and corruption.

The department's leadership was criticised for not holding officials accountable for their actions.

# ANC leadership in Western Cape divided over re-election of Zuma

From Page 1

not yet had an opportunity to discuss leadership since nominations opened.

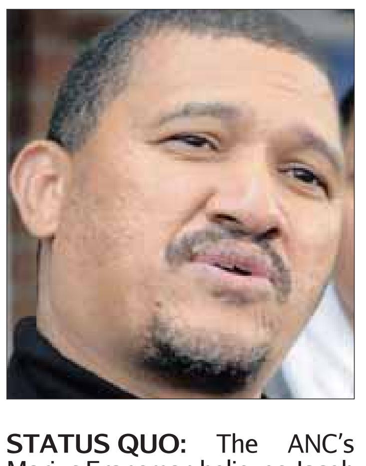
"But the issue of a generational transition is an urgent question confronting the ANC. If you speak about organisational renewal, how do you respond to that?

"We need to take the ANC to a higher plane. In my view the ANC is spoilt for choice [of leadership]. But the issue of change is inevitable, from the older generation to the generation after that," said Mjongile.

He said the challenge for the ANC was to renew its image "and those values that are being lost".

"As much as branches can elect their preferred leaders, one cannot undermine the role of leadership. So the PEC will begin to discuss details and specific names," said Mjongile.

The Western Cape ANC has been in disarray for some time and the audited membership figures released by the ANC on Friday show the number of members in the province continues to decline. The ANC in the Western Cape now has just over 38 000 members.



**STATUS QUO:** The ANC's Marius Fransman believes Jacob Zuma must get a second term.

Members are also unhappy, blaming the ANC's auditors for unfairly disqualifying Western Cape branches.

The ANC Youth League has been the most vocal and prominent structure of the party in the province and publicly embarrassed Zuma by disrupting the ANC centenary lecture he was delivering at the Good Hope Centre in January.

The league is also the most vocal about pushing for leadership change at Mangaung.

Mjongile, a former youth league leader, said the "generational change" was not about "which individual is in the top six".

"We need to rejuvenate the image of the ANC and we can't do that by recycling [leaders]. And where were branches saying at the policy conference? They said they wanted change," said Mjongile.

Fransman did not respond to calls and messages requesting his comment yesterday.

*babalo.ndenze@inl.co.za*

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## 11 LEGALS

NOTICE IN RESPECT OF A LICENCE APPLICATION IN TERMS OF THE PETROLEUM PRODUCTS ACT, 1977 (ACT NO 120 OF 1977)

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CLASSIFIED INFO
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- How Seda assists manufacturing companies to become export ready and
- Support available to help companies to become globally competitive.

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Date: 4 October 2012
Venue: Regent Hotel
Time: 09:00am – 14:00pm

**BOOKINGS TO BE MADE NOT LATER THAN 14:00PM ON WEDNESDAY, 3 OCTOBER 2012**

To book space to attend this seminar, contact Nadia Dukashe at Seda Provincial Office on (043) 721 1264/1130 or ndukashe@seda.org.za

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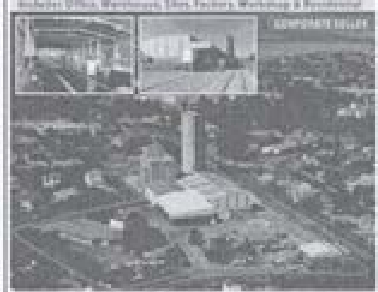
Industrial Property in Queenstown with Mixed Use Potential

Aucor PROPERTY

ON AUCTION



Jonathan Aitken 082 453 1119

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VIGNE & HOWARD

**PUBLIC AUCTION**

Tomorrow (Wednesday) 10am at Havelock Street, Central.

Various Catering & Restaurant Equipment; Indoor Furniture; 3 Pool Tables; Pie Door Glass Displays; Cane Patio Suite; Gas Braai; Various Exercise Equipment; Compressor; Beechwood TV Unit; Beds; Fridges; Work bench; Glassware; Crockery; Ornaments; Paintings; Etc, etc.
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**BID NOTICE**

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**ENVIRONMENTAL IMPACT ASSESSMENT, WASTE MANAGEMENT LICENSE AND WATER USE LICENSE PROCESS**

Notice is hereby given in terms of the National Environmental Management Act (No. 107 of 1998) (NEMA) as amended and the Environmental Impact Assessment Regulations (2010); the National Environmental Management Waste Act (No 59 of 2008) (NEMWA) and the National Water Act (No 36 of 1998) (NWA) of the proposed Coega Wastewater Treatment Works and Outfall Sewer in Port Elizabeth. Application forms have been submitted to the relevant authorities in order to begin the required environmental authorisation processes.

| | |
|---|---|
| PROJECT NATURE | Nelson Mandela Bay Municipality (NMBM) has identified the need for a Wastewater Treatment Works (WWTW) to provide additional treatment capacity for the Motherwell North residential areas and the Coega IDZ. The WWTW will treat a combination of industrial effluent and domestic sewage to provide sufficient treatment capacity to cater for present and future development requirements. The effluent will be used optimally to provide water to supplement the Return Effluent (RE) scheme which provides industrial process water for the Coega IDZ. The WWTW will be designed to treat approximately 120 Ml/day, consisting of 2 identical trains of 40Ml/day. |
| NAME OF PROPONENT | Nelson Mandela Bay Municipality |
| LOCATION | The project will be located within the Coega Industrial Development Zone (IDZ) in Port Elizabeth. |
| ENVIRONMENTAL LEGISLATION | • National Environmental Management Act (No. 107 of 1998) (NEMA)<br>o GN R.544 (Listing Notice 1): 11, 15 and 22<br>o GN R.545 (Listing Notice 2): 14, 15 and 24<br>• National Environmental Management Waste Act (No. 59 of 2008) (NEMWA)<br>o GN R.718 (Category B): 7 and 11<br>• National Water Act (No. 36 of 1998)<br>An Environmental Impact Assessment (EIA), a Waste Management License and a Water Use License will therefore be undertaken for the proposed project. |
| HOW TO REGISTER | You are invited to register as an Interested and Affected Party (I&AP) or request additional information, by contacting Royal HaskoningDHV (Previously SSI Engineers and Environmental Consultants (Pty) Ltd) who have been appointed as the independent Environmental Assessment Practitioner (EAP) for the project. I&APs are further requested to provide their name and surname, contact information and interest in the project (contact details provided below). |
| ENVIRONMENTAL ASSESSMENT PRACTITIONER | Royal HaskoningDHV<br>Vivienne Vorster<br>PO Box 13281<br>Beacon Bay, 5205<br>Tel: 043 707 3037<br>Fax: 043 707 3005 |
| DATE OF NOTICE | September 2012 |

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**PUBLIC PARTICIPATION PROCESS**

TOTAL

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cca ENVIRONMENTAL

Date of advertisement: 02 October 2012

'HY TOON GEEN BEROU NIE'

# 'Pedofiel' neem meisies glo naak af

## Polisie kry vibrators, kondome

**Jana Breytenbach**

KAAPSTAD. – 'n Vermeende pedofiel van Parow het glo jong skoolmeisies, soms nog in hul skooldrag, na sy huis gelok en hulle naak op gimnasiumtoerusting afgeneem.

Dít is van die getuienis wat gister in die saak teen Johannes Kleinhans (73) in die Parowstreekhof gehoor is.

Kleinhans staan tereg op 95 aanklagte van die besit van kinderpornografie en seksuele aanranding.

Hy het skuld beken op al die aanklagte, maar tydens sy getuienis in die vonnisoplegging het landdros Amanda van Leeve gesê hy toon geen berou nie. Sy het die skuldbekenning nie aanvaar nie en gesê Kleinhans moet verhoor word.

Hy het glo in 2009 en 2010 drie minderjarige meisies seksueel aangerand en naakfoto's van hulle geneem.

Ao. Gerhardus Jakobus Hendrik Kotze, wat by die polisie se afdeling vir mensehandel werk, het gister getuig oor die aand van 12 November 2010 toe Kleinhans in hegtenis geneem is.

**"'n Buurvrou van Kleinhans het ons gekontak en gesê hy het 'n jong meisie by hom in sy huis.**

" 'n Buurvrou van Kleinhans het ons gekontak en gesê hy (Kleinhans) het 'n jong meisie by hom in sy huis."

Die polisie het na Kleinhans se huis gegaan. "Binne het ons gimnasiumtoerusting gekry waarop kameras gemonteer was."

Kotze het getuig dat hulle die slagoffer gevra het of sy familie van Kleinhans is, waarop sy nee geantwoord het.

Sy is na 'n polisievoertuig buite die huis geneem, waar 'n vrouepolisiebeampte haar ondervra het.

"Sy het ons vertel dat Kleinhans naakfoto's van haar en ander meisies geneem het en dat hy dit op 'n geheuekaart gebêre het."

Kotze het gesê die slagoffer was baie ontsteld en het gehuil terwyl sy ondervra is.

Kleinhans het ontken dat hy enigiets van die geheuekaart weet en die polisie het toe sy huis deursoek.

"Ons het niks gekry nie, maar daarna het ons Kleinhans deursoek en die kaart in sy sokkie gekry."

Daar is ook op vibrators, kondome, klere vir jong vroue, DVD's en laserskywe beslag gelê. Op die DVD's en laserskywe is kinderpornografie en foto's van sy slagoffers gevind.

Op die foto's het sy slagoffers van die vroueklere aangehad wat in die huis gevind is.

Die verhoor word vandag voortgesit.


Die polisie skiet gister traanrook in die rigting van betogers op Klapmuts. Nagenoeg 300 mense het die R44 na Stellenbosch met boomstompe en vullis bestrooi toe hulle vir beter behuising betoog het. Foto: LEÁNNE STANDER

# Oproeriges ontstoke oor 'hokke'

**Alet Janse van Rensburg**

KLAPMUTS. – Vrot vleis, groenteskille en eierdoppe het gister oral uit stukkende vullissakke in die strate hier gelê terwyl inwoners al singende vir beter behuising betoog het.

Dié vullis, meen die inwoners, is simbolies van die haglike omstandighede waarin hulle moet woon.

Nagenoeg 300 mense het van omstreeks 05:00 op die R44 tussen Klapmuts en Stellenbosch betoog en moes met traanrook en rubberkoeëls in bedwang gehou word.

Hulle beweer hulle was te voet op pad na Stellenbosch om by die munisipaliteit 'n antwoord op die memorandum te kry wat hulle sowat twee weke gelede aan die burgemeester oorhandig het.

Verkeerspolisie moes bontstaan om die oggendverkeer te reguleer terwyl die polisie die betogers van die pad verdryf het.

Teen 10:00 was Merchantstraat, die enigste toegangsroete tot die dorp, met boomstompe, klippe en vullis versper.

"Dit voel of ons in 'n begraafplaas lewe," het Malibongwe Gebhu, 'n gemeenskapleier, gesê. "Soggens word jy wakker in 'n nat, koue hok. Dan staan jy op, maak klaar en gaan werk toe, maar jy kan net sowel dood wees, want dit is geen manier om te lewe nie."

Inwoners is ontevrede met die bestuur van die waglys vir huise en beweer sommige mense wat reeds huise ontvang het se name is nou vir 'n tweede keer bo-aan die lys.

Hulle is ook verontreg omdat inwoners van die nabygeleë Koelenhof- en Brickfields-nedersettings na bewering die huise wat tans hier in aanbou is, gaan kry.

Daar blyk ook algemene ontevredenheid te wees oor die toeganklikheid van die raadslid vir die gebied, Sophie Louw.

Die skerp reuk van traanrook en brandende buitebande het laatmiddag nog in die lug gehang. 'n Sterk polisieteenwoordigheid moes deurgaans die skare mense met rubberkoeëls en traanrook in bedwang hou.

Talle betogers het skerp stokke of knopkieries by hulle gehad. Kinders, wat vir die skoolvakansie by die huis was, het rubberkoeëldoppies vir aandenkings opgetel en daarmee gespog.

Lt.kol. André Traut, 'n provinsiale polisiewoordvoerder, het gesê niemand is in hegtenis geneem nie en niemand is ernstig beseer nie.

Die polisie was gistermiddag laat steeds op die toneel om die situasie dop te hou.

Die Stellenbosch-munisipaliteit het teen druktyd nie op navrae gereageer nie.

# Dewani dalk in Februarie uitgelewer vir verhoor

**Maygene de Wee**

KAAPSTAD. – Die Britse sakeman wat daarvan beskuldig word dat hy in November 2010 die moord op sy Sweedse bruid beplan het, kan al in Februarie 2013 aan Suid-Afrika uitgelewer word as alles reg verloop.

Só het 'n Suid-Afrikaanse bron na aan die ondersoek na die moord op Anni Dewani gesê. Hy het bygevoeg indien haar man, Shrien Dewani, uitgelewer word, hy heel moontlik vir twee weke tot 'n maand vir waarneming na die Valkenberg-hospitaal verwys sal word.

Daarna, afhangende van wie hom in Suid-Afrika verteenwoordig, kan sy regsverteenwoordigers vra dat hy geëvalueer word deur 'n psigiater wat deur hulle aangewys word.

Dewani sal eers in 'n plaaslike landdroshof moet verskyn voordat sy saak na die Wes-Kaapse hooggeregshof vir verhoor oorgeplaas word.

Intussen blyk dit dat die ondersoek wat die Britse vervolgingsgesag sou begin na die sakeverbintenis tussen twee psigiaters in die Dewani-saak nooit gedoen is nie. 'n Woordvoerder van die Britse vervolgingsgesag wat sy naam slegs as Tim gegee het, kon gister nie sê hoekom die ondersoek na die sakebetrekkinge tussen prof. Nigel Eastman en prof. Michael Kopelman nie gedoen is nie.


Shrien Dewani

*Die Burger* het in Augustus berig Kopelman en Eastman het mededirekteure van 'n forensiese psigiatriese maatskappy geword 13 dae voor hulle 'n gesamentlike verklaring oor Dewani se geestestoestand uitgereik het.

Dié maatskappy, Forensic Psychiatry Chambers LLP, is op 1 Julie 2011 gestig. Kopelman en Eastman het op 14 Julie die verklaring uitgereik waarin hulle onder meer saamgestem het dat Dewani aan erge depressie en post-traumatiese stressindroom ly.

Hulle het ook aangevoer dat hy 'n risiko loop om selfmoord te pleeg, dat hy nie kan pleit nie omdat hy nie die hofverrigtinge kan volg nie en dat hy ook nie sy regsverteenwoordigers die nodige instruksies kan gee nie.

Kopelman, 'n Britse neuropsigiater, het namens die Suid-Afrikaanse regering in Dewani se uitleweringsverhoor getuig en Eastman namens Dewani.

Die bron het gesê hy dink nie die Britte sal kommentaar lewer oor die twee se sakeverbintenis nie.

"Dis 'n groot verleentheid vir hulle en die Britte sal dit nie verder wil laat uitkring nie."

'n Britse psigiater, dr. Ian Cumming, wat deur die Britse vervolgingsgesag aangestel is om Dewani se geestestoestand namens die Suid-Afrikaanse regering te evalueer, sal vandag sy verslag by die Westminsters-magistraatshof indien.

By die laaste hofsitting op 18 September het regter Howard Riddle gelas dat Dewani die volgende hofsitting op 12 Oktober moet bywoon.

Indien hy versuim om dit te doen, gaan die hof nie 'n aansoek oorweeg om sy borgtogvoorwaardes te verslap nie.

Die hofsitting op 12 Oktober vind plaas om 'n datum vas te stel vir die voortsetting van die uitleweringsverhoor.

# Ons kry swaar in ons hutte, sê betogers

**Jan Gerber**

KAAPSTAD. –"Weg met kapitalisme, weg!" het 'n man met 'n megafoon gister geskree toe sowat 100 inwoners van plaaslike townships gister in Waalstraat betoog het vir beter behuising en dienslewering.

Die betogers was onder meer van die townships Samora Machel, Philippi en Kosovo afkomstig.

Die optog is gereël deur die Wes-Kaapse tak van Abahlali Basem'Jondolo, 'n drukgroep vir plakkershut-bewoners.

Die optoggangers het eers voor die provinsiale parlement en daarna voor die kantoor van die Wes-Kaapse departement van behuising betoog.

**Sowat 100 inwoners van Kaapse townships het gister voor die provinsiale parlement en die kantoor van die Wes-Kaapse departement van behuising in Waalstraat vir beter behuising en dienslewering betoog.** Foto: JAN GERBER

Hier het die provinsiale minister van behuising, Bonginkosi Madikizela, hul griefskrif ontvang. Hulle het ook griefskrifte aan Helen Zille, Wes-Kaapse premier, en Patricia de Lille, Kaapstadse burgemeester, gerig.

Hulle eis onder meer:

- basiese dienste soos water, sanitasie en elektrisiteit;
- grond- en behuisingsgeleenthede op leë, nabygeleë grond;
- om dienste op die proef te stel voordat dit aangelê word;
- huise vir almal; en
- dat diegene wat nie toegang tot basiese dienste het nie verskuif word.

Hulle is ook ontevrede oor wat hulle as 'n gebrek aan inspraak by die owerhede ervaar.

"Ons eis dat die regering vir ons huise bou. Ons bly in hutte en kry swaar," het Mtmobeli Qona, een van die organiseerders, gesê.

"Selfs nou is ons hutte oorstroom. In die somer is ons die slagoffers van brande en in die winter van oorstromings," het hy bygevoeg.

# Dronkbestuursake nie teruggetrek ná hofuitspraak

KAAPSTAD. – Alle hangende dronkbestuursake sal nie nou op grond van 'n hofuitspraak verlede week teruggetrek word nie, het die nasionale vervolgingsgesag (NVG) gister gesê.

Dit volg nadat regter Lee Bozalek in die Wes-Kaapse hooggeregshof beslis het dat uitslagsertifikate wat die bloedalkoholvlakke van dronkbestuurders aandui ingevolge die Strafproseswet ontoelaatbaar is.

Volgens Bozalek se uitspraak is daar 'n gedeelte in die wet wat nie voorsiening maak vir 'n sertifikaat as genoegsame bewys vir die kalibrasie of akkuraatheid van die toestelle wat gebruik word om bloedalkoholvlakke te meet nie.

Getuienis om die bloedalkoholvlakke te staaf, moet deur middel van 'n beëdigde verklaring of mondelinge getuienis by die hof ingedien word.

Eric Ntabazalila, 'n woordvoerder van die NVG in die Wes-Kaap, het gesê die NVG sal beëdigde verklarings wysig om by die bepalings van die uitspraak te hou.

Die NVG gaan nie teen die uitspraak appèl aanteken nie, maar geen sake sal teruggetrek word nie.

"Die uitspraak skep wel 'n nuwe presedent, maar op 'n beperkte manier."

Op 'n vraag of mense op grond van dié uitspraak teen skuldigbevindings kan appelleer, het hy gesê niks keer iemand om te appelleer indien hy/sy voel daar is genoeg gronde nie.

**– Carryn-Ann Nel en Maygene de Wee**

# Appèlhof verleng Cwele se vonnis

**Philip de Bruin**

KAAPSTAD. – Sheryl Cwele, eksvrou van die minister van staatsveiligheid, dr. Siyabonga Cwele, se vonnis van 12 jaar tronkstraf weens dwelmhandel is gister in die appèlhof tot 20 jaar verhoog.

Haar medebeskuldigde, die Nigeriër Frank Nabolisa, het dieselfde lot getref. Hy moet ook nou agt jaar langer agter tralies sit.

Die verskil tussen die vonnis van 12 jaar en die vonnis van 20 jaar wat hulle sou oplê, is só groot dat die vonnis van 12 jaar tereg as "ontstellend misplaas" beskryf kan word, het die appèlregters gesê.

Cwele en Nabolisa is aanvanklik in die hooggeregshof in Pietermaritzburg aan dwelmhandel skuldig bevind nadat hulle van 'n dwelmmuil, Tessa Beetge – 'n jong vrou en vriendin van Cwele – gebruik gemaak het om kokaïen uit Brasilië na Suid-Afrika te bring.

Beetge is in 2008 op die lughawe in São Paulo, Brasilië, met 10 kg kokaïen in haar tas betrap en sewe jaar tronk toe gestuur.


Sheryl Cwele

Cwele is ná haar skuldigbevinding uit haar pos as direkteur van die Hibuskus-kus-munisipaliteit geskop.

Appèlregters L. Mpati, J. Heher, V. Ponnan, B. Southwood en N. Erasmus het gesê verskeie verswarende omstandighede het teen Cwele en Nabolisa.

Vir eers is dit altyd die dwelmmuile wat die spit afbyt as hulle betrap word, terwyl die werklike skuldiges skotvry daarvan afkom.

Tweedens is Cwele 'n opgeleide verpleegkundige wat deeglik bewus moes gewees het van die vernietigende en selfs dodelike uitwerking wat dwelms op mense het.

"Sy was 'n gewillige vennoot in die pleging van die misdaad en het op weerlose jong vroue jag gemaak om haar (dwelm)onderneming te bevorder."

Volgens die regters het Cwele onder meer aan een van die vroue wat sy gewerf het, gesê dat "God in 'n droom vir my gesê het dat jy vir my moet werk". Dié vrou het egter op die nippertjie koue voete gekry en het nie oorsee gegaan nie.

Nog 'n verswarende faktor teen Cwele was dat sy haar elektroniese toerusting by die munisipaliteit misbruik het om die dwelmhandel te beplan. Só het sy aan Beetge 'n e-pos gestuur waarin sy haar gewaarsku het om "mense te vermy wat te veel vrae sal begin vra" terwyl sy oorsee is.

Cwele sal haar nou binne 72 uur vir haar tronkstraf moet aanmeld.

## DIE LEWE IN 'N TOWNSHIP

# 'n (Wit) vrou in Bikoville

**Hilda Fourie**

JOHANNESBURG. – Jy kan jou nie met die *struggle* vereenselwig totdat jy in 'n plakkershut gewoon en 'n kruiwa gestoot het nie.

Dié woorde van 'n swart vrou in Hammanskraal, noord van Pretoria, het die kunstenaar Jeanne Silver (65) oortuig om haar dogter, wat toe sowat nege jaar oud was, te neem en in 'n plakkershut in Steve Bikoville te gaan bly.

Dis nou sewe jaar later.

Silver, of Ma Jenny soos die inwoners haar noem, wil nêrens anders bly nie.

Silver verstaan nie hoekom daar nie meer wit mense in plakkerskampe bly nie, want sy voel veiliger in Hammanskraal as in Pretoria waar sy lank gebly het.

Sy het haar huis omskep in Freedom Walls, 'n toeriste-bestemming wat 'n plek moet wees waar mense byeenkom en gesels.

Haar plakkershut is deesdae 'n ateljee waarin sy haar kuns beoefen. Sy gee kunsterapie aan mense met geestesversteurings en leer ander handwerk met herwinbare materiaal.

Silver skilder hoofsaaklik regeringslui, *struggle*-vegters en wyle prinses Diana.

Sy sê daar is 'n kultuur en reëls in 'n plakkerskamp wat lei tot sterk dissipline wat in die gemeenskap gehandhaaf word.

Niks kan net gebeur nie. Vergaderings word gereël en met 'n megafoon word afgekondig dat inwoners by die begraafplaas of watertenk moet vergader.

Op die vergadering moet oor alles ooreengekom word. Die besluit word tot op die letter uitgevoer.

As iets verander, word 'n vergadering weer gereël.

"Ek het in die *township* gekom en die mense het my plek en ruimte gegee. Hulle respekteer my," sê Silver.


Jeanne in haar ateljee.


Jeanne staan in die straat waar sy woon.

Jeanne en haar dogter Jenni-Lee voor 'n muur van haar huis, Freedom Walls.

Aanvanklik was die grootste aanpassing vir haar en Jenni-Lee (16) om sonder water en elektrisiteit klaar te kom.

Vir water moes Silver met twee 10 liter-kanne op 'n kruiwa sowat 3 km stap. Soontoe was maklik, want dit is afdraande met leë kanne. Die pad huis toe is egter 'n perd van 'n ander kleur.

"Hier is 'n *culture*. Soggens vee die vroue hul erwe. As jy nie vee nie of jou potte is nie skoon nie, word jy snaaks aangekyk.

"Saterdag is wasdag. Jy gebruik die bure se *fence* om jou klere te hang, maar jy vra altyd.

"As jy hier praat, hoor almal jou. Almal weet alles. Daar is nie iets soos privaatheid nie," vertel Silver.


**Jeanne Silver by haar huis in Steve Bikoville in Hammanskraal, noord van Pretoria.** Foto's: FRANCO MEGANNON

# Geklassifiseerd

T: 041 503 6111 F: 041 503 6039



## 808 Sterfgevalle

### BOTES
LAURET

Onverwags heengegaan op Vrydag 28 September 2012. Ons groet 'n wonderlike ma, ouma, suster, tannie en vriendin. Waar ma nou is, is geen pyn of bekommernis nie. Ons gun ma die rus. Mag Jesus ma in Sy hande vashou en beskerm tot ons weer ontmoet. Die diens vind plaas op Donderdag 4 Oktober 2012 om 11:00 in die NG Kerk Eendrag-gemeente, Despatch. Van die familie.

**Reëlings:**

AVBOB

**LID VAN NBOV**
**Despatch: ☎ 041 933 2039**
**AVBOB AANVAAR POLISHOUERS VAN METROPOLITAN, SAMBA, ASSUPOL EN ANDER MAATSKAPPYE**

### KOK
STEPHANUS
GEBORE 19/3/1926 - OORLEDE 29/9/2012

Sag heengegaan op Saterdag 29 September 2012 op Humansdorp. Sy heengaan word diep betreur deur sy geliefde kinders, kleinkinders, familie en vriende. Die dankdiens vind plaas op Dinsdag 2 Oktober 2012 om 14:00 in die Edenglen Aftreeoord-saal, Jeffreysbaai. Verassing privaat.

**Reëlings: Bokkie Els**

AVBOB

**HUMANSDORP: ☎ 042 291 1230**
**LID VAN NBOV**
AVBOB aanvaar polishouers van Metropolitan, GBA, SAMBA, Assupol, ens.

### VAN DER BERG
ANNA CATHERINA
GEBORE 26/7/1933 - OORLEDE 1/10/2012

Sag heengegaan op Maandag 1 Oktober 2012 op Jeffreysbaai. Haar heengaan word diep betreur deur haar geliefde kinders, kleinkinders, familie en vriende. Die dankdiens vind plaas op Woensdag 3 Oktober 2012 om 11:00 in die NG Kerk, Da Gamaweg, Jeffreysbaai. Verassing privaat.

**Reëlings: Bokkie Els**

AVBOB

**HUMANSDORP: ☎ 042 291 1230**
**LID VAN NBOV**
AVBOB aanvaar polishouers van Metropolitan, GBA, SAMBA, Assupol, ens.



## 08 Sterfgevalle

### KNOETZE SOPHIA ELIZABETH

Het sag heengegaan op 28 September 2012. Sy laat haar seuns, kleinkinders en familie agter. Word ten ruste gelê op 3 Oktober 2012 vanuit NG Kerk Despatch om 12:00.

**AFSA BEGRAFNISDIENSTE**
Ons aanvaar ander Maatskappye se polisse
**TEL./FAKS 041 933 2060**

### KOCK ZYLANDRI

Sag heengegaan op Vrydag 28 September 2012. Haar heengaan word diep betreur deur Juan, Liza, Shana-Lee, oumas, oupas en familie. Die begrafnisdiens vind plaas op Woensdag 3Oktober 2012 om 14:00 vanuit NG Kerk PE Hoogland, Isobellaan, Charlo.

**Reëlings: Miemie Gardiner**

ALGOA BEGRAFNISDIENSTE bk FUNERAL SERVICES cc

**041 363 4874 a.u.**

### NEL STEVE

Aan 'n geliefde eggenoot en pa. Jy en jy alleen is die man wat ons alles geleer het wat ons weet. Baie dankie vir al die liefde wat pa ons ma gegee het en alles wat pa vir haar gedoen het. Mag God u seën, en mag die wonderlike herinneringe vir ewig in ons harte bly voortleef.

Baie dankie vir die baie 'lag' wat oupa ons gegee het en na my omgesien het vir sestien jaar. Ek sal die laataand 'snacks' wat ons saam gehad het, nooit vergeet nie. Dankie vir alles, Oupie. Bianca.

### NEL STEVE

Die begrafnisdiens vind plaas op Donderdag 4 Oktober 2012 om 10:00 in die Milnerton Huis Kapel, First Avenue Funeral Home, Walmer. Parkering beskikbaar op die gronde. Moet asb. nie by Spar parkeer nie

**BEGRAFNISREËLINGS: SUE**
**FIRST AVENUE FUNERAL HOME, WALMER☎ 041 581 5028**



### REDDERING
KOOS

Roudiens vind plaas op Donderdag 4 Oktober 2012 om 14:00 in die St John's Metodistekerk, Havelockstraat, Sentraal. Geen blomme op versoek. Alle donasies aan Hospice.

**Reëlings: Marie Steyn**
**☎041 364 1342**

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### VAN AS JAN SENEKAL

Sag heengegaan op Donderdag 27 September 2012. Sy heengaan word diep betreur deur sy familie en vriende. Die diens vind plaas op Donderdag 4 Oktober 2012 om 14:00 in die Volle Evangelie Kerk, Chasestraat, Uitenhage.

**BEGRAFNISREËLINGS: TAMMY DU PISANIE**

DOVES

**UITENHAGE**
**(Lid van NBOV)**
**☎041 992 1349**

### VAN DER LINDE KITTY
**Gebore: 27 November 1927**

Sag heengegaan op 1 Oktober 2012. Word oorleef deur haar 5 kinders en 6 kleinkinders. Gedenkdiens vind plaas by NG Kerk De Duin Humewood Port Elizabeth op 5 Oktober 2012 om 11:00

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### KENNISGEWING
**AANSOEK OM 'N LISENSIE KRAGTENS DIE WET OP PETROLEUMPRODUKTE, 1977 (WETNR. 120 VAN 1977)**

Belanghebbende of geaffekteerde partye word met hierdie kennisgewing in kennis gestel dat BVT PETROLEUM PRODUCTS (PTD) LTD, hierin later verwys na as "die applikant", 'n aansoek ingedien het vir 'n Kleinhandelslisensie, aansoeknr. B/2012/09/27/0002, ten opsigte van die perseel geleë by: Erf 2187 & 1743 Parsonsvlei, Port Elizabeth, Kaapweg 615, Kabega, Port Elizabeth.

Die doel van die aansoek is dat 'n lisensie aan die applikant toegeken word vir die bedryf van petroleum-kleinhandelsaktiwiteite, soos na verwys in die aansoek.

Reëlings vir die inspeksie van die aansoek-dokumentasie kan getref word deur die Kontroleur van Petroleumprodukte te kontak by:

* Telefoon 041 396 3948/041 396 3925
* Faks 086 5356548/086 5921636
*E-pos: lihle. mdungwana@energy.gov.za/yolisa.sunduzwayo@energy.gov.za

Enige besware teen die uitreiking van 'n lisensie ten opsigte van die aansoek moet 'n duidelike verwysing na die bogenoemde aansoeknommer bevat en moet by die Kontroleur van Petroleumprodukte ingedien word binne 'n tydperk van (20) werksdae vanaf die datum van publikasie van hierdie kennisgewing. Besware moet ingedien word by die volgende straat- of posadres:

| Straatadres: | Posadres: |
|---|---|
| Die Kontroleur van Petroleumprodukte | Die Kontroleur van Petroleumprodukte |
| Departement van Energie | Departement van Energie |
| h.v. Mount- & Diazstraat | Privaatsak X6013 |
| Mount Croix | Port Elizabeth |
| Port Elizabeth 6000 | 6000 |

9456327(1BSKUYK) 1/10(180)

1BSKUYK-021012-OS-mfjkl-kennis

### PUBLIEKE DEELNAMEPROSES
TOTAL
**VOORGESTELDE OLIE EN GAS EKSPLORASIE IN DIE OUTENIEKWA SUID AREA LANGS DIE SUIDKUS VAN SUID AFRIKA**

Kennis geskied hiermee in terme van die Wet op die Ontwikkeling van Minerale en Petroleumhulpbronne (No. 28 van 2002) (MPRDA) en die bygaande Regulasies van die voorneme om die volgende aktiwiteit te onderneem:

Total E and P South Africa (Edms) Bpk het 'n aansoek om 'n Eksplorasiereg by die Petroleum Agentskap van Suid Afrika (PASA) ingedien in terme van Gedeelte 74 van die MPRDA om te kan verken vir olie en gasreserwes in die diep aflandige area van die Suidkus van Suid Afrika, rofweg tussen Kaap Agulhas en Kaap St Francis – die Outeniekwa Suid area. Die verkenningsarea is ongeveer 90 km aflandig geleë by die naaste punt. Eksplorasie aktiwiteite sal 'n 2D seismiese opname van ongeveer 7 000 km, die neem van seevloerkernmonsters en 'n sonar bathymetriese opname insluit. Die seismiese opname sal tussen twee en drie maande neem om te voltooi en word beplan vir November 2013. Die neem van seevloerkernmonsters (ongeveer 150 tot 200 kernmonsters) en sonar bathymetriese opname sal afhang van die resultate van die seismiese opname en word beplan vir November 2014.

CCA Environmental (Edms) Bpk (CCA) is aangestel as die onafhanklike omgewingskonsultant om die Omgewingsbestuursplan (OBP) wat deur die MPRDA vereis word, saam te stel.

'n Agtergrondinligtingsdokument (AID), wat verdere inligting oor die voorgestelde projek verskaf en van die kern kwessies weergee is vir 'n 21-dae oorsig en kommentaarperiode beskikbaar vanaf **02 Oktober 2012 tot 23 Oktober 2012**. Kopieë van die AID is op aanvraag of op die CCA webblad beskikbaar (www.ccaenvironmental.co.za).

Indien u of u organisasie wil registreer as 'n belanghebbende party en/of u wil deelneem aan die proses, skakel asseblief met Eloise Costandius van CCA by die onderstaande kontakbesonderhede. Indien u enige kommentaar wil indien op die AID en/of MPRDA proses moet u dit **teen 23 Oktober 2012** indien.

Neem kennis dat die OBP ook vir 'n 30-dae kommentaarperiode beskikbaar gestel sal word.

**CCA ENVIRONMENTAL (EDMS) BPK**
Posbus 10145, Caledonplein, 7905
Tel: 021 461 1118/9; Faks: 021 461 1120
E-pos:eloise@ccaenvironmental.co.za
8802472(1BSPZCV)

cca ENVIRONMENTAL
Datum van advertensie: 02 Oktober 2012
2/10(180)

1BSPZCV-021012-OS-mfjkl-SASOL

# ANNEXURE 4

# COPIES OF WRITTEN SUBMISSIONS RECEIVED

# ENVIRONMENTAL MANAGEMENT PLAN FOR A PROPOSED 2D SEISMIC SURVEY, DROP CORING SAMPLING AND SONAR BATHYMETRY, OUTENIQUA SOUTH AREA, SOUTH COAST, SOUTH AFRICA

## INTERESTED AND AFFECTED PARTY (I&AP) REGISTRATION AND RESPONSE FORM

**Would you or your organisation like to become a registered I&AP and continue to receive information on the proposed project?**

**Yes** X **No** ______

**Name:** DAVE MURRAY

**Organisation:** SMIT AMANDLA MARINE (PTY) LTD

**Postal address:** P O Box 1339, CAPE TOWN 8000

**Email address:** d.murray@smit.com

**Telephone number:** (021) 5075777 **Fax number:** (021) 5075885

**Do you or your organisation have any issues or concerns regarding the proposed exploration activities off the South Coast of South Africa?**

**Yes** ______ **No** X

**If yes, please provide details below** (or use extra pages if necessary):

Please forward to:
**CCA ENVIRONMENTAL (PTY) LTD**
Attention: Eloise Costandius
PO Box 10145, Caledon Square, 7905
Tel: (021) 461 1118/9 Fax: (021) 461 1120
Email: eloise@ccaenvironmental.co.za

Comments must reach
CCA Environmental no later than
**23 October 2012**

cca ENVIRONMENTAL

## Eloise Costandius

**From:** thabo.mokonenyane@gmail.com
**Sent:** 02 October 2012 06:31 PM
**To:** eloise@ccaenvironmental.co.za

Good day

I would like to register as an interested party and to participate in your study for the "proposed exploration acticities in the Outeniqua South area off the South Coast of South Africa."

Contact Details

C: 0822922081

Kind Regards
Thabo Mokonenyane
thabo mokonenyane

**Eloise Costandius**

**From:** Deanne Wilson <deawilson@polka.co.za>
**Sent:** 02 October 2012 10:14 PM
**To:** eloise@ccaenvironmental.co.za
**Subject:** register

I'm registering as an I&AP. For the proposed oil and gas exploration in outeniqua south area
D Wilson

Harbour Place, Foreshore, Cape Town P O Box 2066, Cape Town, 8000
Phone: 021 425 27 27 --- Cell: 08 26 58 57 33 --- Fax 021 419 07 85 --- E-Mail: deepsea@iafrica.com

03 October 2012

**CCA Environmental (Pty) Limited**
**P O Box 10145**
**Caledon Square**
**7905**

**Per email: Eloise@ccaenvironmental.co.za**

---

**ENVIRONMENTAL MANAGEMENT PLAN FOR A PROPOSED 2D SEISMIC SURVEY, DROP CORING SAMPLING AND SONAR BATHYMETRY – OUTENIQUA AREA**

---

Further to your letter dated 1st October 2012, we would like to place on record our concerns with regard to the abovementioned project. Attached is the response form.

- **FishSA is an over-arching industry body representing commercial fisheries:**
  - South African Deep-Sea Trawl Industry Association (Hake)
  - South African Pelagic Fishing Industry Association (Pilchards & Sardines)
  - South Coast Rock Lobster Industry Association
  - West Coast Rock Lobster Association
  - South African Mid-water Trawling Association (Horse Mackerel)
  - South African Tuna Association
  - South African Squid Management Industrial Association
  - South East Coast Fishing Industry Association (Inshore Hake and Sole trawl fishery)
  - Fresh Tuna Exporters Association
  - South African Hake Longline Association

Yours sincerely

**SULEIMAN SALIE**
Chairman

# ENVIRONMENTAL MANAGEMENT PLAN FOR A PROPOSED 2D SEISMIC SURVEY, DROP CORING SAMPLING AND SONAR BATHYMETRY, OUTENIQUA SOUTH AREA, SOUTH COAST, SOUTH AFRICA

TOTAL

## INTERESTED AND AFFECTED PARTY (I&AP) REGISTRATION AND RESPONSE FORM

**Would you or your organisation like to become a registered I&AP and continue to receive information on the proposed project?**

**Yes** YES **No** ________

**Name:** SULEIMAN SALIE (CHAIRMAN - FISH SA)

**Organisation:** FISH SA

**Postal address:** HARBOUR PLACE, FORESHORE, CAPE TOWN

**Email address:** SULEIMANS@BLUECON.CO.ZA

**Telephone number:** (021) 425 2727 **Fax number:**

(021) 528 9652; 0824551211

**Do you or your organisation have any issues or concerns regarding the proposed exploration activities off the South Coast of South Africa?**

**Yes** YES **No** ________

**If yes, please provide details below** (or use extra pages if necessary):

- POSSIBLE CONFLICT WITH FISHING ACTIVITIES
- POSSIBLE NEGATIVE IMPACT ON FISH RESOURCES

Please forward to:
**CCA ENVIRONMENTAL (PTY) LTD**
Attention: Eloise Costandius
PO Box 10145, Caledon Square, 7905
Tel: (021) 461 1118/9 Fax: (021) 461 1120
Email: eloise@ccaenvironmental.co.za

Comments must reach
CCA Environmental no later than
**23 October 2012**

cca ENVIRONMENTAL

**Eloise Costandius**

**From:** Roy Bross <deepsea@iafrica.com>
**Sent:** 03 October 2012 02:05 PM
**To:** 'Jeremy Blood'; Eloise@ccaenvironmental.co.za
**Subject:** Seismic Surveys
**Attachments:** Communication 03 October 2012.pdf

Hi Jeremy and Eloise

Please see attached letter. The situation intensifies. We must find a way that works for everybody.

Roy

SOUTH AFRICAN DEEP-SEA TRAWLING INDUSTRY ASSOCIATION
Harbour Place, Martin Hamerschlag Way, Foreshore Cape Town
P.O. Box 2066, Cape Town 8000
www.sadstia.co.za
Phone: (021) 425 27 27
Cell: (082) 658 57 33
Fax: (021) 419 07 85
deepsea@iafrica.com

03 October 2012

CCA Environmental (Pty) Limited
P O Box 10145
Caledon Square
7905

Per email: Eloise@ccaenvironmental.co.za
jeremy@ccaenvironmental.co.za

**PETROSA - PROPOSED 3D AND 2D SEISMIC SURVEY PROGRAMME IN LICENCE BLOCK 1, WEST COAST, SOUTH AFRICA: AVAILABILITY OF ENVIRONMENTAL MANAGEMENT PLAN ADDENDUM FOR REVIEW AND COMMENT**

**TOTAL - ENVIRONMENTAL MANAGEMENT PLAN FOR A PROPOSED 2D SEISMIC SURVEY, DROP CORING SAMPLING AND SONAR BATHYMETRY – OUTENIQUA AREA**

Dear Jeremy and Eloise

I trust that it is acceptable to communicate with CCA Environmental regarding two different seismic surveys in a single communication.

This letter is sent largely with a view to ensuring that this Association is registered as an I&AP in both the above instances.

We have a number of reservations which would be basically the same in each case.

In particular, we object that inasmuch as these surveys interact with the trawl footprint, the desired exclusion zones are excessive having regard to commercial bottom trawlers also being vessels with limited manoeuvreabillty while engaged in fishing. In brief we would have to contend with exclusion zones of about 400 sq kilometres moving at a rate of about 200 sq kilometres per hour. An already serious situation would be exacerbated by the aforementioned surveys taking place on some of our best fishing grounds.

We are aware of another entity, Anadarko, involved in seismic surveys on the West Coast and we trust that our I&AP credentials are also in good standing in that regard.

Yours sincerely

C A R Bross
SECRETARY

## Eloise Costandius

**From:** tamsanqa moses Jawula <moses.jawula@gmail.com>
**Sent:** 03 October 2012 03:57 PM
**To:** eloise@ccaenvironmental.co.za
**Subject:** APPLICATION FOR INFORMATION ABOUT THE PROPOSED PROJECT AND HIGHLIGHTS

Dear Sir /Madam

I am representing OUR HOPE ,OUR FUTURE Enterprise (Pty) Ltd and we are much interested to the proposed Oil development in the Southern coast near st Francis Bay.

I can be contacted in my fax which is 086 6565979 and my mobile is 082
6222580 .

I am looking forward to hear from you.

Regards

Moses Jawula

TOTAL

# ENVIRONMENTAL MANAGEMENT PLAN FOR A PROPOSED 2D SEISMIC SURVEY, DROP CORING SAMPLING AND SONAR BATHYMETRY, OUTENIQUA SOUTH AREA, SOUTH COAST, SOUTH AFRICA

## INTERESTED AND AFFECTED PARTY (I&AP) REGISTRATION AND RESPONSE FORM

Would you or your organisation like to become a registered I&AP and continue to receive information on the proposed project?

Yes Y No ____

**Name:** MOSES JAWULA

**Organisation:** ONE HOPE, VILK FUTURE ENTERPRISE PTY LTD

**Postal address:** P.O BOX 540 KENTON-ON-SEA 6191

**Email address:** moses.jawula@gmail.com

**Telephone number:** 082 6327530 **Fax number:** 074 6580474

Do you or your organisation have any issues or concerns regarding the proposed exploration activities off the South Coast of South Africa?

Yes ____ No X

If yes, please provide details below (or use extra pages if necessary):

Please forward to:
**CCA ENVIRONMENTAL (PTY) LTD**
Attention: Eloise Costandius
PO Box 10145, Caledon Square, 7905
Tel: (021) 461 1118/9 Fax: (021) 461 1120
Email: eloise@ccaenvironmental.co.za

Comments must reach
CCA Environmental no later than
**23 October 2012**

cca ENVIRONMENTAL

**ENVIRONMENTAL MANAGEMENT PLAN FOR A PROPOSED 2D SEISMIC SURVEY, DROP CORING SAMPLING AND SONAR BATHYMETRY, OUTENIQUA SOUTH AREA, SOUTH COAST, SOUTH AFRICA**

**INTERESTED AND AFFECTED PARTY (I&AP) REGISTRATION AND RESPONSE FORM**

Would you or your organisation like to become a registered I&AP and continue to receive information on the proposed project?

Yes YES No

Name: CAPT. GUY ODELL

Organisation: FUGRO SURVEY (MIDDLE EAST) LTD

Postal address: P.O. BOX 43088, ABU DHABI, U.A.E

Email address: G.ODELL@FUGRO-UAE.COM

Telephone number: +971 2 5547810

Fax number: +971 2 5547811

Do you or your organisation have any issues or concerns regarding the proposed exploration activities off the South Coast of South Africa?

Yes ______ No NO

If yes, please provide details below (or use extra pages if necessary):

Please forward to:
CCA ENVIRONMENTAL (PTY) LTD
Attention: Eloise Costandius
PO Box 10145, Caledon Square, 7905
Tel: (021) 461 1118/9 Fax: (021) 461 1120
Email: eloise@ccaenvironmental.co.za

Comments must reach CCA Environmental no later than **23 October 2012**

## Eloise Costandius

| | |
|---|---|
| **From:** | George Sieraha <gsieraha@gmail.com> |
| **Sent:** | 05 October 2012 03:58 PM |
| **To:** | eloise@ccaenvironmental.co.za |
| **Cc:** | Smith, Gavin; Gray, John |
| **Subject:** | Please Register GCTCA as an Interested Party (PROPOSED OIL AND GAS EXPLORATION ACTIVITIES IN THE OUTENIQUA SOUTH AREA OFF THE SOUTH COAST OF SOUTH AFRICA) |
| **Attachments:** | GCTCA EIA - Oil & Gas Outeniqua South Coast - Cape Times - 20121004.pdf |

**NOTICE OF PUBLIC PARTICIPATION PROCESS**
**PROPOSED OIL AND GAS EXPLORATION ACTIVITIES IN THE OUTENIQUA SOUTH AREA OFF THE SOUTH COAST OF SOUTH AFRICA**

Good Day

Please register The Greater Cape Town Civic Alliance (GCTCA) as an Interested party. Information can also be sent to the postal address below. If any correspondence is mailed please make it for the attention of the GCTCA and not in my personal capacity. In the meantime could you mail me some information regarding the proposed oil and gas exploration. Please confirm that you have received this notification. Thanks.

GCTCA
P.O.Box 31010
Grassy Park
7888

Regards
George Sieraha
Greater Cape Town Civic Alliance
Portfolio – Heritage & Environment
082 490 7628

## Eloise Costandius

**From:** Courtoreille JESSICA <JESSICA.Courtoreille@petrosa.co.za>
**Sent:** 08 October 2012 10:44 AM
**To:** eloise@ccaenvironmental.co.za
**Subject:** Total proposed 2D

Hi Eloise

I am sure we are on the list but please confirm PetroSA as an IAP for this project.

Many thanks

**Jessica Courtoreille**
Environmental Leader
Corporate SHEQ
Tel: 021- 929 3216
Fax: 021- 929 3018
Email: jessica.courtoreille@petrosa.co.za
www.petrosa.co.za

**TOTAL**

# ENVIRONMENTAL MANAGEMENT PLAN FOR A PROPOSED 2D SEISMIC SURVEY, DROP CORING SAMPLING AND SONAR BATHYMETRY, OUTENIQUA SOUTH AREA, SOUTH COAST, SOUTH AFRICA

## INTERESTED AND AFFECTED PARTY (I&AP) REGISTRATION AND RESPONSE FORM

**Would you or your organisation like to become a registered I&AP and continue to receive information on the proposed project?**

**Yes** ✓ **No** ______

**Name:** Steven Cameron-Dow

**Organisation:** [illegible] Tuna Exporters Association

**Postal address:** P O Box 26938 Hout Bay

**Email address:** [illegible]

**Telephone number:** 021 - 790 4023 **Fax number:** --

**Do you or your organisation have any issues or concerns regarding the proposed exploration activities off the South Coast of South Africa?**

**Yes** ✓ **No** ______

**If yes, please provide details below** (or use extra pages if necessary):

As has previously been stated we are extremely concerned regarding the effect on highly migrating fish species such as Tuna. Although our Tuna fishermen do not fish in these potential areas we are of the opinion that Yellowfin Tuna that reach our waters will cross paths with the survey area. As there is no [illegible] proof that seismic surveys do not affect them, we will unfortunately only find out after the fact. Our greatest concern is for the number of surveys taking place around our coast at the same time.

- Thank you

Please forward to:
**CCA ENVIRONMENTAL (PTY) LTD**
Attention: Eloise Costandius
PO Box 10145, Caledon Square, 7905
Tel: (021) 461 1118/9 Fax: (021) 461 1120
Email: eloise@ccaenvironmental.co.za

Comments must reach CCA Environmental no later than **23 October 2012**

CCA ENVIRONMENTAL

Western Cape Government
Environmental Affairs and Development Planning

Land Management
(Region 3)

**REFERENCE:** 16/3/1/6/1/D1/17/0207/12

**ENQUIRIES:** Shireen Pullen

**DATE OF ISSUE:** 2012 -10- 17

The Director
CCA Environmental (Pty) Ltd
PO Box 10145
Caledon Square
7905

Tel: 044 6901 3054
Fax: 044 691 1520

**Attention: Mr. J. Crowther**

Dear Madam

**ACKNOWLEDGEMENT OF RECEIPT OF THE BACKGROUND INFORMATION DOCUMENT FOR ENVIRONMENTAL MANAGEMENT PLAN FOR A PROPOSED 2ND SEISMIC SURVEY, DROP CORING SAMPLING AND SONAR BATHYMETRY, OUTENIQUA SOUTHA AREA, SOUTH COAST, SOUTH AFRICA**

1. The abovementioned document received by this Department on 02 October 2012 refers.

2. This letter serves as an acknowledgment of receipt of the abovementioned document by this Department.

3. Please note that the information is currently under consideration and this Department will respond to you in due course.

4. Kindly quote the abovementioned reference number in any future correspondence in respect of the application.

5. The Department reserves the right to revise initial comments and request further information from you based on any new or revised information received.

Yours faithfully

**HEAD OF DEPARTMENT**

Cc: Mr. K. Grunewald George Municipality Fax: 044 874 3936

4th Floor, York Park Building,
93 York Street, George, 6529
tel: +27 44 805 8600 fax: +27 44 874 2423

Private Bag X6509, George, 6530

www.westerncape.gov.za/eadp

# APPENDIX 2

# CONVENTION FOR ASSIGNING SIGNIFICANCE RATINGS TO IMPACTS

# CONVENTION FOR ASSIGNING SIGNIFICANCE RATINGS TO IMPACTS

Specialists must consider seven rating scales when assessing potential impacts. These include:

1 Extent;
2 Duration;
3 Intensity;
4 Significance;
5 Status of impact;
6 Probability; and
7 Degree of confidence.

In assigning significance ratings to potential impacts before and after mitigation specialists are instructed to follow the approach presented below:

- The core criteria for determining significance ratings are "extent" (Section 1), "duration" (Section 2) and "intensity" (Section 3). The preliminary significance ratings for combinations of these three criteria are given in Section 4.

- The status of an impact is used to describe whether the impact would have a negative, positive or zero effect of the surrounding environment. An impact may therefore be negative, positive (or referred to as a benefit) or neutral.

- Describe the impact in terms of the probability of the impact occurring (Section 5) and the degree of confidence in the impact predictions, based on the availability of information and specialist knowledge (Section 6).

- Additional criteria to be considered, which could "increase" the significance rating if deemed justified by the specialist, with motivation, are the following:
  - Permanent / irreversible impacts (as distinct from long-term, reversible impacts);
  - Potentially substantial cumulative effects; and
  - High level of risk or uncertainty, with potentially substantial negative consequences.

- Additional criteria to be considered, which could "decrease" the significance rating if deemed justified by the specialist, with motivation, are the following:
  - Improbable impact, where confidence level in prediction is high.

- When assigning significance ratings to impacts *after mitigation*, the specialist needs to:
  - First, consider probable changes in intensity, extent and duration of the impact after mitigation, assuming effective implementation of mitigation measures, leading to a revised significance rating; and
  - Then moderate the significance rating after taking into account the likelihood of proposed mitigation measures being effectively implemented. Consider:
    - Any potentially significant risks or uncertainties associated with the effectiveness of mitigation measures;
    - The technical and financial ability of the proponent to implement the measure; and
    - The commitment of the proponent to implementing the measure, or guarantee over time that the measures would be implemented.

The significance ratings are based on largely objective criteria and inform decision-making at a project level as opposed to a local community level. In some instances, therefore, whilst the significance rating of potential impacts might be "low" or "very low", the importance of these impacts to local communities or individuals might be extremely high. The importance which Interested and Affected Parties (I&APs) attach to impacts must be taken into consideration, and recommendations should be made as to ways of avoiding or minimising these negative impacts through project design, selection of appropriate alternatives and / or management.

The relationship between the significance ratings after mitigation and decision-making can be broadly defined as follows:

| Significance rating | Effect on decision-making |
|---|---|
| Very Low; Low | Would not have an influence on the decision to proceed with the proposed project, provided that recommended measures to mitigate negative impacts are implemented. |
| Medium | Should influence the decision to proceed with the proposed project, provided that recommended measures to mitigate negative impacts are implemented. |
| High; Very High | Would strongly influence the decision to proceed with the proposed project. |

## 1. EXTENT

"Extent" defines the physical extent or spatial scale of the impact.

| Rating | Description |
|---|---|
| LOCAL | Extending only as far as the activity, limited to the site and its immediate surroundings. Specialist studies to specify extent. |
| REGIONAL | South Coast. Specialist studies to specify extent. |
| NATIONAL | South Africa |
| INTERNATIONAL | |

## 2. DURATION

"Duration" gives an indication of how long the impact would occur.

| Rating | Description |
|---|---|
| SHORT TERM | 0 - 5 years |
| MEDIUM TERM | 6 - 15 years |
| LONG TERM | Where the impact would cease after the operational life of the activity, either because of natural process or human intervention. |
| PERMANENT | Where mitigation either by natural processes or by human intervention would not occur in such a way or in such time span that the impact can be considered transient. |

## 3. INTENSITY

"Intensity" establishes whether the impact would be destructive or benign.

| Rating | Description |
|---|---|
| ZERO TO VERY LOW | Where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected. |
| LOW | Where the impact affects the environment in such a way that natural, cultural and social functions and processes continue, albeit in a slightly modified way. |
| MEDIUM | Where the affected environment is altered, but natural, cultural and social functions and processes continue, albeit in a modified way. |
| HIGH | Where natural, cultural and social functions or processes are altered to the extent that it will temporarily or permanently cease. |

# 4. SIGNIFICANCE

"Significance" attempts to evaluate the importance of a particular impact, and in doing so incorporates the above three scales (i.e. extent, duration and intensity).

| Rating | Description |
|---|---|
| VERY HIGH | Impacts could be EITHER:<br>of ***high intensity*** at a ***regional level*** and endure in the ***long term***[1];<br>OR of ***high intensity*** at a ***national level*** in the ***medium term***;<br>OR of ***medium intensity*** at a ***national level*** in the ***long term.*** |
| HIGH | Impacts could be EITHER:<br>of ***high intensity*** at a ***regional level*** and endure in the ***medium term***;<br>OR of ***high intensity*** at a ***national level*** in the ***short term***;<br>OR of ***medium intensity*** at a ***national level*** in the ***medium term;***<br>OR of ***low intensity*** at a ***national level*** in the ***long term***;<br>OR of ***high intensity*** at a ***local level*** in the ***long term***;<br>OR of ***medium intensity*** at a ***regional level*** in the ***long term.*** |
| MEDIUM | Impacts could be EITHER:<br>of ***high intensity*** at a ***local level*** and endure in the ***medium term***;<br>OR of ***medium intensity*** at a ***regional level*** in the ***medium term***;<br>OR of ***high intensity*** at a ***regional level*** in the ***short term***;<br>OR of ***medium intensity*** at a ***national level*** in the ***short term***;<br>OR of ***medium intensity*** at a ***local level*** in the ***long term***;<br>OR of ***low intensity*** at a ***national level*** in the ***medium term;***<br>OR of ***low intensity*** at a ***regional level*** in the ***long term.*** |
| LOW | Impacts could be EITHER<br>of ***low intensity*** at a ***regional level*** and endure in the ***medium term***;<br>OR of ***low intensity*** at a ***national level*** in the ***short term***;<br>OR of ***high intensity*** at a ***local level*** and endure in the ***short term***;<br>OR of ***medium intensity*** at a ***regional level*** in the ***short term***;<br>OR of ***low intensity*** at a ***local level*** in the ***long term***;<br>OR of ***medium intensity*** at a ***local level*** and endure in the ***medium term.*** |
| VERY LOW | Impacts could be EITHER<br>of ***low intensity*** at a ***local level*** and endure in the ***medium term***;<br>OR of ***low intensity*** at a ***regional level*** and endure in the ***short term***;<br>OR of ***low to medium intensity*** at a ***local level*** and endure in the ***short term.*** |
| INSIGNIFICANT | Impacts with:<br>***Zero to very low intensity*** with any combination of extent and duration. |
| UNKNOWN | In certain cases it may not be possible to determine the significance of an impact. |

# 5. STATUS OF IMPACT

The status of an impact is used to describe whether the impact would have a negative, positive or zero effect on the affected environment. An impact may therefore be negative, positive (or referred to as a benefit) or neutral.

[1] For any impact that is considered to be "Permanent" apply the "Long-Term" rating.

# 6. PROBABILITY

“Probability” describes the likelihood of the impact occurring.

| Rating | Description |
|---|---|
| IMPROBABLE | Where the possibility of the impact to materialise is very low either because of design or historic experience. |
| PROBABLE | Where there is a distinct possibility that the impact would occur. |
| HIGHLY PROBABLE | Where it is most likely that the impact would occur. |
| DEFINITE | Where the impact would occur regardless of any prevention measures. |

# 7. DEGREE OF CONFIDENCE

This indicates the degree of confidence in the impact predictions, based on the availability of information and specialist knowledge.

| Rating | Description |
|---|---|
| HIGH | Greater than 70% sure of impact prediction. |
| MEDIUM | Between 35% and 70% sure of impact prediction. |
| LOW | Less than 35% sure of impact prediction. |

# APPENDIX 3

# SPECIALIST STUDIES

# APPENDIX 3.1

# FISHING INDUSTRY ASSESSMENT

**INTERIM LEASE-SPECIFIC ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT FOR CONDUCTING 2D SEISMIC SURVEY, SONAR BATHYMETRY AND DROP CORING SAMPLING, OUTENIQUA SOUTH AREA, SOUTH COAST, SOUTH AFRICA**

**Fisheries Impact Assessment**

Compiled for:

CCA Environmental (Pty) Ltd

On behalf of:

TOTAL

Prepared by:

CapFish

*D.W. Japp and S. Wilkinson*
*CapFish SA (Pty) Ltd*
Cape Town

October 2012

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**CAPFISH SA(PTY)LTD**
***Reg. No. 2004 / 004844 / 07***
Unit 15 Foregate Square, Table Bay Blvd, Cape Town South Africa.
P.O. Box 50035, Waterfront, Cape Town 8002 Tel : (021) 4256226 Fax: (021) 4251994
Web: www.capfish.co.za

15 October 2012

***EXPERTISE AND DECLARATION OF INDEPENDENCE***

This report was prepared by Dave Japp and Sarah Wilkinson of CapFish SA (Pty) Ltd. Dave Japp has a BSC in Zoology, University of Cape Town (UCT) and a MSc degree in Fisheries Science from Rhodes University. Sarah Wilkinson has a BSc (Hons) degree in Botany from UCT.

Both have considerable experience in undertaking specialist environmental impact assessments relating to fishing and fish stocks. Dave Japp has worked in the field of Fisheries Science and resource assessment since 1987. His work has included environmental economic assessments and the evaluation of the environmental impacts on fishing. Sarah Wilkinson has worked on marine resource assessments, specializing in spatial and temporal analysis (GIS) as well as the economic impacts of fisheries exploitation.

This specialist report was compiled for CCA Environmental (Pty) Ltd for their use in compiling an Environmental Management Plan(EMP) for aproposed speculative 2D seismic survey located on the South and East Coasts of South Africa. We do hereby declare that we are financially and otherwise independent of Total E and P South Africa (Pty) Ltd and of CCA Environmental (Pty) Ltd.

Dave Japp

Sarah Wilkinson

## EXECUTIVE SUMMARY

Total E and P South Africa (Pty) Ltd (Total E&P) is proposing to explore for oil and gas reserves in the deep offshore area of the South Coast of South Africa. The proposed area is located roughly between Cape Agulhas and Cape St Francis, referred to as the Outeniqua South area. Exploration activities would include a two-dimensional (2D) seismic survey, sonar bathymetry and drop coring sampling. The proposed exploration site covers an area of approximately 76 060 km$^2$ with water depths ranging from 200 m to over 4 000 m.

This report gives an assessment of the likely impact of the proposed survey on the fishing industry in terms of disruption to fishing activity and loss of access to fishing grounds. Furthermore, mitigation measures are proposed with a view to reducing potential negative effects between seismic and fishing operations. This report was commissioned as part of the undertaking of an Environmental Management Plan (EMP), which has to be approved by the Petroleum Agency of South Africa (PASA) prior to the granting of an Exploration Right.

The impact of the proposed survey is considered to be of short-term duration and the status of the impact on all fishery sectors is assessed to be negative. The impact on the demersal trawl, mid-water trawl, demersal long-line and south coast rock lobster fisheries is assessed to be of local extent, and of regional extent for the pelagic long-line fishery. The intensity of the impact on the demersal trawl, mid-water trawl, demersal long-line and south coast rock lobster trap fisheries is assessed to be of MEDIUM intensity and of overall VERY LOW significance. The intensity of the impact on the pelagic long-line fishery is assessed to be of HIGH intensity and of overall MEDIUM significance. There is no impact expected by the proposed survey on the small pelagic purse-seine, demersal shark long-line, traditional linefish and squid jig fisheries and the degree of confidence in the predictions for all fisheries is high.

The impact on the demersal trawl and acoustic research surveys is assessed to be regional in extent and of short-term duration. The intensity of the impact is assessed to be MEDIUM and of overall LOW significance. The degree of confidence in the assessments for all fisheries is high.

In terms of minimizing the impact on the fishing industry it is recommended that interested and affected parties (IAPs) are identified and that sufficient notification of the proposed survey operations be given prior to the commencement of the survey and throughout the duration of the survey. IAPs should include; South African Deep-sea Trawling Industry Association (SADSTIA), South East Coast Inshore Fishery Association (SECIFA), Small Hake Quota Holders Association, South African Tuna Longline

Association, Hake Longline Association, South Coast Rock Lobster Association and Blue Continent Products.

With respect to the research cruises undertaken by the Department of Agriculture, Forestry and Fisheries (DAFF), demersal surveys and acoustic surveys are undertaken within the proposed survey area and it is therefore suggested that a consultation programme be set up between Total E&P and DAFF prior to the commencement of the survey to negotiate the timing and/or placement of seismic transects and research trawls.

It is recommended that the survey vessel be accompanied by a chase vessel with staff familiar with the fisheries expected in the area. It is also recommended that an experienced on-board Observer should be deployed on the survey vessel to facilitate communication with maritime vessels. The on-board Observer should be familiar with fisheries operational in the area, as well as with environmental monitoring protocols relating specifically to marine mammals, birds and other fauna.

# 1. INTRODUCTION

Total E&P is proposing to explore for oil and gas reserves in the deep offshore area of the South Coast of South Africa roughly between Cape Agulhas and Cape St Francis, referred to as the Outeniqua South area (see Figure 1). In this regard, Total E&P lodged an application for an Exploration Right with PASA in terms of Section 74 of the Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA). A requirement of obtaining the Exploration Right is that an Environmental Management Plan (EMP) has to be compiled and submitted to PASA in terms of Section 39 of the MPRDA. This report was prepared as part of the EMP, which is being compiled by CCA Environmental (Pty) Ltd (CCA), and gives an assessment of the likely impact of the proposed survey on the fishing industry in terms of disruption to fishing activity and loss of access to fishing grounds.

Seismic surveys are undertaken to collect either 2D or 3D data. For this investigation Total E&P is proposing to undertake a 2D seismic survey, which is typically applied to obtain regional data from widely spaced survey grids (tens of kilometres). The proposed survey would be in the order of 7 000 km in length comprising a number of low density, spaced survey lines covering Total E&P's entire licence block area in the Outeniqua South area.The proposed area is located at a substantial distance offshore in water depths ranging from 200 m to over 4 000 m. From Cape Agulhas and Cape St Francis, the block is approximately 180 km and 90 km offshore, respectively. The larger harbours located at Mossel Bay and Port Elizabeth are approximately 150 km north and 130 km north-east of the area, respectively. Although survey commencement would ultimately depend on a permit award date, it is anticipated that the survey would be undertaken during the last quarter of 2013 and would take in the order of two to three months to complete (between November 2013 and March 2014).

The seismic vessel would travel along transects of a prescribed grid within the survey area that have been chosen to cross any known or suspected geological structure in the area. During surveying the seismic vessel would travel at a speed of between four and six knots. On completion of a transect, the survey vessel would be required to make a "turning circle" in order to shift to the next transect. The vessel would also be expected to move out of the acquisition area during periods of inclement weather and adverse sea conditions. Inclement weather conditions would occasionally affect data acquisition and lead to an extended survey duration.

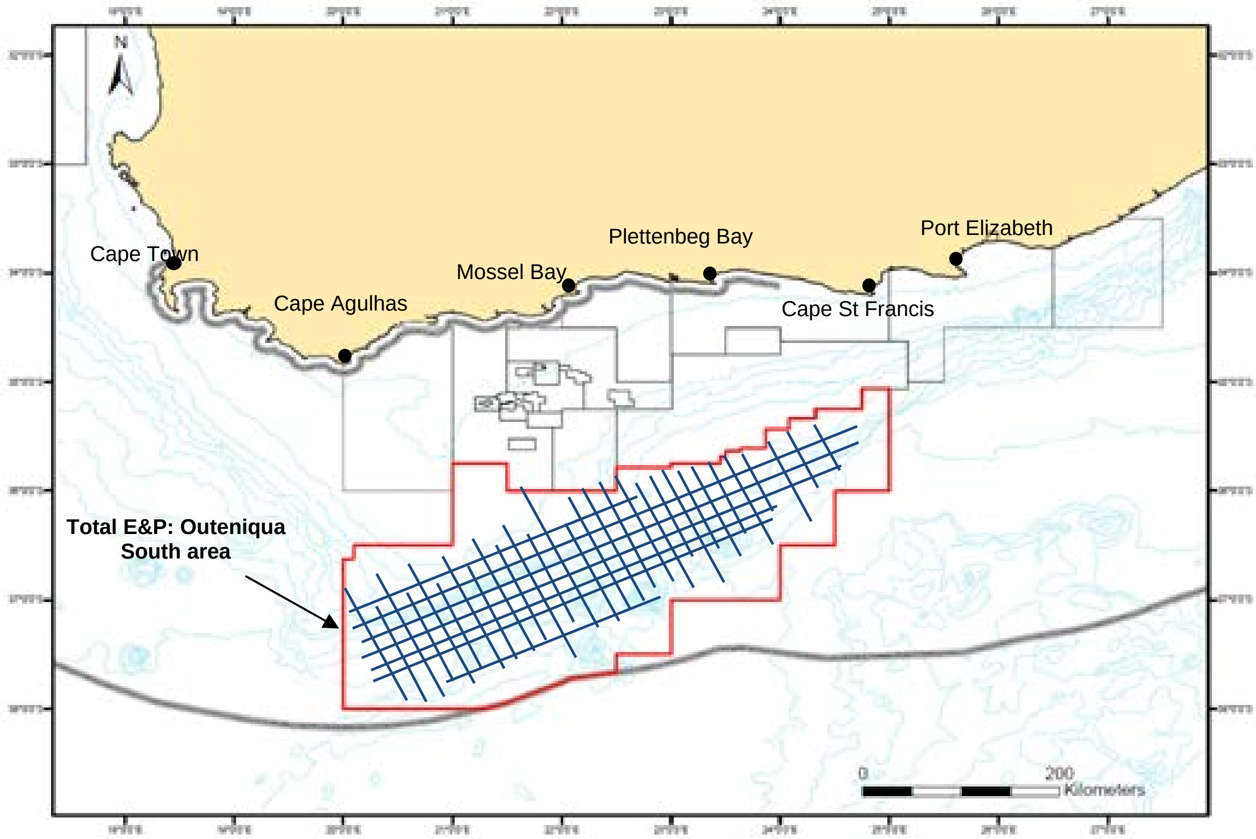


**Figure 1**. Location of Total E&P's 2D seismic survey off the South Coast of South Africa, with approximate survey lines indicated.

A seismic survey involves a towed airgun array which provides the seismic source energy for the profiling process, and a seismic wave detector system, usually known as the hydrophone streamer. The sound source would be situated 100 m to 200 m behind the vessel at a depth of 5 m to 20 m below the surface. The airgun array would be fired at approximately 10 to 20 second intervalsto generate an acoustic signal in the order of 250 dB re 1 mPa @ 1m which is reflected by boundaries between sediments of different densities. These sound-waves are recorded by hydrophones housed within the streamer cable, and the returned signal is processed on board. Because the sound-waves are extremely weak as they are recorded, the operation is very sensitive to outside sources of vibration, such as vessels, rigs and engineering activity. A 2D survey typically involves a single receiver streamer cable which extends astern of the vessel to a distance of up to 12 000 m. The streamer would be towed just below the water surface and would therefore not be visible, except for a surface tail-buoy with radar reflectors which is attached to the end of the streamer cable.

Under the Convention on the International Regulation for Preventing Collisions at Sea (COLREGS 1972), seismic survey vessels that are engaged in surveying are defined as vessels restricted in their ability to manoeuvre. As such it is a requirement that sea-going vessels that are engaged in fishing activities when surveys are underway shall be warned to stay as far as safely possible from vessels with restricted manoeuvrability. It should also be noted that under the Marine Traffic Act (Act No. 2 of 1981), seismic survey vessels are considered to be “offshore installations” and as such are protected by a 500 m safety zone. It is an offence for an unauthorised vessel to enter these safety zones. In addition to the statutory 500 m safety zone, a seismic contractor may request a safe operational limit that is greater than the 500 m safety zone that it would like other vessels to stay beyond. Typical safe operational limits for 2D surveys are illustrated in Figure 2. Support vessels are usually commissioned as “chase” boats to ensure that other vessels adhere to the safe operational limits.

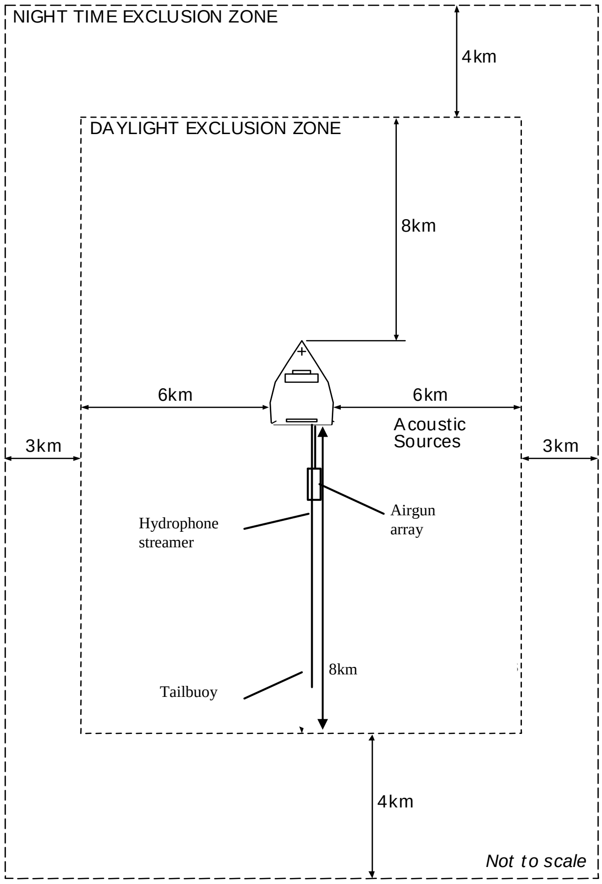


Figure 2. Typical gear configuration and safe operational limits for a 2D seismic survey

Based on the outcome of the 2D seismic survey, follow-up sonar bathymetry and drop core sampling would be undertaken. Total E&P is proposing to use a piston coring system to undertake sediment core samples of the seabed surface. Approximately 150 to 200 core samples would be collected across the 2D seismic survey area. This number and the exact location of the core samples would be confirmed following the analysis of the 2D survey results. It is proposed to commence with the sonar survey and core drilling during November 2014.

This report was prepared as part of the EMP, which is being compiled by CCA Environmental (Pty) Ltd (CCA), and gives a synopsis of commercial fish resources and fisheries which may be affected by the proposed speculative survey. An assessment is made of the likely impact of the proposed survey on the fishing industry in terms of disruption to fishing activity and loss of access to fishing grounds due to the temporary displacement of fishing activities resulting from the safety zone and larger safe operational limit required around the survey vessel and gear. Furthermore, mitigation measures are proposed with a view to reducing potential negative effects between seismic and fishing operations.

## 2. DATA SOURCES

Relevant fisheries data were sourced from the Department of Agriculture, Forestry and Fisheries (Branch: Fisheries) (DAFF) record of commercial catch and effort. Data were obtained for the following sectors; small pelagic (1987 to 2009), demersal trawl (2006 to 2010), mid-water trawl (2000 to 2008), large pelagic (1998 to 2007), demersal hake long-line (2002 to 2008), demersal shark long-line (2003 to 2008), South Coast rock lobster (2001 to 2008), traditional line fishery (1985 to 2010) and squid jig. Catch and effort statistics are captured on grid areas of either 10 x 10 or 5 x 5 minutes of latitude and longitude. There is an associated minimal amount of incorrectly-reported data associated with the commercial datasets. Additional information was obtained from the *South Africa, Namibia and Mozambique Fishing Industry Handbook 2011*.

## 3. BACKGROUND TO FISHERIES

The South African fishing industry consists of at least 20 commercial fishing sectors operating within the country's 200 nautical mile Exclusive Economic Zone (EEZ). The western coastal shelf is a highly productive upwelling ecosystem (Benguela Current) and supports a diversity of fisheries. The most economically valuable of these are the demersal trawl and long-line fisheries, targeting the cape hakes *Merluccius paradoxus* and *M. capensis*. Secondary commercial species landed in the hake-directed fisheries include an assemblage of demersal fish of which monk fish (*Lophius vomerinus*), Kingklip (*Genypterus capensis*) and snoek (*Thyrsites atun*) are the most important. However, the largest fishery by volume is the one for small pelagic species using small pelagic purse-seine gear. This fishery targets sardine (*Sardinops sagax*), anchovy (*Engraulis encrasicolus*) and round herring (*Etrumeus whitheadii*). Other fisheries active on the South-West Coast are the pelagic long-line fishery for tunas and swordfish, and the tuna pole and traditional linefish sectors. West Coast rock lobster (*Jasus lalandii*) is an important commercial trap fishery exploited close to the shoreline. The commercial sectors that operate in the vicinity of the proposed survey area are listed in Table 1 below:

**Table 1**. List of commercial fisheries that operate in the vicinity of the proposed survey area.

| No. | Fishery | Gear Type | Targeted Species |
|---|---|---|---|
| 1. | Small pelagic purse-seine | Purse-Seine | Sardine (*Sardinops sagax*), anchovy (*Engraulis encrasicolus*), round herring (*Etrumeus whitheadii*) |
| 2. | Demersal offshore trawl | Demersal trawl | Cape hakes (*Merluccius paradoxus, M. capensis*) |
| 3. | Mid-water trawl | Mid-water trawl | Horse mackerel (*Trachurus capensis*) |
| 4. | Demersal long-line | Demersal long-line | Cape hakes (*M. paradoxus, M. capensis*) |

| | | | |
|---|---|---|---|
| 5. | Demersal shark | Demersal long-line | Soupfin shark (*Galeorhinus galeus*), smooth-hound shark (*Mustelus spp*.) |
| 6. | Large pelagic long-line | Pelagic long-line | Yellowfin tuna (*Thunnus albacares*), bigeye tuna (*T. obesus*), swordfish (*Xiphias gladius*), mako shark (*Isurus oxyrinchus*), blue shark (*Prionace glauca*) |
| 7. | South Coast rock lobster | Long-line trap | *Palinurus gilchristi* |
| 8. | Traditional line fish & Hake handline | Hand line or rod-and-reel | Snoek (*Thyrsites atun*), longfin tuna, sparidae, serranidae, caragidae, scombridae, sciaenidae |
| 9. | Squid Jig | Hand line jig | *Loligo vulgaris reynaudii* |

## 4.0 COMMERCIAL FISHING SECTORS

### 4.1 Small Pelagic Purse-Seine Fishery

The small pelagic fishery is the largest South African fishery by volume and the second most important in terms of value. Small pelagic species abundance and distribution fluctuates considerably in accordance with the upwelling ecosystem in which they exist. Annual landings have fluctuated between 300 000 and 600 000 tons over the last decade[1], with landings of 312 000 tons recorded for 2009 (all species). The two main targeted species are sardine and anchovy, with associated by-catch of round herring (red-eye) and juvenile horse mackerel. In 2012 the TAC for sardine was set at 100 595 tons. Fishing grounds occur primarily along the West and South coasts of the Western Cape and the Eastern Cape coast up to a distance of 50 nautical miles offshore, but usually closer inshore than this and inshore of the 100 m bathycontour. Ports of deployment correspond to the location of canning factories and fish reduction plants along the coast. The majority of the fleet of 78 vessels operates from St Helena Bay, Saldanha Bay and Hout Bay with fewer vessels operating on the South Coast from the harbours of Gansbaai, Mossel Bay, Port St Francis and Port Elizabeth.

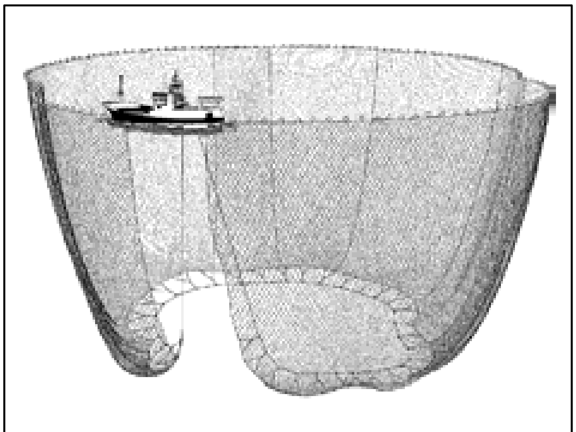

**Figure 3**. Typical gear configuration of a pelagic purse-seine vessel targeting small pelagic species

The small pelagic sector operates throughout the year with a short break over the Christmas and New Year period. The geographical distribution and intensity of the fishery is largely dependent on the seasonal fluctuation and geographical distribution of the targeted species. The sardine-directed fleet consists of larger vessels that tend to concentrate effort in a broad area extending from St Helena Bay, southwards past Cape Town towards Cape Point and then eastwards along the coast to Mossel bay and

[1]Acoustic surveys are conducted to assess the pre- and post-spawning biomass of small pelagic species and the TAC is set and adjusted accordingly each year.

Port Elizabeth. The anchovy-directed fishery takes place predominantly on the South-West Coast from St Helena Bay to Cape Point and similarly the intensity of this fishery is dependent on fish availability and is most active in the period from March to September. Round herring (non-quota species) is targeted when available and specifically in the early part of the year (January to March) and is distributed South of Cape Point to St Helena Bay. This fishery may extend further offshore than the sardine and anchovy-directed fisheries.Vessels based in Port St Francis and Port Elizabeth target sardine exclusively.

The fleet consists of wooden, glass-reinforced plastic and steel-hulled vessels ranging in length from 11 m 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 to 90 m (see Figure 3). Netting walls surround aggregated fish, preventing them from escaping by diving downwards. These are surface nets framed by lines: a float line on top and lead line at the bottom. Once the shoal has been encircled the net is pursed, hauled in and the fish pumped onboard into the hold of the vessel. It is important to note that after the net is deployed the vessel has no ability to manoeuvre until the net has been fully recovered onboard and this may take up to 1.5 hours. Therefore, direct communication from the survey vessel would be required to ensure pure-seine vessels stay clear of the survey vessel. Vessels usually operate overnight and return to offload their catch the following day.

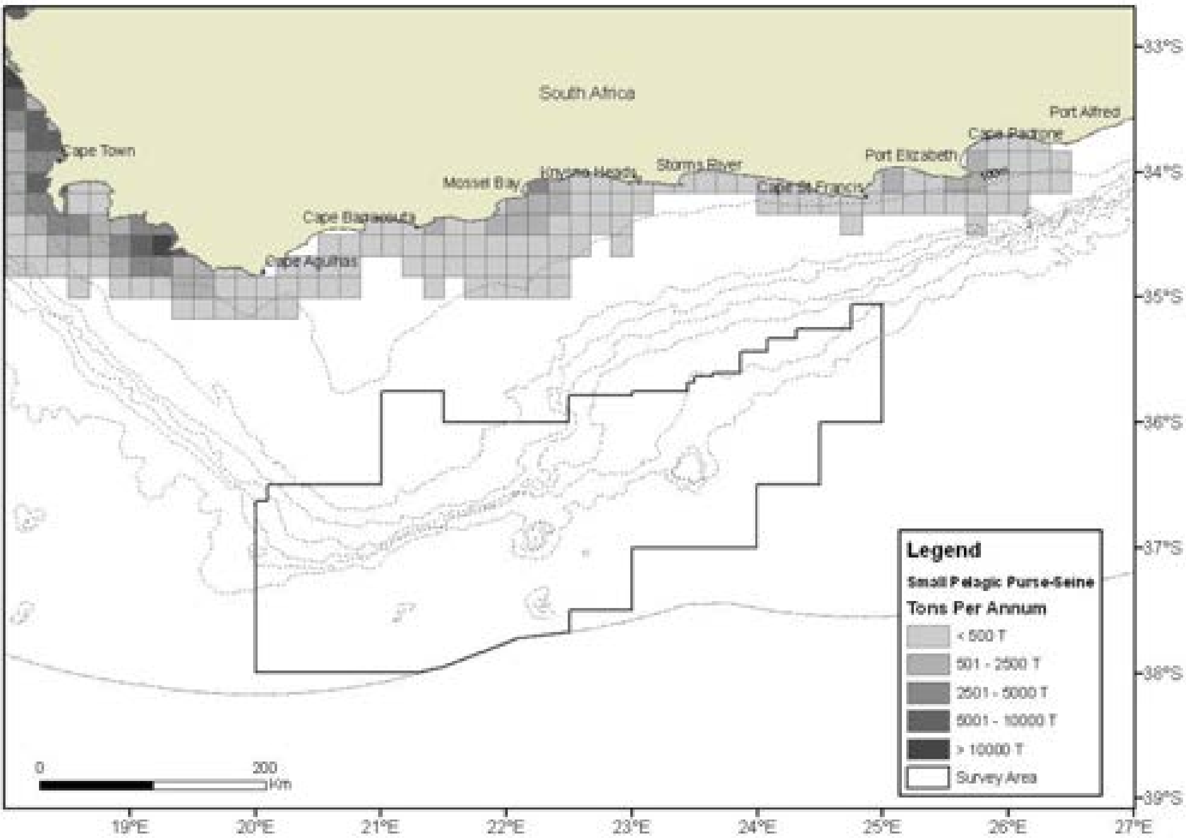


**Figure 4**. Distribution of fishing activity within the small pelagic purse-seine fishery in respect to the proposed survey area (1987 – 2009).

Since the pelagic purse-seine fishery operates within 50 nm of ports, the proposed survey area does not coincide with areas of operation of the fishery. As such, is no impact expected on the pelagic purse-seine fishery and the degree of confidence of the assessment for this fishery is high.

### 4.2 Demersal Trawl Fishery

The demersal trawl fishery is South Africa's most important fishery and, for the last decade, it has accounted for more than half of the income generated from commercial fisheries. Prior to 1978 a single demersal trawl fishery targeted the two Cape hake species off southern Africa. After this date, the fishery was formally separated into an offshore sector targeting deep-water hake (*M. paradoxus)* and an inshore sector targeting shallow-water hake (*M. capensis*) and Agulhas sole (*Austroglossuspectoralis*). These sectors are divided at the 110 m depth contour on the South Coast (the inshore fishery does not occur West of the 20° E line of longitude). Offshore fishing grounds along the West Coast are centred at depths of between 200 m and 900 m and extend from Hondeklipbaai in a southward direction to the southern point of the Agulhas Bank. On the South Coast, deep-sea trawlers may not fish shallower than 110 m depth or within 20 nautical miles of the coast. In this southern region, rocky terrain largely forces trawlers to concentrate on the offshore edge of the Agulhas Bank. Inshore trawl grounds are located between Cape Agulhas and the Great Kei River. In this region hake directed trawling is most intense along the 100 m depth contour, although in the vicinity of Mossel Bay trawling occurs close inshore. Sole directed fishing takes place primarily between Mossel Bay and Struisbaai and there is no sole-directed activity West of the 20° E line of longitude. The Total Allowable Catch of hake for the demersal trawl fishery is currently set at 144 741 tons (2012).

The deep-sea fleet is segregated into wet fish and freezer vessels which differ in terms of the capacity for the processing of fish offshore (at sea) and in terms of vessel size and capacity (shaft power of 750 – 3000 kW). Wet fish vessels have an average length of 45 m, are generally smaller than freezer vessels which may be up to 90 m in length. While freezer vessels may work in an area for up to a month at a time, wet fish vessels fish may only remain in an area for about a week before returning to port. Trawl gear configurations are similar for both freezer and wet fish vessels, the main elements of which are trawl warps, bridles and doors, a footrope, headrope, net and codend (see Figure 5). Generally, trawlers tow their gear at 3.5 knots for up to four hours per drag. When towing gear, the distance of the trawl net from the vessel is usually between two and three times the depth of the water. The horizontal net opening may be up to 50 m in width and 10 m in height. The swept area on the seabed between the doors may be up to 150 m.

Typical demersal trawl gear configuration consists of (see Figure 4):

i. Steel warps up to 32 mm diameter - in pairs up to 3 km long when towed
ii. A pair of trawl doors (500 kg to 3 tons each)
iii. Net footropes which may have heavy steel bobbins attached (up to 24" diameter) as well as large rubber rollers (“rock-hoppers”)
iv. Net mesh (diamond or square shape) is normally wide at the net opening whereas the bottom end of the net (or cod-end) has a 130 mm stretched mesh

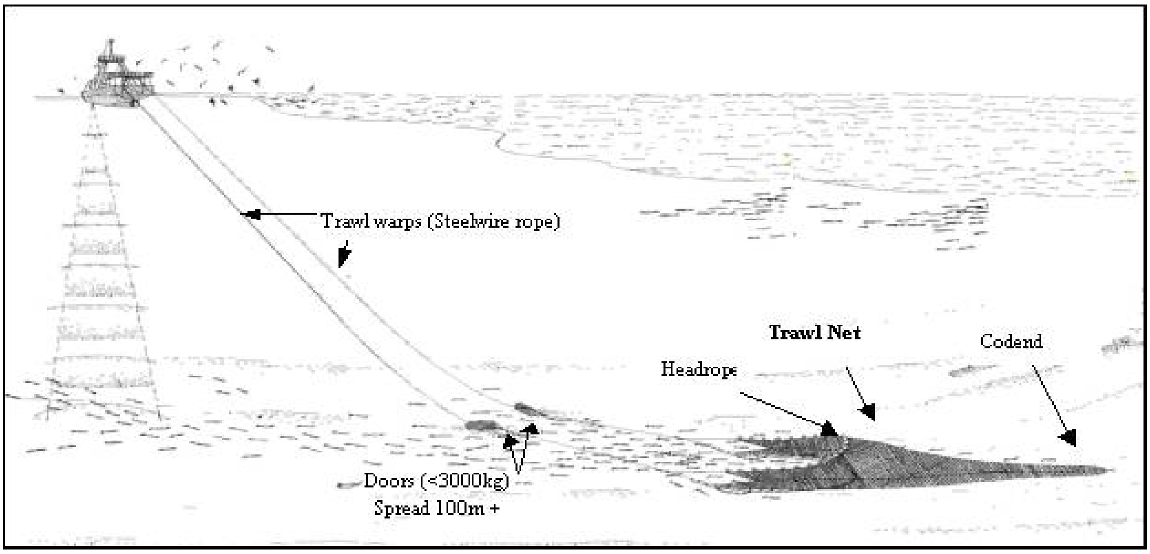


**Figure 5.** Schematic diagram of trawl gear typically used by deep-sea demersal trawl vessels.

The majority of vessels licensed to conduct hake deep-sea trawl are registered at the ports of Cape Town and Saldanha Bay, with 15 of a total of 98 vessels registered at South and East Coast harbours. It is highly likely that both freezer and wet fish trawler vessels would be encountered within the proposed survey area and there is generally no seasonal differentiation in effort levels. Although these vessels are restricted in manoeuvrability when gear is deployed the gear can be recovered within a period of 30-minutes or the vessel can take avoiding action at its trawl speed. Therefore, direct communication from the survey vessel would be required in order to keep trawl vessels clear of the survey vessel.

Trawling grounds extend across the western portion of the proposed survey area (West of 22°E), inshore of the 1 000 m isobath (see Figure 6). Approximately 4 510 km$^2$ of trawling grounds coincide with the proposed survey area which is equivalent to approximately 6.4 % of the total ground available to the fishery. Over the period 2006 to 2010, 7.8 % of the total effort of the demersal trawl fishery was conducted within the area at an average of 2 740 trawls per year.

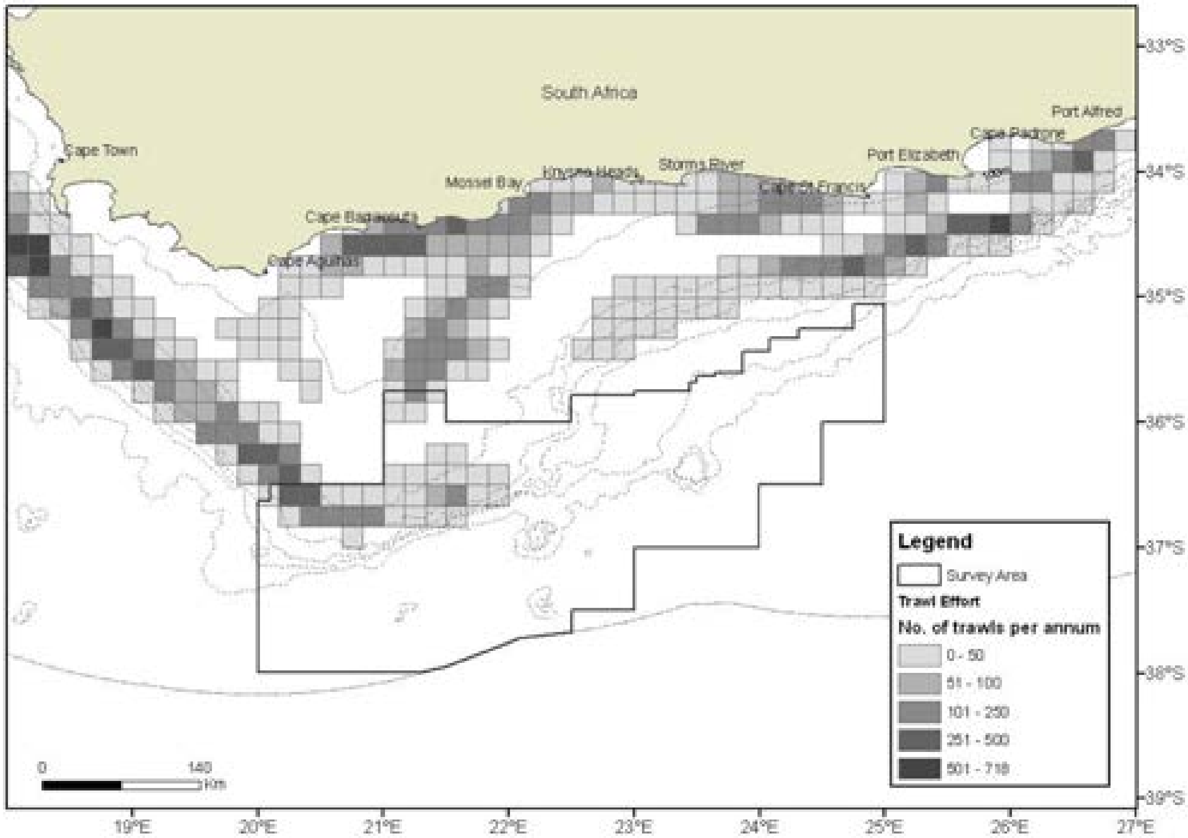


**Figure 6**. Distribution of demersal trawling activity over the period 2006 to 2010 in relation to the proposed survey area.

The impact of the proposed survey operations on the demersal trawl sector is considered to be of local extent and short-term duration. The status of the impact is assessed to be negative, of MEDIUM intensity and of overall VERY LOW significance. It is highly probable that the impact would occur and the degree of confidence of the assessment for this fishery is high.

| ***Environmental Impact Assessment of Fisheries: Demersal Trawl*** | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local | Local |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | Medium | Medium |
| **Significance** | Very Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Highly Probable | Highly Probable |
| **Confidence** | High | High |

### 4.3 Mid-Water Trawl

There are currently 15 rights holders within this fishing sector, however the majority of effort is undertaken by a single dedicated vessel which operates all year round. A large factory vessel capable of sustained operation has made economically viable targeting of horse mackerel possible. The fishery targets adult horse mackerel (*Trachuruscapensis*).

Mid-water trawling is defined in the Marine Living Resources Act (No. 18 of 1998) (MLRA) as any net which can be dragged by a fishing vessel along any depth between the sea bed and the surface of the sea without continuously touching the bottom. In practice, mid-water trawl gear does occasionally come into contact with the seafloor.

Mid-water trawling gear configuration is similar to that of demersal trawlers (refer to Figure 7), except that the net is manoeuvred vertically through the water column. Currently the FMV *Desert Diamond* is the only dedicated mid-water trawler and is the largest registered South African commercial fishing vessel. The *Desert Diamond* is 120 m in length and has a Gross Registered Tonnage (GRT) of 8 000 t. The towed gear may extend up to 1 km astern of the vessel and comprises trawl warps, net and codend. Trawl warps between 32 and 38 mm in diameter. The trawl doors (3.5 t each) maintain the net opening which ranges from 120 to 130 m in width and from 40 m to 80 m in height. Weights in front of, and along the ground-rope provide for vertical opening of the trawl. The cable transmitting acoustic signal from the net sounder might also provide a lifting force that maximizes the vertical trawl opening. To reduce the resistance of the gear and achieve a large opening, the front part of the trawls are usually made from very large rhombic or hexagonal meshes. The use of nearly parallel ropes instead of meshes in the front part is also a common design. Once the gear is deployed, the net is towed for several hours at a speed of 4.8 to 6.8 knots predominantly parallel with the shelf break.

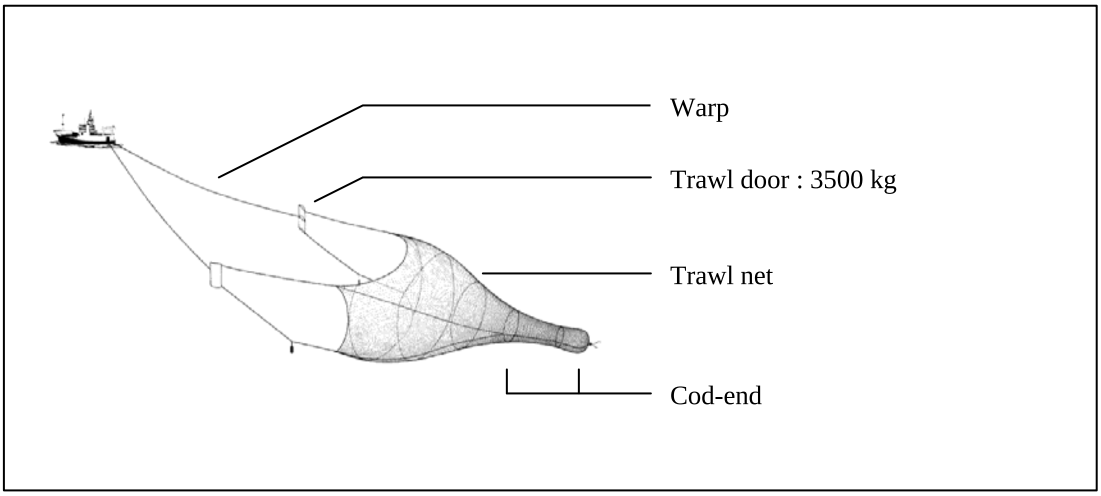


**Figure 7**. Schematic diagram showing the typical configuration of mid-water trawl gear.

The fishery targets adult horse mackerel 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 condensed into three areas on the shelf edge of the south and east coasts. The first lies between 22 °E and 23 °E at a distance of approximately 70 nm offshore from Mossel Bay and the second extends from 24 °E to 27 °E at a distance of approximately 30 nm offshore. A more recently exploited area lies to the south of the Agulhas Bank 21 °E and 22 °E. These grounds range in depth from 100 m to 400 m. However, isolated trawls are occasionally made further offshore in deeper water (up to 650 m) (See Figure 8).

Mid-trawling grounds to the South of the Agulhas Bank are coincident with the proposed survey area, inshore of the 500 m isobath between 21°E and 22.5°E. Approximately 1 291 $km^2$ of mid-water ground coincides with the proposed survey area which is equivalent to approximately 7.8 % of the total ground available to the fishery. Between 2000 and 2008, 1.7 % of the total effort of the fishery was conducted within the area at an average of approximately 22 trawls per year. An annual average of approximately 1.6 % (339 tons) of the total catch (all species landed) was taken within the survey area.

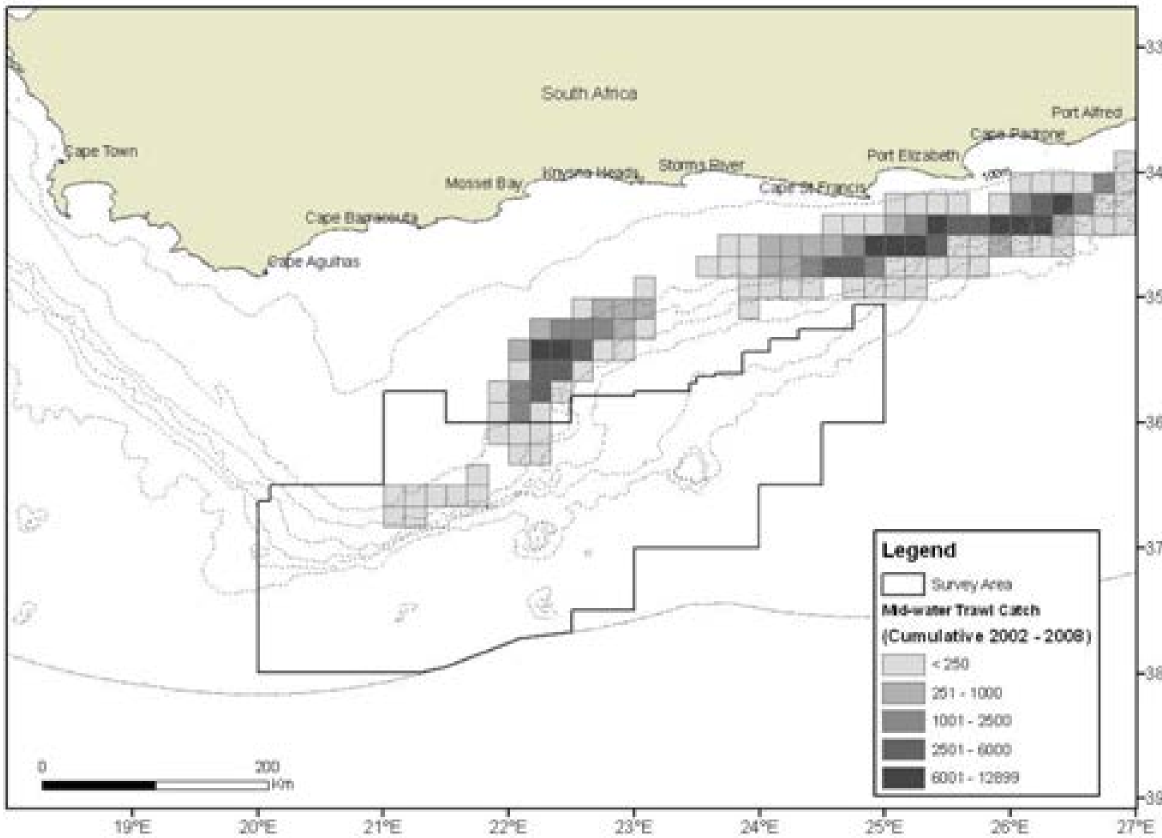


**Figure 8.** Distribution of fishing effort of the mid-water trawl fishery in the vicinity of the proposed survey area. Data are presented on a 10' by 10' grid for the period 2000 to 2008.

The impact of the proposed survey operations on the mid-water trawl sector is considered to be of local extent and short-term duration. The status of the impact is assessed to be negative, of MEDIUM intensity and of overall VERY LOW significance. It is highly probable that the impact would occur and the degree of confidence of the assessment for this fishery is high.

| ***Environmental Impact Assessment of Fisheries: Mid-Water Trawl*** | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local | Local |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | Medium | Medium |
| **Significance** | Very Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Highly Probable | Highly Probable |
| **Confidence** | High | High |

## 4.4 Demersal Long-Line Fisheries

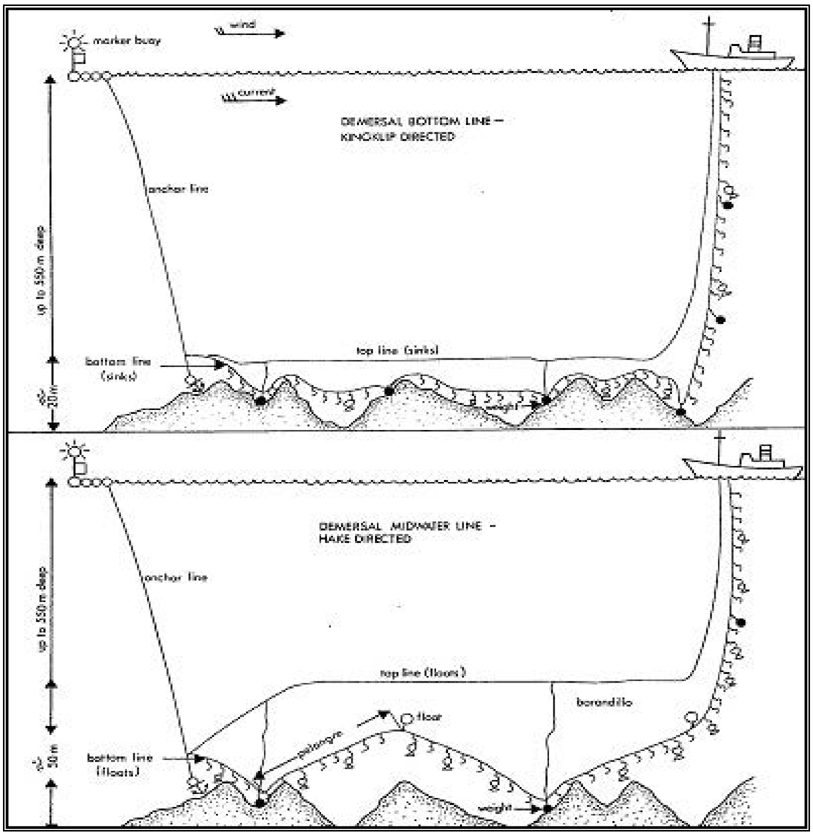


**Figure 9**. Schematic diagram showing a typical configuration of long-line gear used to target demersal fish species.

The demersal long-line fishing technique is used to target bottom-dwelling species of fish. Two fishing sectors utilize this method of capture, namely the long-line fishery for Cape hakes and the shark long-line sector targeting only the demersal species of shark. A demersal long-line vessel may deploy either a double or single line which is weighted along it's length to keep it close to the seafloor (see Figure 9). Steel anchors, of 40 to 60 kg are placed at the ends of each line to anchor it. These anchor positions are marked with an array of floats. If a double line system is used, top and bottom lines are connected by means of dropper lines. Since the top-line (polyethylene, 10 – 16 mm diameter) is more buoyant than the bottom line, it is raised off the seafloor and minimizes the risk of snagging or fouling. The purpose of the top-line is to aid in gear retrieval if the bottom line breaks at any point along the length of the line. Lines are typically 20 – 30 nautical miles in length. Baited hooks are attached to the bottom line at regular intervals (1 to 1.5 m) by means of a snood. Gear is usually set at night at a speed of 5 – 9 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 1 knot) and can take six to ten hours to complete. During hauling operations manoeuvrability would be severely restricted and direct communications from the survey vessel would be required in order to keep vessels and gear clear of the survey vessel.

#### 4.4.1 Hake-Directed Long-line Fishery

Like the demersal trawl fishery the target species of this fishery is the Cape hakes, with a small non-targeted commercial by-catch that includes kingklip. A total nominal catch weight of 9 493.8 tons has been set for this fishery in 2012 – this has increased in recent years (in 2009, some 7 713 tons was caught by the fishery). The hake long-line fishery is a relatively new fishery in South Africa, having started in 1994 as an experimental fishery, with long-term commercial rights being allocated in 2004. Fishing takes place along the West and South East coasts, in areas similar to those targeted by the demersal trawl fleet. The catch is landed predominantly prime quality hake for export to Europe. The catch is packed unfrozen on ice and the value is approximately 50% higher than that of trawled hake. There are currently 64 vessels licensed within the sector, operating from all major harbours, including Cape Town, Hout Bay, Mossel Bay and Port Elizabeth. Secondary points of deployment include St Helena Bay, Saldanha Bay, Hermanus, Gansbaai, Plettenberg Bay and Cape St Francis; however there is far less activity from these areas than from the main harbours. Vessels based in Cape Town and Hout Bay operate almost exclusively on the West Coast (west of 20° E). Vessels vary from 18 m to 50 m in length and remain at sea for four to seven days at a time. 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.

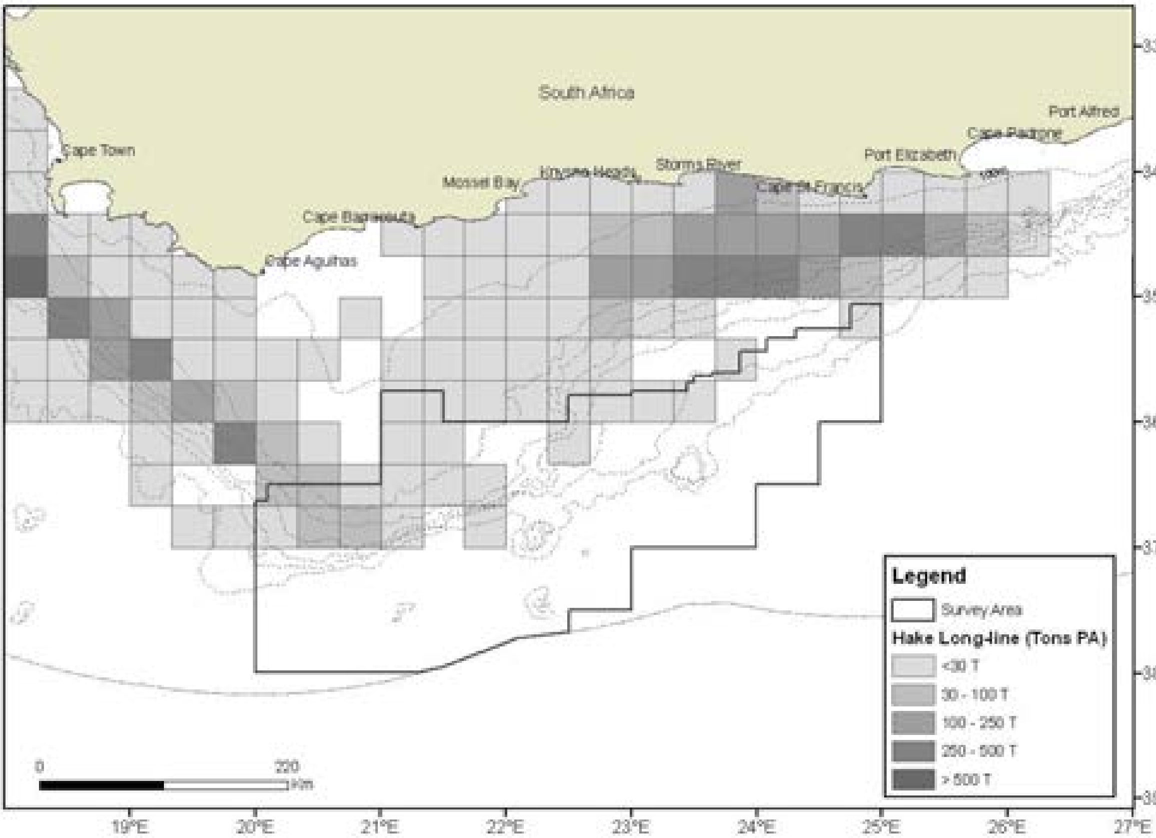


**Figure 10.** Distribution of fishing effort of the demersal long-line fisheries for hake (2002 – 2008) in the vicinity of the proposed survey area.

Demersal long-line vessels operate in well-defined areas extending along the shelf break from Port Nolloth to Port Elizabeth (Figure 10). Fishing activity would be expected to occur within the survey area along and inshore of the 500 m depth contour. Long-line grounds coincide with approximately 2 304 $km^2$ of the proposed survey area which is estimated to be 3.9 % of the total grounds fished by the demersal long-line fishery. An annual average of 1.0 million hooks were set and 215 tons of hake (whole, gutted) were caught in the area over the period 2002 to 2008, corresponding to 2.6 % of the overall national effort and 2.8 % of the total landings respectively.

The impact of the proposed survey operations on the demersal hake-directed long-line sector is considered to be of local extent and short-term duration. The status of the impact is assessed to be negative, of MEDIUM intensity and of overall VERY LOW significance. It is highly probable that the impact would occur and the degree of confidence of the assessment for this fishery is high.

| *Environmental Impact Assessment of Fisheries: Demersal Long-Line (Hake)* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local | Local |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | Medium | Medium |
| **Significance** | Very Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Highly Probable | Highly Probable |
| **Confidence** | High | High |

### 4.4.2 Shark-Directed Long-Line Fishery

Capture of demersal shark species occurs primarily in the demersal shark long-line fishery whilst catches of pelagic shark species occurs primarily in the large pelagic sector that targets tuna and swordfish. Prior to 2006, both demersal and pelagic shark catches were managed as a single shark fishery. The demersal shark fishery targets soupfin shark (*Galeorhinus galeus*), smooth-hound shark (*Mustelus spp*.), spiny dogfish (*Squalus* spp), St Joseph shark (*Callorhinchus capensis*), *Charcharhinus* spp., rays and skates. Other species which are not targeted but may be landed include cape gurnards (*Chelidonichthys capensis*), jacopever (*Sebastichthys capensis*) and smooth hammerhead shark (*Sphyrna zygaena*). Catches are landed at the harbours of Cape Town, Hout Bay, Mossel Bay, Plettenberg Bay, Cape St Francis, Saldanha Bay, St Helena Bay, Gansbaai and Port Elizabeth and currently six permit holders have been issued with long-term rights to operate within the fishery.

The fishery operates relatively close to shore, inshore of the 100 m isobaths (see Figure 11). Fishing grounds do not coincide with the proposed survey area as the survey area lies offshore of the 100 m isobaths and there is therefore no impact expected by the proposed survey on the fishery. The degree of confidence in this assessment is high.

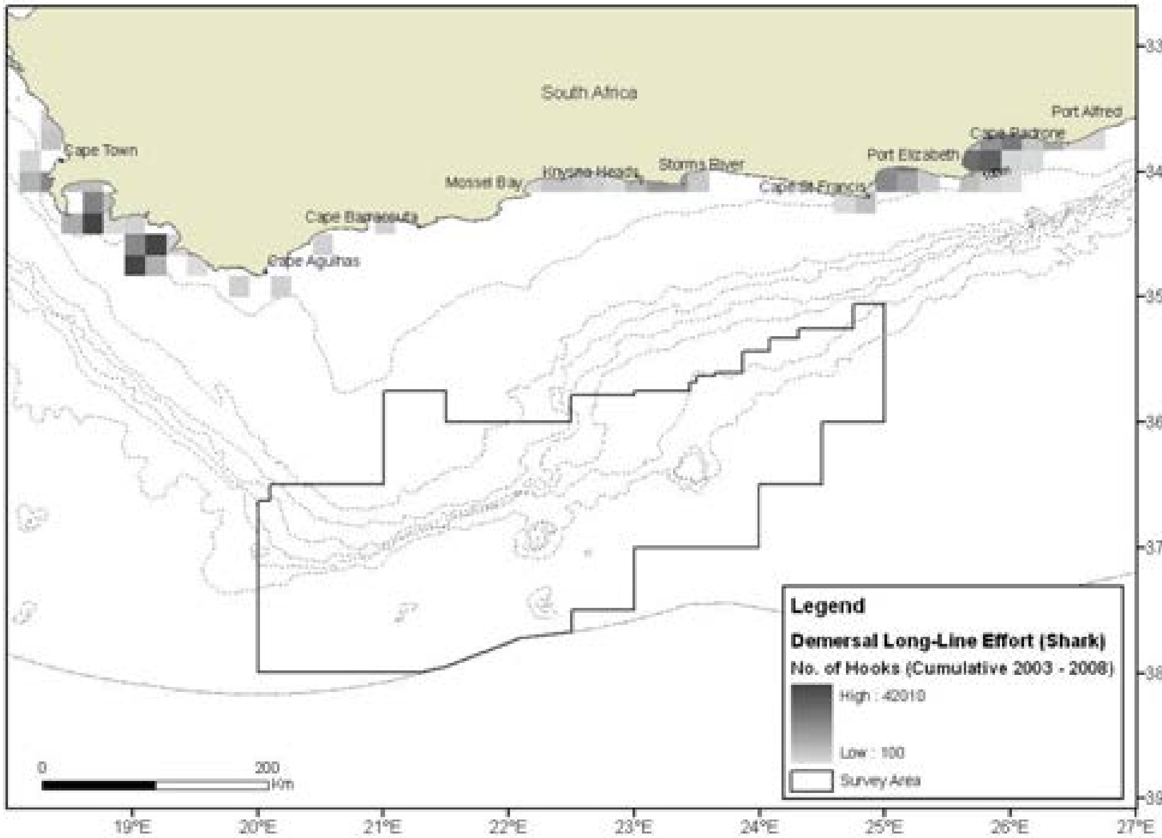


**Figure 11.** Distribution of fishing effort of the demersal long-line fisheries for shark (2006 – 2008) in the vicinity of the proposed survey area.

## 4.5 Large Pelagic Long-Line Fishery

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 EEZs of a number of countries and international waters. As such they are managed at an international level through country allocations and global effort control. It is at this level that Regional Fisheries Management Organisations (RFMOs) such as the International Commission for the Conservation of Atlantic Tunas (ICCAT), the Indian Ocean Tuna Commission (IOTC) and the Commission for the Conservation of Southern Bluefin Tuna (CCBT) are instrumental in managing the pelagic long-line sector around the South African coast. Nominal reported landings of 2 136 tons were recorded within the fishery for the year 2009 within the South African EEZ and on the high seas.

Twenty-nine foreign and South-African-flagged vessels operate within South African waters. Trip lengths range from three weeks to three months in duration. Although most vessels operate from the Cape Town harbour, the areas of operation are extensive within the entire South African EEZ. Tuna are targeted at thermocline fronts, predominantly along and offshore of the shelf break. Pelagic long-line vessels set a drifting mainline, up to 50-100 km in length, and are marked at intervals along its length with radio buoys (Dahn) and floats to facilitate later retrieval (see Figure 12). 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. Between radio buoys the mainline is kept near the surface or at a certain depth by means of ridged hard-plastic buoys, (connected via a "buoy-lines" of approximately 20 to 30 m). The buoys are spaced approximately 500 m apart along the length of the mainline. Hooks are attached to the mainline on branch lines, (droppers), which are clipped to the mainline at intervals of 20 to 30 m between the ridged buoys. The main line can consist of twisted tarred rope (6 to 8 mm diameter), nylon monofilament (5 to 7.5 mm diameter) or braided monofilament ~6mm in diameter. 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, however, in an emergency situation, the line may be dropped to be hauled in at a later stage. Note that the gear is set close to the sea surface and will present a potential obstruction to surface navigation and the towed seismic array if encountered. Therefore, direct communication between the survey vessel and the pelagic long-line vessels is important.

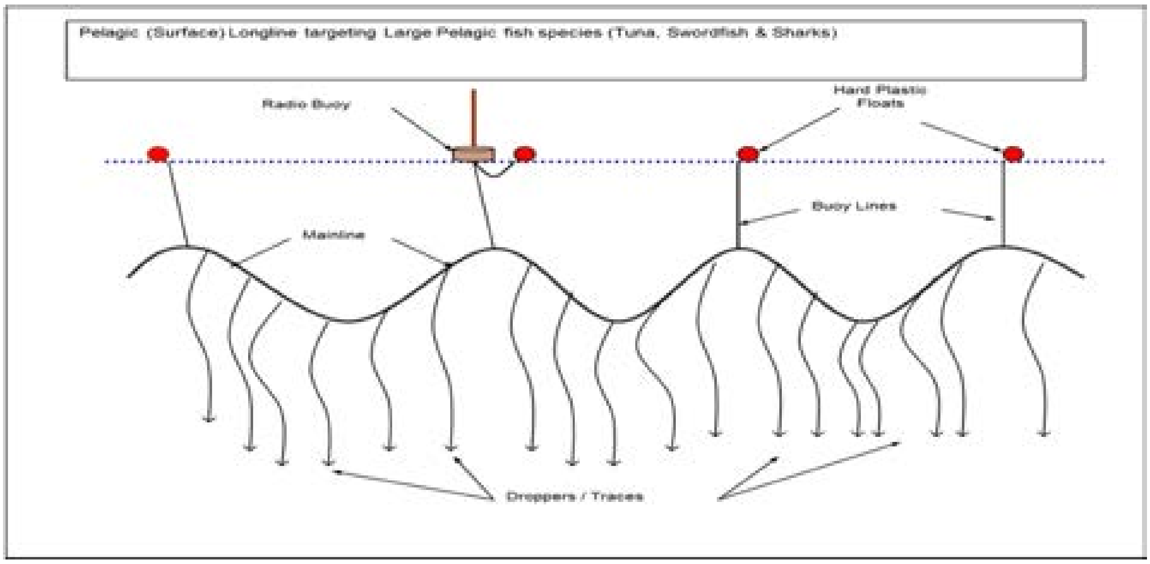


**Figure 12**. Typical pelagic long-line gear configuration targeting tuna, swordfish and shark species. Note the gear floats close to the surface of the sea and would present a potential obstruction to surface navigation.

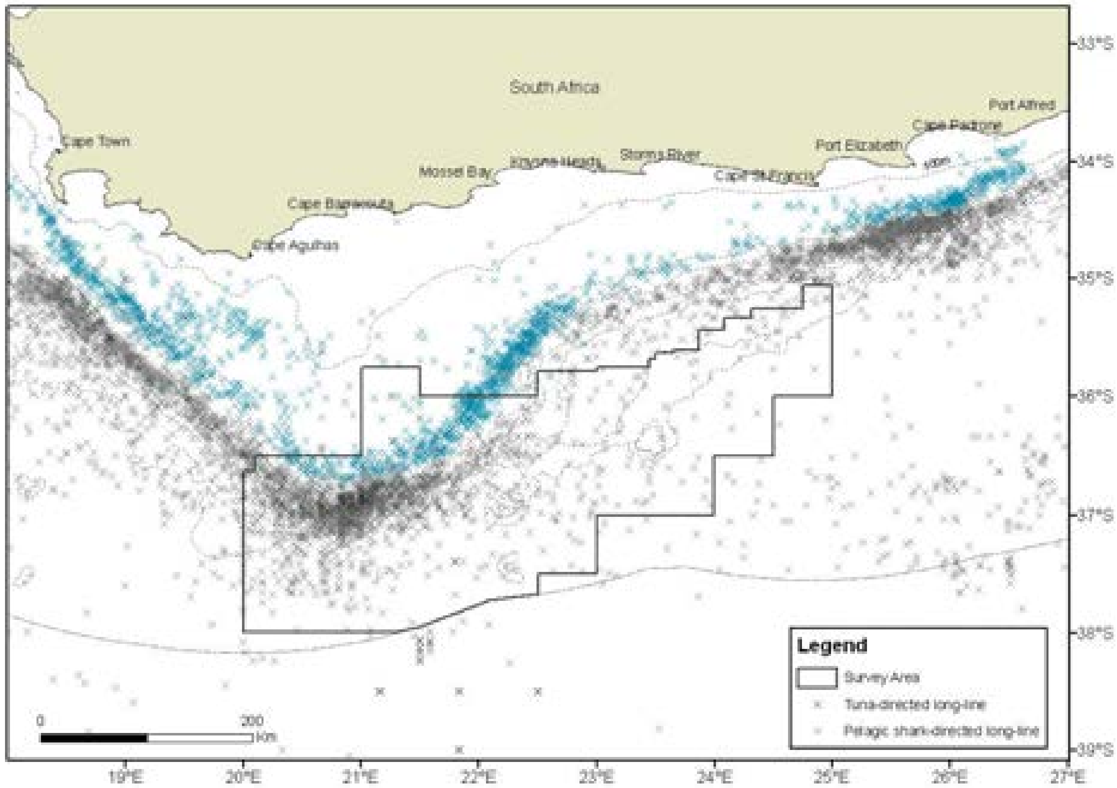


**Figure 13.** Distribution of fishing positions of the tuna-directed (1998 – 2007) and shark-directed pelagic (2003 – 2008) long-line fisheries in relation to the proposed survey area. The start position of each line set is shown.

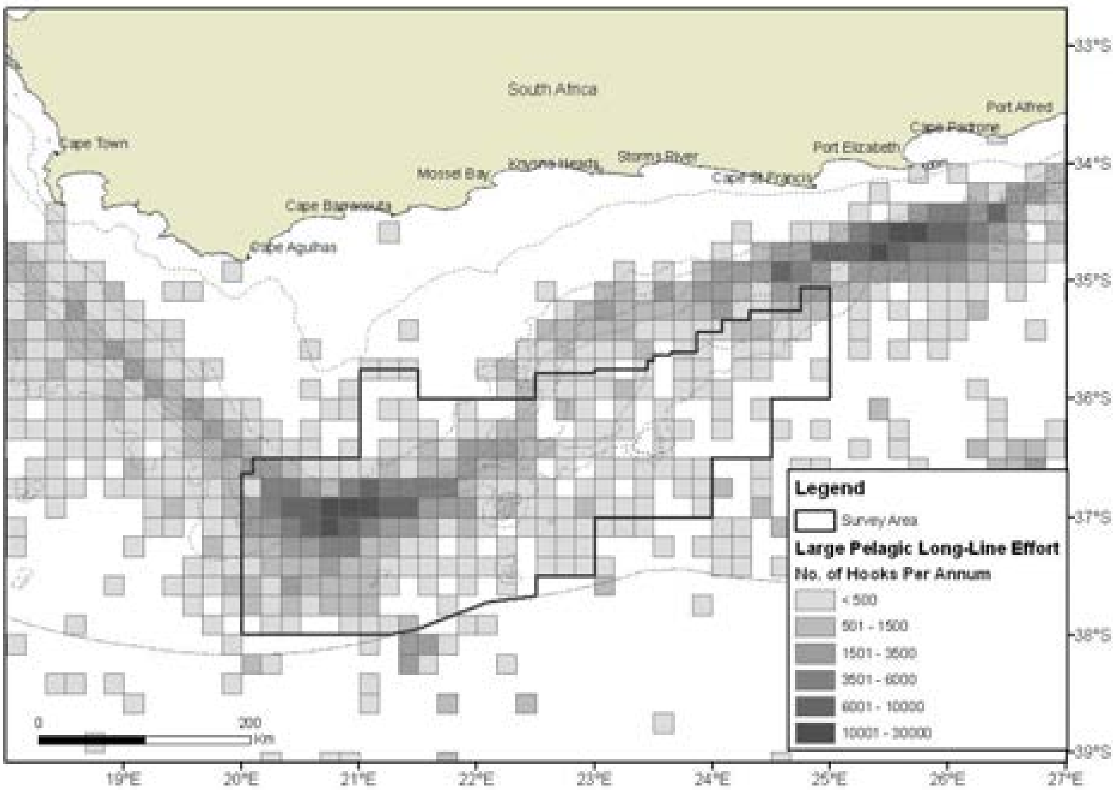


**Figure 14**. Distribution of long-line fishing effort targeting large pelagic species (tuna, swordfish) from 1997 to 2007 in relation to the proposed survey area.

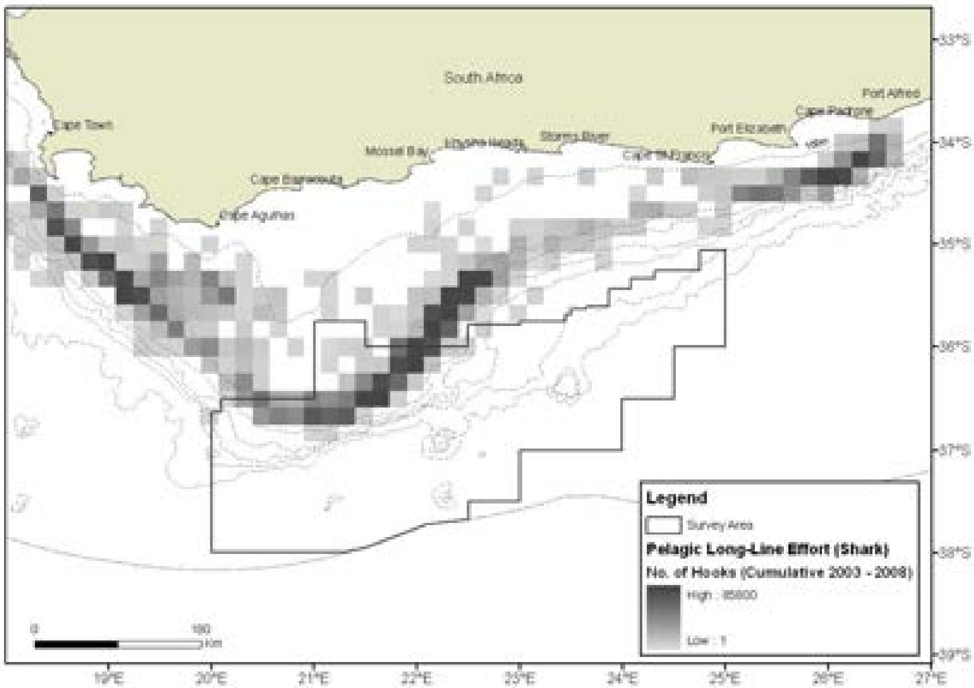


**Figure 15**. Distribution of long-line fishing effort targeting pelagic shark species from 2003 to 2008 in relation to the proposed survey area.

Pelagic long-line effort extends along and offshore of the 500 m isobath whilst pelagic shark species are targeted primarily along the 200 m isobath. Grounds are extensive within the proposed survey area (see Figures 13 – 15). Within the South African and foreign-flagged fleet combined approximately 18.1 % of the total national effort is conducted within this area each year (approximately 387 000 hooks), and 19.8 % of the total national catch is taken by this fishery (approximately 289 tons of targeted species).

The impact of the proposed survey operations on the large pelagic long-line sector is considered to be of regional extent and short-term duration. The status of the impact is assessed to be negative, of HIGH intensity and of overall MEDIUM significance. It is highly probable that the impact would occur and the degree of confidence of the assessment for this fishery is high.

| ***Environmental Impact Assessment of Fisheries: Pelagic Long-Line*** | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Regional | Regional |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | High | High |
| **Significance** | Medium | Medium |
| **Status** | Negative | Negative |
| **Probability** | Highly Probable | Highly Probable |
| **Confidence** | High | High |

## 4.6 South Coast Rock Lobster

The South Coast rock lobster fishery is a deep-water long-line trap fishery. Barrel-shaped plastic traps are set for periods ranging from 24 hours to several days. Each vessel typically hauls and resets approximately 2 000 traps per day in sets of 100 to 200 traps per line. They will set between ten lines and 16 lines per day, each of which may be up to 2 km in length. Each line will be weighted to lie along the seafloor and will be 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 that have on-board freezing capacity will remain at sea for up to 40 days per trip, while those retaining live catch will remain at sea between seven and 10 days before discharging at port. The fishery operates year-round with the month of October showing relatively low activity within the fishery. There are currently (2012) seven vessels operating within the fishery.

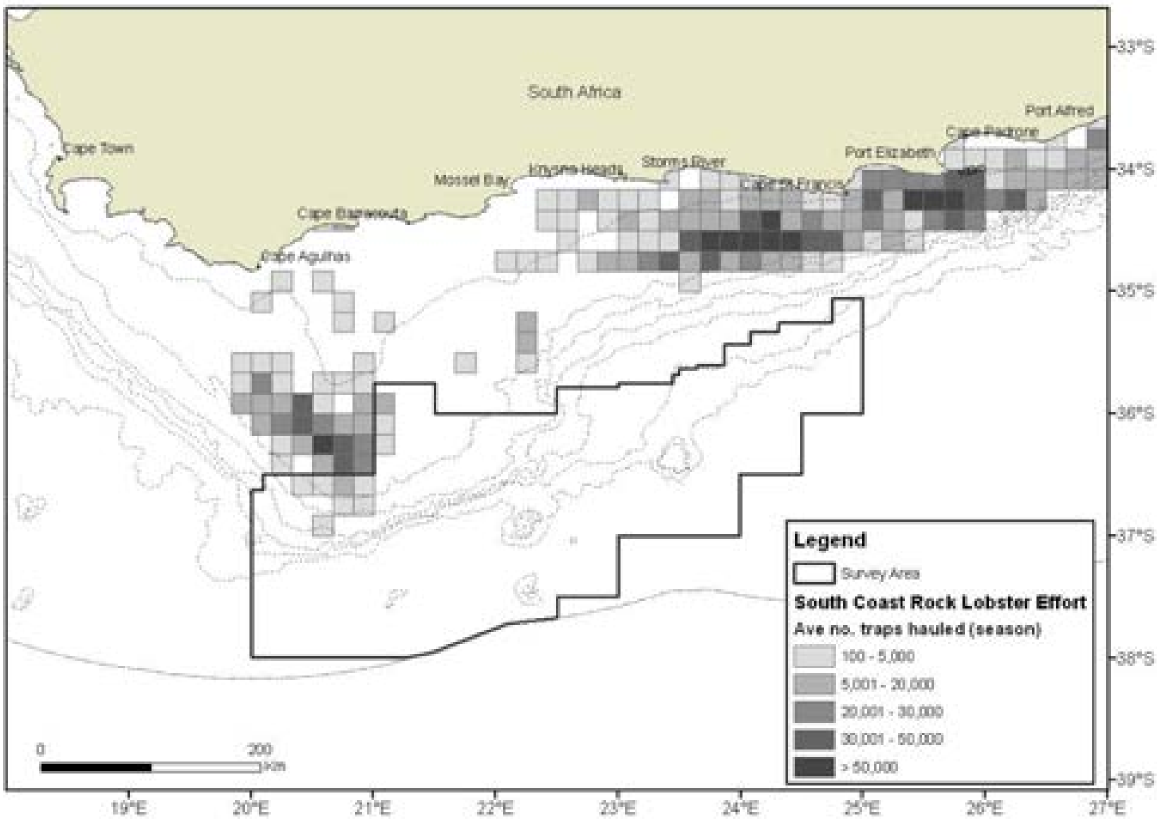


**Figure 16**. Distribution of the South Coast rock lobster trap fishery in relation to the proposed survey area. Data are presented as the average annual number of traps hauled on a 10' by 10' grid basis for the period 2001 to 2008.

South Coast Rock Lobster (*Palinurus gilchristi*) occurs on the continental shelf of the South Coast between depths of 50 m and 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 (see Figure 16). The fishery is restricted by the Agulhas

Current from operating far offshore. The proposed survey area coincides with approximately 278 $km^2$ of South Coast rock lobster fishing grounds on the Agulhas Bank. Within the proposed survey area an average of 93 500 traps were set per annum between 2001 and 2008. This is approximately 3.4 % of the total effort conducted within South African waters by the South Coast rock lobster fishery. The catch of rock lobster taken from the area amounted to 13.3 tons (tail) which is 3.6 % of the total catch taken by the fishery.

The impact of the proposed survey operations on the South Coast rock lobster fishery is considered to be of local extent and short-term duration. The status of the impact is assessed to be negative, of MEDIUM intensity and of overall VERY LOW significance. It is highly improbable that the impact would occur and the degree of confidence of the assessment for this fishery is high.

| ***Environmental Impact Assessment of Fisheries: South Coast Rock Lobster*** | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local | Local |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | Medium | Medium |
| **Significance** | Very Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Probable | Probable |
| **Confidence** | High | High |

### 4.7 Traditional Line Fishery

The traditional line fishery is based on approximately 35 species. Different assemblages of species are targeted according to the region in which they are being fished and include tuna species, sparidae, serranidae, caragidae, scombridae and sciaenidae. On the West Coast the dominant species targeted is snoek (*Thyrsites atun*). This fishery comprises recreational, commercial and subsistence sectors, jointly landing approximately 14 100 tons per annum (2009). Historically, the sector incorporated the tuna pole fishery and was ranked third according to volume of landings and overall economic value. Currently, the volume of fish caught by the traditional line fishery is much lower than many other commercial sectors, but is one of the most important in terms of the number of active participants. Almost all of the traditional line fish catch is consumed locally.

The commercial 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. Gear consists of hand line or rod-and-reel. Recreational permit-holders fish via skiboat (fast motor boats) 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 thewide operational range, the line fishery is managed on an effort basis, rather than on a catch basis. There are currently about 450 commercial vessels operating extensively around the coast and many more skiboats used in the recreational sector which may be launched from a number of slipways and harbours.

On the South and East Coast, vessels are restricted in range due to the fast-flowing Agulhas Current to a water depth of approximately 100 m (see Figure 17). As such, the fishery does not coincide with the proposed survey area and is not expected to be impacted by seismic operations. The degree of confidence of the assessment for this fishery is high.

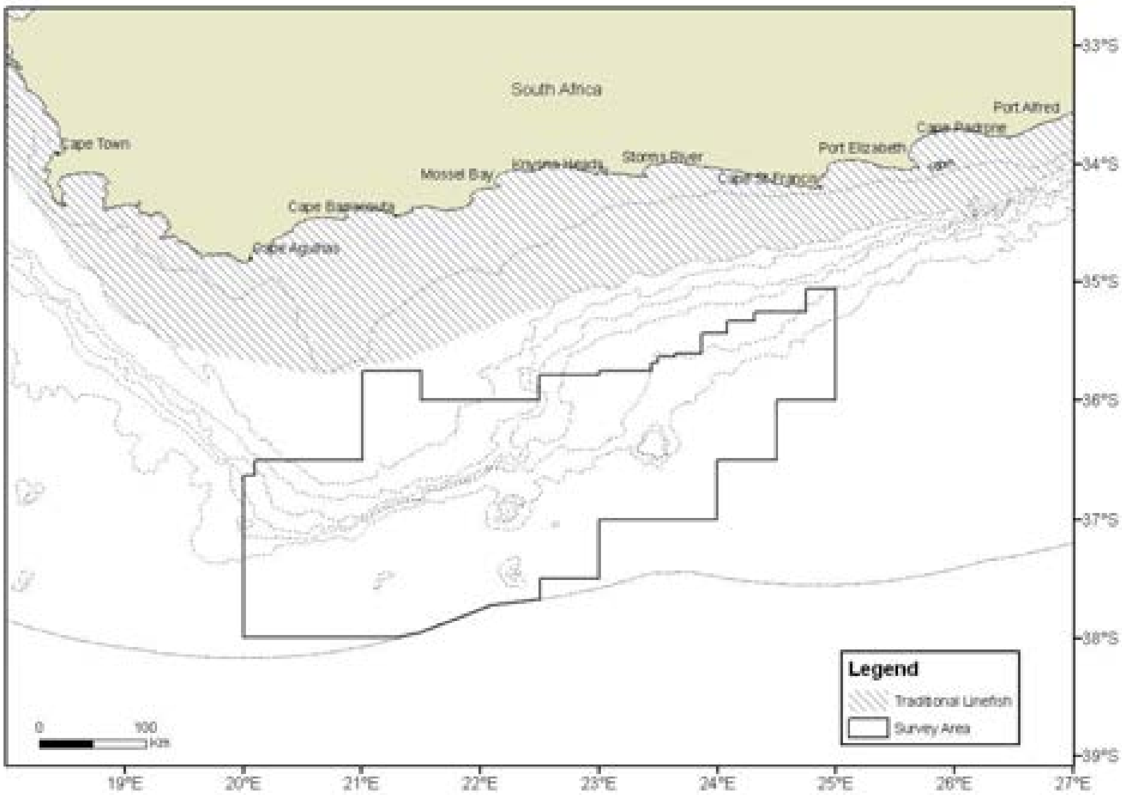


**Figure 17**. Approximate range of traditional line and hake hand-line fisheries in relation to the proposed survey area.

## 4.8 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 18). The fishery is seasonal, with most effort conducted between November and March. The method of fishing involves hand-held jigs and bright lights which are used to attract squid at night. The catch is frozen at sea or at land-based facilities at harbours between Plettenberg Bay and Port Alfred.

The squid fishery is managed in terms of the Total Allowable Effort (TAE) allowed within the fishery and also sees an annual four week closure between October and November during which time DAFF undertakes a survey on spawning aggregations in the bay areas. Fishing rights were issued to 121 companies for the period 2006 to 2013 with the number of crew and vessels active within the fishery listed as 2422 and 136 respectively. A maximum landed catch of 12 000 tons was recorded in 2003/4 with a leveling-off thereafter to 9 000 tons between 2005 and 2008. The annual average catch value is approximately R180 million.

The grounds for the squid fishery lie well inshore of the proposed survey area and there is therefore no impact expected on the fishery. The degree of confidence in this assessment is high.

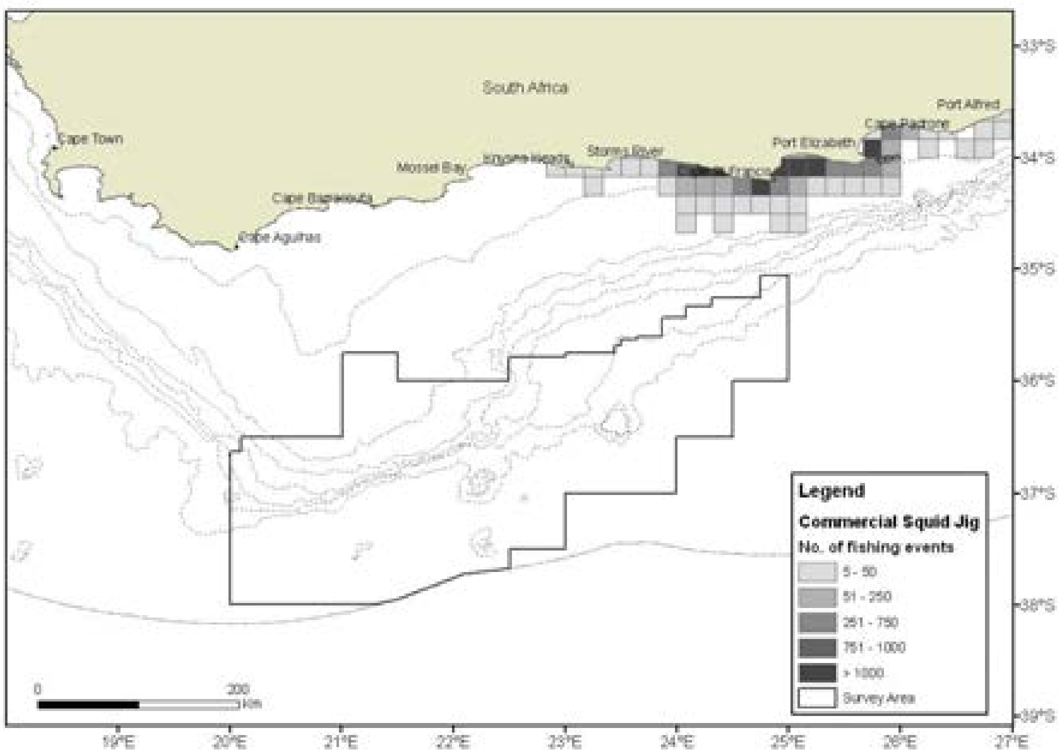


**Figure 18**. Distribution of the squid jig fishery in relation to the proposed survey area

## 5.0 FISHERIES RESEARCH

A survey of demersal fish resources is carried out on the South Coast twice a year by DAFF in order to set the annual TACs for demersal fisheries. 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 survey vessel *FRS Africana* is the dedicated research vessel used to conduct both surveys. A similar gear configuration is used 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 coast to the 1 000 m bathycontour. The South Coast surveys usually last one month each, and take place in May and September. It is expected that demersal surveys would coincide with the proposed survey area if the survey were to take place during May or September, but since the position of research trawls is random, the research survey design could avoid areas of seismic survey activity.

The biomass of small pelagic species is assessed bi-annually by an acoustic survey during November and April. The survey vessel travels pre-determined transects (perpendicular to bathycontours) running from the coast out to approximately the 200 m bathycontour. The survey is designed to cover an area extensive area from the Orange River on the West Coast to Port Alfred on the South Coast and the survey vessel *FRS Africana* progresses systematically from the Northern border Southwards, around Cape Agulhas and on towards the East. The timings of the demersal and acoustic surveys are not flexible, due to restrictions with availability of the research vessel as well as scientific requirements.

The impact of the proposed survey operations on the demersal and acoustic research surveys is considered to be of regional extent and short-term duration. The status of the impact is assessed to be negative, of MEDIUM intensity and of overall LOW significance. It is highly improbable that the impact would occur and the degree of confidence of the assessment is high[2].

| ***Environmental Impact Assessment of Fisheries: Demersal and Acoustic Research Surveys*** | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Regional | Regional |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | Medium | Medium |
| **Significance** | Low | Low |
| **Status** | Negative | Negative |
| **Probability** | Probable | Probable |
| **Confidence** | High | High |

[2]Note that due to problems with the administration of the research fleet, no surveys were conducted in 2012

The intensity of the impact could be lowered through effective mitigation measures and the most effective means of mitigation would be the timing of seismic survey operations to avoid periods during which research survey activity would be conducted. It is recommended that the managers of the research survey programmes be involved during the planning stages of the seismic survey in order to negotiate the timing of transects or trawls to avoid conflict between the seismic and research survey operations. The relevant contacts at DAFF currently responsible for the planning of the demersal and acoustic cruises are Deon Durholtz (DeonD@nda.agric.za) and Janet Coetzee (JanetC@nda.agric.za) respectively.

## 6.0 SUMMARY AND RECOMMENDATIONS

Five commercial fisheries have been identified as being active in the vicinity of the proposed survey area and could potentially be impacted by seismic operations (Table 2).

- A significant amount of activity within the demersal long-line and trawl fisheries (both targeting Cape hakes) takes place within the proposed survey area. Long-line fishing grounds are situated along the 500 m bathycontour and extending to a depth of 900 m within the proposed survey area. Trawlers would be expected to occur between the 200 m and 900 m depth contours. Both fisheries are active all year round.

- Long-line vessels targeting pelagic tuna species, swordfish and shark operate extensively around the entire coast along the shelf-break and into deeper waters. As such vessel activity would be expected to be encountered within the survey area offshore of the 200 m bathycontour. Since the gear used by this fishery consists of surface-set drifting lines of up to 100 km in length, this fishery would be highlighted as posing a potential hazard to the seismic operation in terms of gear entanglements. Note that the datasets for the tuna-directed and historical shark-directed fisheries have been combined in this assessment as similar gear types are used in both sectors. Shark-directed pelagic long-line vessels fish shallower than tuna-directed long-line vessels.

- With respect to the research cruises undertaken by DAFF, demersal surveys and acoustic surveys are undertaken within the survey area four times per year. The potential impact of the seismic survey operations on the demersal and acoustic research is considered to be medium (low significance) if the research survey areas of operation coincide with seismic survey areas.

The following recommendations are proposed in order to minimize disruptions to both the survey and fishing operations:

1. Prior to the commencement of the survey, the fishing industry, DAFF (Branch: Fisheries) and other IAPs should be consulted and informed of the pending activity and the likely implications for the various fishing sectors in the area as well as research surveys planned to coincide with the proposed seismic operations. IAPs should include; South African Deepsea Trawling Industry Association (SADSTIA), South East Coast Inshore Fishery Association (SECIFA), Small Hake Quota Holders Association, South African Tuna Longline Association, Hake Longline Association, South Coast Rock Lobster Association and Blue Continent Products.
2. It is recommended that the survey vessel be accompanied by at least one chase boat. An experienced Fisheries Liaison Officer (FLO) should be deployed on board either the survey vessel or chase boat to facilitate communication with maritime vessels. In the case where an FLO is not deployed, the on-board Marine Mammal Observer should be familiar with fisheries operational in the area.
3. The Observer should report daily on vessel activity and respond and advise on action to be taken in the event of encountering fishing gear and the survey vessel's potential impacts on marine fauna.
4. A daily electronic reporting routine should be set up to keep interested and affected parties informed of survey activity, fisheries interactions and environmental issues.

In terms of fishing sector-specific communications, the following mitigation measures are recommended:

1. **Pelagic Long-line**: Establish communications with the known operators if drifting buoys (with radar responders) are sighted.
2. **Demersal Long-line**: Identify gear (marked at each end by a surface buoy) - demersal long-liners generally stay close to their lines when gear is deployed and communication with skippers on the position of set gear is essential.
3. **Demersal and Mid-Water Trawl**: Identify vessels – due to proximity to trawl grounds, notification of survey areas of operation is essential. With good communication and reduced time in the area disruption of fishing activity can be minimised.
4. **South Coast Rock Lobster Trap**: Establish a direct line of communication with operators and proposed trap areas – sectors of the fishing area will need to be closed when doing 3D and will have a significant impact on both the seismic operator and the fisher if fouling occurs. This will require negotiation with the fishing companies.

**Table 2**. Summary table showing impact ratings of the proposed offshore seismic survey on the fishing industry and fisheries research cruise both with and without mitigation measures.

| | Extent | Duration | Intensity | Significance | Probability | Confidence |
|---|---|---|---|---|---|---|
| ***Environmental Impact Assessment of Fisheries: Safety zone during proposed survey operations*** | | | | | | |
| ***Demersal Trawl*** | | | | | | |
| Without mitigation | Local | Short-term | Medium | Very Low | Highly Probable | High |
| With mitigation | Local | Short-term | Medium | Very Low | Highly Probable | High |
| ***Mid-Water Trawl*** | | | | | | |
| Without mitigation | Local | Short-term | Medium | Very Low | Highly Probable | High |
| With mitigation | Local | Short-term | Medium | Very Low | Highly Probable | High |
| ***Demersal Longline (Hake-directed)*** | | | | | | |
| Without mitigation | Local | Short-term | Medium | Very Low | Highly Probable | High |
| With mitigation | Local | Short-term | Medium | Very Low | Highly Probable | High |
| ***Pelagic Longline*** | | | | | | |
| Without mitigation | Regional | Short-term | High | Medium | Highly Probable | High |
| With mitigation | Regional | Short-term | High | Medium | Highly Probable | High |
| ***South Coast Rock Lobster*** | | | | | | |
| Without mitigation | Local | Short-term | Medium | Very Low | Probable | High |
| With mitigation | Local | Short-term | Medium | Very Low | Probable | High |
| ***Demersal and acoustic research surveys*** | | | | | | |
| Without mitigation | Regional | Short-term | Medium | Low | Probable | High |
| With mitigation | Regional | Short-term | Medium | Low | Probable | High |

*APPENDIX 1*

*CONVENTION FOR ASSIGNING SIGNIFICANCE RATINGS TO IMPACTS*

The following convention was used to determine significance ratings in the assessment:

| Rating | Definition of Rating |
|---|---|
| ***Extent – defines the physical extent or spatial scale of the impact*** | |
| LOCAL | Extending only as far as the activity, limited to the site and its immediate surroundings. Specialist studies to specify extent. |
| REGIONAL | e.g. South-East Coast |
| NATIONAL | South Africa |
| INTERNATIONAL | Extending beyond the borders of South Africa |
| ***Duration – the time frame over which the impact will be experienced*** | |
| SHORT TERM | 0 - 5 years |
| MEDIUM TERM | 6 - 15 years |
| LONG TERM | Where the impact would cease after the operational life of the activity, either because of natural processes or by human intervention. |
| PERMANENT | Where mitigation either by natural processes or by human intervention would not occur in such a way or in such time span that the impact can be considered transient. |
| ***Intensity – establishes whether the magnitude of the impact is destructive or benign in relation to the sensitivity of the receiving environment*** | |
| Zero to Very Low | Where fishing operations are not affected. |
| LOW | Where fishing operations continue, albeit in a slightly modified way. |
| MEDIUM | Where fishing operations continue, albeit in a modified way. |
| HIGH | Where fishing operations are altered to the extent that they temporarily or permanently cease. |
| ***Status – describes whether the impact would have a negative, positive or zero effect on the affected environment*** | |
| POSITIVE | The impact benefits fishing operations |
| NEGATIVE | The impact results in a cost to the fishing industry |
| NEUTRAL | The impact has no effect |
| ***Probability – the likelihood of the impact occurring*** | |
| IMPROBABLE | Where the possibility of the impact to materialise is very low either because of design or historic experience. |
| PROBABLE | Where there is a distinct possibility that the impact would occur. |
| HIGHLY PROBABLE | Where it is most likely that the impact would occur. |
| DEFINITE | Where the impact would occur regardless of any preventive measures. |

| *Degree of confidence in impact predictions – based on available information and specialist knowledge* | |
|---|---|
| LOW | Less than 35% sure of impact prediction. |
| MEDIUM | Between 35% and 70% sure of impact prediction. |
| HIGH | Greater than 70% sure of impact prediction. |

Using core criteria above, the significance of the impact is determined:

| Rating | Definition of Rating |
|---|---|
| ***Significance – attempts to evaluate the importance of a particular impact, and in doing so incorporates extent, duration and intensity*** | |
| VERY HIGH | Impacts could be EITHER:<br>of ***high intensity*** at a ***regional level***and endure in the ***long term***;<br>OR of ***high intensity*** at a ***national level*** in the ***medium term***;<br>OR of ***medium intensity*** at a ***national level***in the ***long term.*** |
| HIGH | Impacts could be EITHER:<br>of ***high intensity*** at a ***regional level*** and endure in the ***medium term***;<br>OR of ***high intensity*** at a ***national level*** in the ***short term***;<br>OR of ***medium intensity*** at a ***national level*** in the ***medium term;***<br>OR of ***low intensity*** at a ***national level*** in the ***long term***;<br>OR of ***high intensity*** at a ***local level*** in the ***long term***;<br>OR of ***medium intensity*** at a ***regional level*** in the ***long term.*** |
| MEDIUM | Impacts could be EITHER:<br>of ***high intensity*** at a ***local level*** and endure in the ***medium term***;<br>OR of ***medium intensity*** at a ***regional level*** in the ***medium term***;<br>OR of ***high intensity*** at a ***regional level*** in the ***short term***;<br>OR of ***medium intensity*** at a ***national level*** in the ***short term***;<br>OR of ***medium intensity*** at a ***local level*** in the ***long term***;<br>OR of ***low intensity*** at a ***national level*** in the ***medium term;***<br>OR of ***low intensity*** at a ***regional level***in the ***long term.*** |
| LOW | Impacts could be EITHER<br>of ***low intensity*** at a ***regional level*** and endure in the ***medium term***;<br>OR of ***low intensity*** at a ***national level*** in the ***short term***;<br>OR of ***high intensity*** at a ***local level*** and endure in the ***short term***;<br>OR of ***medium intensity*** at a ***regional level*** in the ***short term***;<br>OR of ***low intensity*** at a ***local level*** in the ***long term***;<br>OR of ***medium intensity*** at a ***local level*** and endure in the ***medium term.*** |
| VERY LOW | Impacts could be EITHER<br>of ***low intensity*** at a ***local level*** and endure in the ***medium term***;<br>OR of ***low intensity*** at a ***regional level*** and endure in the ***short term***;<br>OR of ***low to medium intensity*** at a ***local level*** and endure in the ***short term.*** |
| INSIGNIFICANT | Impacts with:<br>Zero or Very Low intensity with any combination of extent and duration. |
| UNKNOWN | In certain cases it may not be possible to determine the significance of an impact. |

Additional criteria to be considered, which could “increase” the significance rating are:

- Permanent / irreversible impacts (as distinct from long-term, reversible impacts);
- Potentially substantial cumulative effects; and
- High level of risk or uncertainty, with potentially substantial negative consequences.

Additional criteria to be considered, which could “decrease” the significance rating are:

- Improbable impact, where confidence level in prediction is high.

When assigning significance ratings to impacts *aftermitigation*, the specialist needs to:

- First, consider probable changes in intensity, extent and duration of the impact after mitigation, assuming effective implementation of mitigation measures, leading to a revised significance rating; and
- Then moderate the significance rating after taking into account the likelihood of proposed mitigation measures being effectively implemented. Consider:

    - Any potentially significant risks or uncertainties associated with the effectiveness of mitigation measures;
    - The technical and financial ability of the proponent to implement the measure; and
    - The commitment of the proponent to implementing the measure, or guarantee over time that the measures would be implemented.

The significance ratings are based on largely objective criteria and inform decision-making at a project level as opposed to a local community level. In some instances, therefore, whilst the significance rating of potential impacts might be “low” or “very low”, the importance of these impacts to local communities or individuals might be extremely high. The importance which I&APs attach to impacts must be taken into consideration, and recommendations should be made as to ways of avoiding or minimising these negative impacts through project design, selection of appropriate alternatives and / or management.

The relationship between the significance ratings after mitigation and decision-making can be broadly defined as follows:

| ***Significance after mitigation – considering changes in intensity, extent and duration after mitigation and assuming effective implementation of mitigation measures, the effect on decision-making:*** | |
|---|---|
| Very Low; Low | Will not have an influence on the decision to proceed with the proposed project, provided that recommended measures to mitigate negative impacts are implemented. |
| Medium | Should influence the decision to proceed with the proposed project, provided that recommended measures to mitigate negative impacts are implemented. |
| High; Very High | Would strongly influence the decision to proceed with the proposed project. |

# APPENDIX 3.2

# MARINE FAUNAL ASSESSMENT

# ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT FOR A 2D SEISMIC SURVEY, SONAR BATHYMETRY AND DROP CORE SAMPLING OFF THE SOUTH COAST OF SOUTH AFRICA

## Marine Faunal Assessment

**Prepared for:**

cca ENVIRONMENTAL

**On behalf of**

**TOTAL E&P South Africa (Pty) Ltd**

**October 2012**

PISCES Environmental Services (Pty) Ltd

# ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT FOR A SPECULATIVE 2D SEISMIC SURVEY OFF THE SOUTH COAST OF SOUTH AFRICA

## MARINE FAUNAL ASSESSMENT

Prepared for

CCA Environmental (Pty) Ltd

Prepared by

Andrea Pulfrich
Pisces Environmental Services (Pty) Ltd

October 2012

Contact Details:


Andrea Pulfrich

Pisces Environmental Services

PO Box 31228, Tokai 7966, South Africa,

Tel: +27 21 782 9553, Fax: +27 21 782 9552

E-mail: apulfrich@pisces.co.za

Website: www.pisces.co.za

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## ABBREVIATIONS and UNITS

| | |
|---|---|
| CCA | CCA Environmental (Pty) Ltd |
| cm | centimetres |
| CMS | Centre for Marine Studies |
| CSIR | Council for Scientific and Industrial Research |
| dB | decibells |
| EMP | Environmental Management Programme |
| GAENP | Greater Addo Elephant National Park |
| h | hour |
| Hz | Herz |
| IUCN | International Union for the Conservation of Nature |
| kHz | kiloHerz |
| km | kilometre |
| $km^2$ | square kilometre |
| KZN | KwaZulu-Natal |
| M&CM | Marine & Coastal Management: Department of Environment Affairs |
| MMO | Marine Mammal Observer |
| MPA | Marine Protected Area |
| m | metres |
| m/sec | metres per second |
| PAM | Passive Acoustic Monitoring |
| ppt | parts per thousand |
| PTS | permanent threshold shifts |
| rms | root mean squared |
| S | south |
| TTS | temporary threshold shifts |
| 2D | two-dimensional |
| 3D | three-dimensional |
| µg/l | micrograms per litre |
| µPa | micro Pascal |
| °C | degrees Centigrade |
| % | percent |
| ~ | approximately |
| < | less than |
| > | greater than |

PTS — Permanent threshold shift is a raising of the hearing threshold from over-exposure to high-level sound; but, in this case, permanent damage occurs to the inner ear sensory mechanisms and hence the shift is non-reversible.

TTS — Temporary threshold shift is the temporary raising of hearing threshold resulting from exposure to high-level sounds. This is the lowest end of the physical effects scale, which is a temporary, reversible form of hearing impairment. In TTS, the lower threshold of hearing in the relevant frequency band is increased (*i.e.* hearing becomes less sensitive) when exposed to a critical combination of sound intensity and duration.

## EXPERTISE AND DECLARATION OF INDEPENDENCE

This report was prepared by Dr Andrea Pulfrich of Pisces Environmental Services (Pty) Ltd. Andrea has a PhD in Fisheries Biology from the Institute for Marine Science at the Christian-Albrechts University, Kiel, Germany.

As Director of Pisces since 1998, Andrea has considerable experience in undertaking specialist environmental impact assessments, baseline and monitoring studies, and Environmental Management Programmes / Plans relating to marine diamond mining and dredging, hydrocarbon exploration and thermal/hypersaline effluents. She is a registered Environmental Assessment Practitioner and member of the South African Council for Natural Scientific Professions, South African Institute of Ecologists and Environmental Scientists, and International Association of Impact Assessment (South Africa).

This specialist report was compiled on behalf of CCA Environmental (Pty) Ltd for their use in preparing an Environmental Management Plan for a proposed speculative 2D seismic survey by Total E&P South Africa (Pty) Ltd, offshore of the South Coast of South Africa. I do hereby declare that Pisces Environmental Services (Pty) Ltd is financially and otherwise independent of the Applicant and CCA Environmental.

Andrea Pulfrich

Dr Andrea Pulfrich

# 1. GENERAL INTRODUCTION

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

Seismic survey programmes comprise data acquisition in either two-dimensional (2D) and/or three dimensional (3D) scales, depending on information requirements. 2D surveys are typically applied to obtain regional data from widely spaced survey grids and provide a vertical slice through the seafloor geology along the survey track-line. Infill surveys on closer grids subsequently provide more detail over specific areas of interest. In contrast, 3D seismic surveys are conducted on a very tight survey grid, and provide a cube image of the seafloor geology along each survey track–line. Such surveys are typically applied to promising petroleum prospects to assist in fault line interpretation.

The nature of the sound impulses utilised during seismic surveys have resulted in concern over their potential impact on marine fauna, particularly marine mammals, fish, and turtles (McCauley *et al*. 2000). Consequently, it has been proposed that environmental management already be applied at the exploration stage of the life cycle of a hydrocarbon field project (Duff *et al*. 1997, in Salter & Ford 2001).

For this investigation TOTAL E&P South Africa (Pty) Ltd (Total) is proposing to undertake a speculative 2D seismic, swath sonar and core-drill survey over a number of licence blocks in the Outeniqua South Area off the South Coast of South Africa. CCA Environmental (Pty) Ltd (CCA) has been appointed by Total to compile the Environmental Management Plan (EMP) to be submitted as part of the application for an exploration right to undertake the survey. CCA in turn has approached Pisces Environmental Services (Pty) Ltd to provide a specialist report on potential impacts of the proposed operations on marine fauna in the area.

## 1.1. Scope of Work

This specialist report was compiled as a desktop study on behalf of CCA, for their use in preparing an EMP for a proposed 2D seismic survey, swath sonar survey and core-drill sampling off the South Coast of South Africa.

The terms of reference for this study, as specified by CCA, are:

- Provide a general description of the local marine fauna in and around the proposed seismic area.
- Identify, describe and assess the significance of potential impacts of the proposed seismic, sonar and coring surveys on the local marine fauna, focussing particularly on marine mammals, fish and penguins, but including generic effects on fish eggs and larvae, and pelagic and benthic invertebrates.
- Identify practicable mitigation measures to reduce any negative impacts and indicate how these could be implemented in the implementation and management of the proposed project.

## 1.2. Approach to the Study

As determined by the terms of reference, this study has adopted a 'desktop' approach. Consequently, the description of the natural baseline environment in the study area is based on a review and collation of existing information and data from the scientific literature, internal reports and the Generic Environmental Management Programme Report (EMPR) compiled for oil and gas exploration in South Africa (CCA & CMS 2001). The information for the identification of potential impacts and the assessment thereof was drawn from various scientific publications, the Generic, information sourced from the Internet as well as Marine Mammal Observer close-out Reports. The sources consulted are listed in the Reference chapter.

All identified marine and coastal impacts are summarised, categorised and ranked in an appropriate impact assessment table, to be incorporated in the overall EMP.

# 2. DESCRIPTION OF THE PROPOSED PROJECT

Total is applying for a reconnaissance permit to undertake a speculative two-dimensional (2D) seismic to investigate for oil and gas reserves in a number of petroleum licence blocks off the South Coast of South Africa. A swath bathymetry sonar survey and seabed drop-core sampling are also proposed.

## 2.1. Seismic Survey

The proposed 2D seismic survey would be approximately 7,000 km in length comprising a number of widely spaced survey lines covering covering an area of approximately 76,060 $km^2$ within the Outeniqua South Block (see Figure 1). The seismic survey is planned to commence in November 2013 and would take in the order of 70 – 90 days to complete.

A single solid streamer of up to 12,000 m would be towed below the sea surface. The streamer would therefore not be visible, except for the tail-buoy at the terminal end of the cable. A single active gun would be used. The operating pressure of the airgun would be 4,000 to 5,000 pound per square inch (psi). The airgun sound source would be situated 100 - 200 m behind the vessel at a depth of 6-10 m below the surface.

The survey vessel would steam a series of predefined transects describing the survey grid, the headings of which would be fixed and reciprocal. During surveying the seismic vessel would travel at a speed of between four and six knots and the sound sources would be "fired" by the airgun array. As the survey vessel would be restricted in manoeuvrability (a turn radius of 4.5 km is expected), other vessels should remain clear of it. A supply/chase vessel usually assists in the operation of keeping other vessels at a safe distance.

Each triggering of a sound pulse is termed a seismic shot, and these are fired at intervals of 6 - 20 seconds (depending on water depth and other environmental characteristics) (Barger & Hamblen 1980). Each seismic shot is usually only between 5 and 30 milliseconds in duration, and despite peak levels within each shot being high, the total energy delivered into the water is low.

Airguns have most of their energy in the 5-300 Hz frequency range, with the optimal frequency required for deep penetration seismic work being 50-80 Hz. The maximum sound pressure levels at the source of airgun arrays in use today in the seismic industry are in the range 230-255 dB re 1 µPa at 1 m, with the majority of their produced energy being low frequency of 10-100 Hz (McCauley 1994; NRC 2003). The location where this level of sound is attained is directly beneath the airgun array, generally near its centre, but the exact location and depth beneath the array are dependent on the detailed makeup of the array, the water depth, and the physical properties of the seafloor (Dragoset 2000).

## 2.2. Geophysical Sonar Survey

Having identified specific target areas with the 2D seismic acquisition, a high resolution sonar survey would subsequently be conducted, followed by drop core sampling (see Section 2.3 below). These surveys are scheduled for November 2014, with an estimated duration of 30 to 45 days.

The geophysical tools that would be implemented for the survey are provided in Table 2.1.

Table 2.1: Specifications of acoustic equipment to be utilised in the proposed sonar survey.

| Type | Frequency (kHz) | Sound duration (secs) | Source level (dB re 1 μPa at 1m) |
|---|---|---|---|
| Chirp sub - bottom profiler | 0.4 - 30 | 0.1 - 160 | 200 - 230 |
| Side Scan Sonar | 50 -500 | 0.01 – 0.1 | 220 - 230 |
| Depth sounders | 12 - 200 | >0.025 | 180+ |
| Fish Finders | 20 - 30 | >0.025 | 216 – 223 |
| Multibeam | 92 -98 | 0.02 | Up to 235 |
| Seismic airgun | 0.001 - 1 | <1 | 216 - 260 |

Multibeam technology is a complex sonar array that allows surveying of the seafloor beyond typical shelf depths (~>200m) at a resolution and accuracy sufficient to image the typical scale of active seafloor seeps. This technology allows for highly accurate imaging and mapping of seafloor topography in the form of digital terrain models.

These bathymetric data alone are not sufficient to identify all possible hydrocarbon seeps, as many seeps have no bathymetric expression. Backscatter data in contrast can measure several properties of the seafloor associated with hydrocarbon seeps including; hardness; roughness; and volumetric heterogeneity. One or more of these three properties can result in an increase in backscatter intensity recorded in by the multibeam system and aid in the identification of potential natural hydrocarbon seeps on the seafloor in the survey area. Backscatter data can be collected with both multibeam echosounders and side-scan sonars.

Chirp seismic systems in contrast are powerful echo-sounders, where the sound source penetrates the seabed up to 60 m beneath the seafloor thereby providing a profiles of the deeper sediment layers.

The data acquired by these sonar techniques would be used to identify, prioritize, and target potential piston coring locations. Selected sites would then be sampled with navigated piston cores 6 to 9 meters in length (an estimated 150-200 cores would potentially be taken, depending on survey results). The final location of the surveys within the block, and potential seafloor coring sites can only be evaluated once the data have been acquired.

The operating frequencies of the acoustic equipment used in sonar surveys typically fall into the high frequency kHz range, and are thus well beyond the hearing abilities of marine fauna.

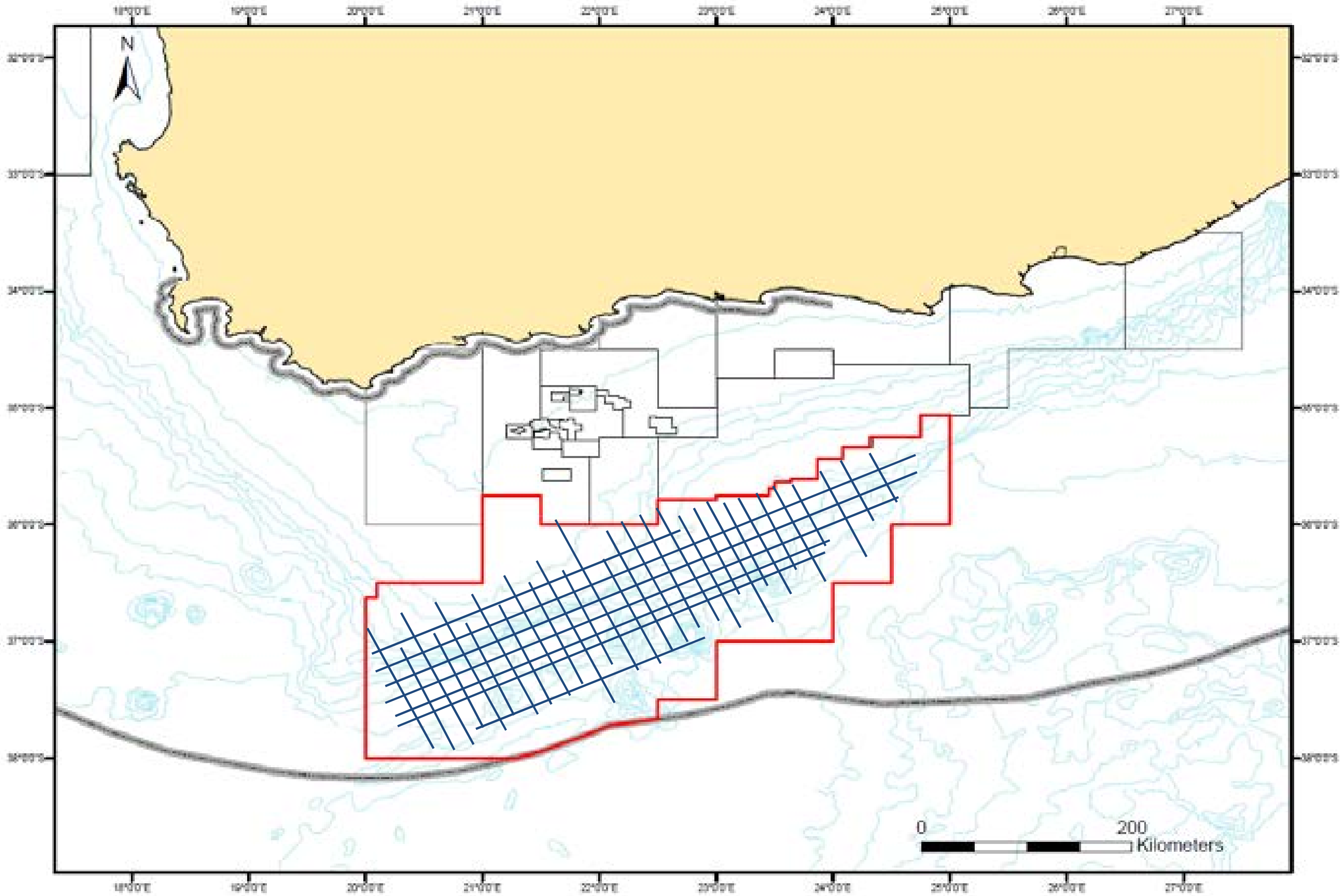


Figure 1: Proposed survey area (red outline) and 2D survey lines (black) on the South Coast of South Africa.

## 2.3. Seabed Drop-core Survey

Having identified possible locations of natural hydrocarbon seeps on the seafloor using multibeam bathymetry, backscatter and sub-bottom profiles, targeted piston coring would be undertaken. Piston coring is one of the more common seabed sampling methods, with the sequence of operation illustrated in Figure 2. The piston coring operation is carried out by winching the tool over the side of the vessel and lowering the corer to just above the seabed (A). As the trigger weight hits the bottom (B), it releases the weight on the trigger arm and the trigger arm begins to rise. Once the trigger arm has risen through its full 1.2 m of travel (C), the corer is released to "free-fall" the 3 m distance to the bottom, forcing the core barrel to travel down over the piston into the sediment. When the corer hits the end of its 3 m slack loop, the piston starts up the core barrel (D) creating suction below the piston, and expelling the water out the top of the corer. When forward momentum of the core has stopped, a slow pullout on the winch is begun. The suction created by the core sample in the liner prevents movement of the piston to the top of the core barrel in response to tension on the core wire. This suction triggers the separation of the top and bottom sections of the piston (E). The bottom half of the piston remains in place over the sediment to maintain integrity of the sample, while the top half (attached to the coring wire) "fetches up" against the stop in the core head, allowing the corer to be pulled out of the sediment and the sample to be hauled onboard. The recovered cores are visually examined at the surface for indications of hydrocarbons (gas hydrate, gas parting, or oil staining) and sampled for geochemical analysis.

Typically core barrels are 6 – 9 m in length, with a diameter of 100 mm. It is proposed to take in the order of 150 to 200 cores.

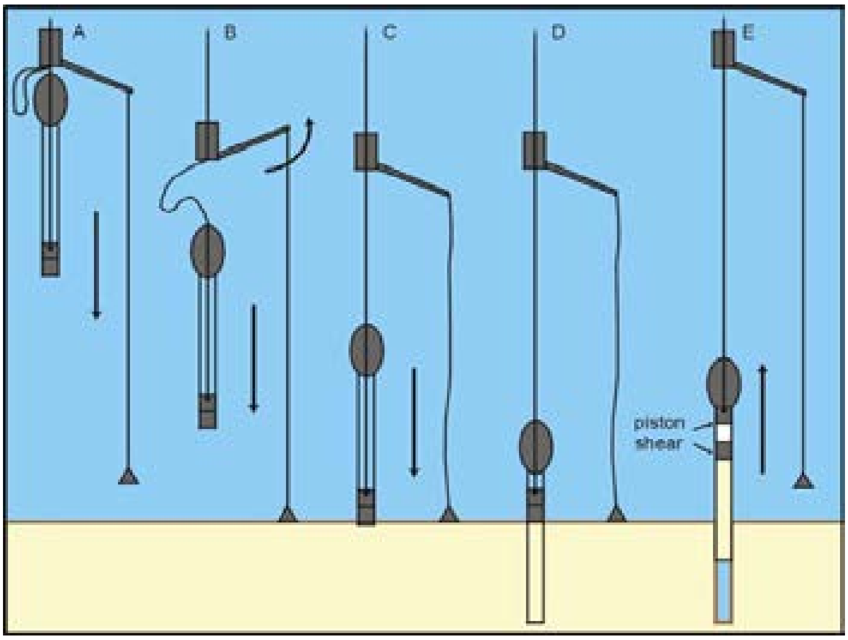


Figure 2: Schematic of the piston core operation at the seabed (Source: TDI-Brooks).

# 3. DESCRIPTION OF THE BASELINE MARINE ENVIRONMENT

The proposed survey area is located on the South Coast, stretching between Cape Agulhas in the Western Cape and Cape St Francis in the Eastern Cape. Descriptions of the physical and biological environments are summarised primarily from information provided in the Generic EMPR for Oil and Gas Prospecting off the Coast of South Africa (CCA & CMS 2001).

## 3.1. The Physical Environment

### 3.1.1 Bathymetry and Sediments

The bathymetry of the South Coast is dominated by the Agulhas Bank. From its narrowest point (40 km) on the West Coast between Cape Columbine and Cape Point, the continental shelf widens to the south reaching its apex 250 km offshore on the Agulhas Bank. Between 22° and 26° E, the shelf break indents towards the coast forming the Agulhas 'bight' (Schumann 1998) narrowing eastwards to ~115 km offshore in the region of Algoa Bay. The bathymetry drops steeply at the coast to approximately 50 m, with depth increasing gradually to the shelf break at a depth of 140 m off Port Elizabeth, 130 m off Cape St Francis, and 300 m south of Cape Agulhas (Birch & Rogers 1973). Major bathymetric features on the Agulhas Bank include the Alphard Banks, situated south of Cape Infanta, the Agulhas Arch and Alphard Rise (Birch & Rogers 1973; CCA & CSIR 1998). Outside the shelf break, depth increases rapidly to more than 1,000 m (Hutchings 1994).

The coastline of the South Coast is characterised by a number of capes separated by sheltered sandy embayments.

A large expanse of the mid-shelf region of the Agulhas Bank comprises either rock or areas with sparse sediment cover, with an inner shelf sediment-wedge extending up to 30 km offshore (Birch & Rogers 1973; Schumann 1998). Although mud patches occur inshore east of Cape Infanta and south of Cape Agulhas, the majority of unconsolidated sediment is sand to muddy sand (Birch & Rogers 1973).

### 3.1.2 Water Masses and Circulation

The oceanography of the South Coast is almost totally dominated by the warm Agulhas Current. The current forms between 25° and 30° S, flowing southwards along the shelf edge of the East Coast (Schumann 1998) as part of the anticyclonic Indian Ocean gyre, before retroflecting between 16° and 20° E. 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/sec or more, and water transport rates of over $60 \times 10^6$ $m^3$/sec having been recorded (Pearce *et al.* 1978; Gründlingh 1980). 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. It may also shed eddies, which travel at around 20 cm/sec and advect onto the Agulhas Bank (Swart & Largier 1987). After detaching from the shelf edge at 15° E, the Agulhas Current retroflects and flows eastwards (Schumann 1998)(Figure 3).

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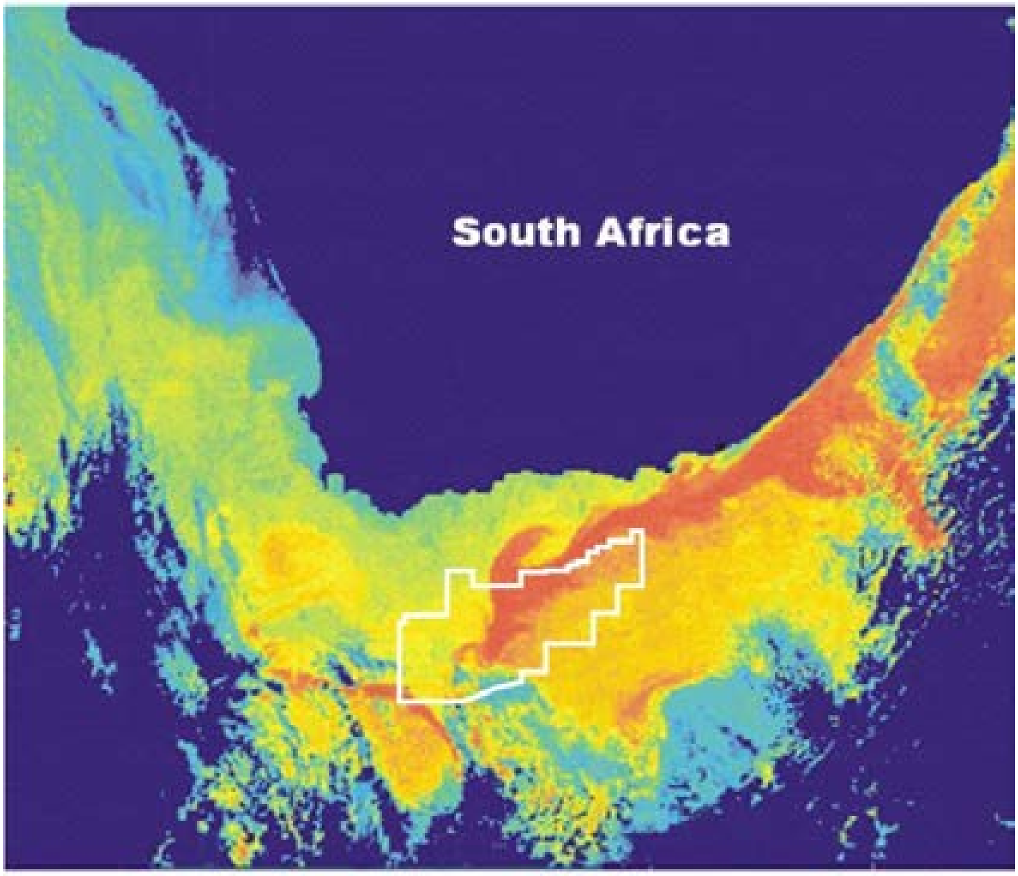


Figure 3: The predominance of the Agulhas current in the oceanography of the proposed survey areas (white outline).

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 midshelf and 10 - 40 cm/sec nearshore. Eastward flow may occur close inshore (Boyd *et al*. 1992; Boyd & Shillington 1994), being particularly strong off 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).

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. The surface waters 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 25º C in summer and 21º 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 14º 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 20º 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. South of Mbashe and East London, a persistent wedge of cooler water is present over the continental shelf during summer (Beckley & Van Ballegooyen 1992), extending northwards to the southern KwaZulu-Natal coast in winter. This wedge is typically cooler than 19° C, but may be cooler than 16° C between East London and Port Alfred, and south of Mbashe. Inshore, waters are warmest during autumn, with warm water tongues found off Cape Recife (near Port Elizabeth) 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).

Strong and persistent thermoclines are common over the shelf, extending inshore during the summer, but breaking down during the cooler and windier winter conditions (Schumann & Beekman 1984; Boyd & Shillington 1994). Thermoclines at the eastern edge of the South Coast are located at 20-40 m depth, whereas they are deeper at the western edge (40-60 m) (Largier & Swart 1987).

### 3.1.3 Upwelling

The predominantly easterly winds during summer result in wind-driven upwelling inshore along the South Coast (Schumann 1998; Schumann *et al*. 1982; Walker 1986), and changes in water temperatures of up to 8° C within a few hours have been reported (Hutchings 1994). Such upwelling usually begins at the prominent capes and progresses westwards (Schumann *et al*. 1982; Schumann *et al*. 1988).

Intensive upwelling of Indian Ocean Central Water also periodically occurs over the shelf and shelf edge, along the inner boundary of the Agulhas Current (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. Such shelf-edge upwelling largely defines the strong thermocline and halocline topography of the Agulhas Bank region, particularly in summer. Cold upwelled water over the shelf edge forms the basal layer on the shelf, while intrusive plumes of more saline surface water replenish the warm mixed water at the surface, resulting in intensive thermo- and haloclines.

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), dividing the waters of the Agulhas Bank into the two-layered structure in the inshore region and a partially mixed structure in the eastern offshore region (Boyd & Shillington 1994).

### 3.1.4 Winds and Swells

Westerly winds predominate along the South Coast 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). The strongest winds are observed at capes, including Agulhas, Infanta, Cape Seal, Robberg and Cape Recife (Jury & Diab 1989). Calm periods are most common in autumn (CSIR & CCA, 1998).

On the South Coast, the majority of waves arrive from the south-west quadrant (Whitefield *et al*. 1983), dominating wave patterns during winter and spring (Carter & Brownlie 1990). Waves from this direction frequently exceed 6 m (Swart & Serdyn 1981, 1982) and can reach up to 10 m (Heydorn 1989). During summer, easterly wind-generated 'seas' occur (Heydorn & Tinley 1980; Heydorn 1989; Carter & Brownlie 1990). Giant waves (>20 m high) that are at times encountered within the Agulhas Current (Heydorn & Tinley 1980). These arise from the meeting of the south-westerly swells and the southerly flowing Agulhas Current, and may be a navigation hazard at times.

## 3.2. The Biological Environment

The majority of the proposed survey area is located beyond the 200 m depth contour, the closest points to shore being just over 100 km offshore of Cape St Francis. Communities within the offshore marine habitat are comparatively homogenous, largely as a result of the greater consistency in water temperature at depths around the South African coastline, than in the shallower coastal waters. Nonetheless, due to the extent of the proposed survey area, it falls within a number of inshore and offshore bioregions (Lombard *et al*. 2004)(Figure 4). The biological communities occurring in the survey area consist of many hundreds of species, often displaying considerable temporal and spatial variability (even at small scales). The deep-water marine ecosystems comprise a limited range of habitats, namely unconsolidated seabed sediments, deep-water reefs and the water column. The biological communities 'typical' of these habitats are described briefly below, focussing both on dominant, commercially important and conspicuous species, as well as potentially threatened species.

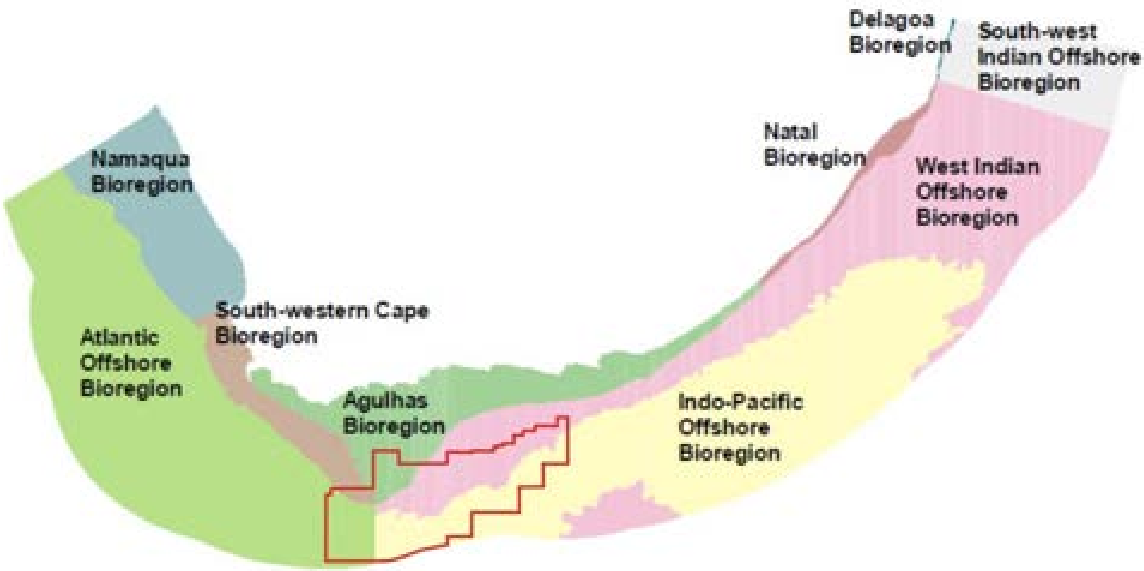


Figure 4: The inshore and offshore bioregions occurring in the proposed survey area (red outline) (adapted from Lombard *et al*. 2004).

### 3.2.1 Phytoplankton

The nutrient-poor characteristics of the Agulhas Current water are reflected in comparatively low primary productivity in the southern portion of the proposed survey area with mean *chlorophyll a* concentrations of 1.46 mg/m$^3$ in the top 30 m of the water column in inshore areas (<200 m depth) dropping to 1.00 mg/m$^3$ further offshore (200 m – 500 m depth)(Brown *et al*. 1991; Brown 1992). *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). 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, phytoplankton concentrations are usually higher than further west and the phytoplankton comprises predominantly large cells (Hutchings 1994).

### 3.2.2 Zooplankton

On the South Coast zooplankton communities have comparatively high species diversity (De Decker 1984), with standing stocks along the eastern half of the South Coast ranging from 3 – 6 gC/m$^2$. The South Coast mesozooplankton (>200 μm) 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). 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. Macrozooplankton (>1600 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).

### 3.2.3 Ichthyoplankton

The Agulhas Bank (particularly the western portion) is an important spawning area for a variety of pelagic species, including anchovy, pilchard, and horse mackerel. East of Cape Agulhas anchovy spawning has been reported between the shelf-edge upwelling and the cold-water ridge, where copepod availability is highest (Hutchings 1994) (Figure 5). 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). Pilchards also spawn on the Agulhas Bank (Crawford 1980), with adults moving eastwards and northwards after spawning. Round herring are also reported to spawn along the South Coast (Roel & Armstrong 1991). Demersal species that spawn along the South Coast include the cape hake and kingklip, the latter spawning off the shelf edge to the south of St Francis and Algoa Bays (Shelton 1986; Hutchings 1994) (Figure 5). Squid (*Loligo* spp.) larvae are widely distributed in inshore waters (<50 m) (Augustyn *et al*. 1994). Eggs and larvae of important linefish species (e.g. elf, leervis and geelbek) are also present inshore along the South Coast, with a significant proportion of the eggs and larvae originating from spawning grounds located along the East Coast (Beckley & van Ballegooyen 1992). The inshore waters of the Agulhas Bank, especially between the cool water ridge and the shore, acts as a nursery area for numerous fish species (Wallace *et al*. 1984; Smale *et al*. 1994).

Pilchard (*Sardinops sagax*) eggs occur in inshore waters along the Eastern Cape and the southern KwaZulu-Natal coast after the "sardine run" in June and July (Anders 1975; Connell 1996). Numerous linefish species (e.g. elf *Pomatomus saltatrix*, leervis *Lichia amia*, geelbek *Atractoscion aequidens*) undertake spawning migrations along the coast into KwaZulu-Natal waters (Van der Elst 1976, 1981; Griffiths 1987; Garret 1988). The eggs and larvae of these species are subsequently dispersed southwards by the Agulhas Current, with juveniles occurring on the inshore Agulhas (Van der Elst 1976, 1981; Garret 1988).

### 3.2.4 Invertebrates

Information on offshore invertebrates occurring along the South Coast is sparse. The squid (*Loligo vulgaris reynaudii*) (Figure 6, left) 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. These spawning aggregations are a seasonal occurrence reaching a peak in November and December.

The deep-water rock lobster (*Palinurus gilchristi*) (Figure 6, right) occurs on rocky substrate in depths of 90 - 170 m between Cape Agulhas and southern KwaZulu-Natal. Larvae drift southwards in the Agulhas Current, settling in the south 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, and off Cape St Francis, Cape Recife and Bird Island.

Other deep-water crustaceans that may occur in the proposed survey 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. Other rock lobster species occurring on the South Coast include the West Coast rock lobster (*Jasus lalandii*) and the East Coast rock lobster (*Palinurus homarus*) all of 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).

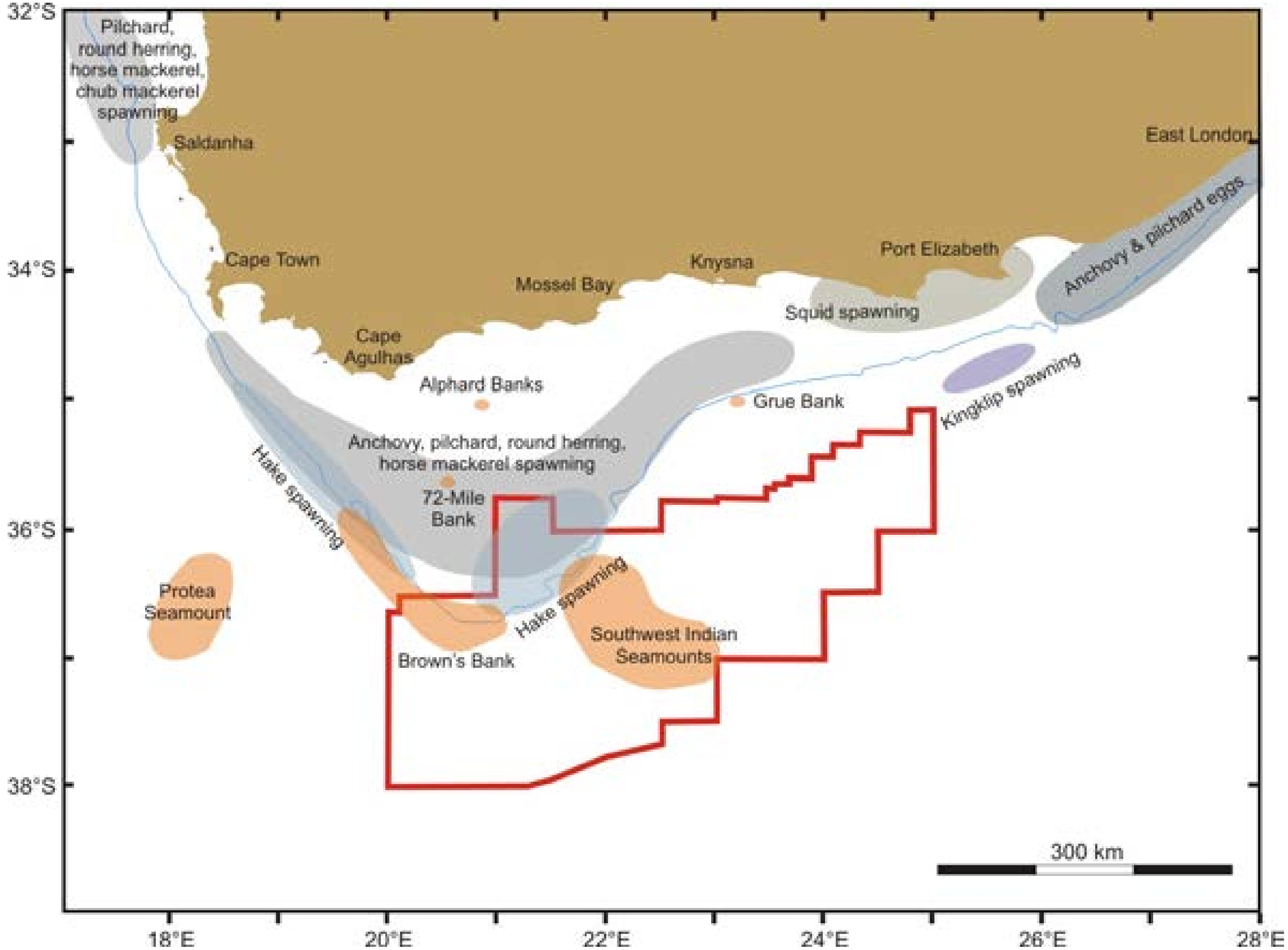


Figure 5: Important fishing banks, seamounts, pelagic and demersal fish and squid spawning areas in relation to the Proposed 2D survey area (red outline) (after Anders 1975, Crawford *et al.* 1987, Hutchings 1994). The 200 m depth contour is also shown.

Figure 6: Squid spawn in nearshore areas off the South Coast (left) and South Coast rock lobster occur in deep water (right) (photos: www.mpa.wwf.org.za; Steve Kirkman).

The benthic biota of offshore soft bottom 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 soft-bottom communities is primarily a function of abiotic factors such as water depth and sediment grain size, but others such as current velocity and organic content abundance also play a role (Snelgrove & Butman 1994; Flach & Thomsen 1998; Ellingsen 2002). Further shaping is derived from biotic factors such as predation, food availability, larval recruitment and reproductive success. The high spatial and temporal variability for these factors results in seabed communities being both patchy and variable. In nearshore waters 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 where near-bottom conditions are more stable, the macrofaunal communities will primarily be determined by sediment characteristics and depth.

There is insufficient information available on benthic invertebrates in the proposed survey area to allow for a description of the zoogeographic distribution of benthic macrofaunal communities. However, from studies conducted off the West Coast (Christie & Moldan 1977; Moldan 1978; Jackson & McGibbon 1991; Environmental Evaluation Unit 1996; Parkins & Field 1997; 1998; Pulfrich & Penney 1999; Goosen *et al*. 2000; Savage *et al*. 2001; Steffani & Pulfrich 2004a, 2004b; 2007; Steffani 2007a; 2007b; Atkinson 2009) and off Richards Bay in northern KwaZulu-Natal (Connell *et al*. 1985, 1989; McClurg *et al*. 1999, 2000, 2001, 2002, 2003, 2004; McClurg & Blair 2005, 2006, 2007, 2008; CSIR 2007, 2009) it can be deduced that in general species diversity, abundance and biomass is relatively low on inshore substrates, but increasing from the shore to ~80 m depth. Communities are characterised equally by polychaetes, crustaceans (of which amphipods, copepods and ostracods are the dominant types), echinoderms and molluscs. Further offshore to 120 m depth, the midshelf is a particularly rich benthic habitat where biomass can attain 60 g/m$^2$ dry weight (Christie 1974; see also Steffani 2007b). The comparatively high benthic biomass in this midshelf region represents an important food source to carnivores such as the mantis shrimp, cephalopods and demersal fish species. Outside of this rich zone biomass declines to 4.9 g/m$^2$ at 200 m depth and then is consistently low (<3 g/m$^2$) on the outer shelf (Christie 1974). The meiobenthos includes the smaller species such as nematode worms, flat worms, harpacticoid copepods, ostracods and gastrotriches. Some of the meiofauna are adept at burrowing while others live in the interstitial spaces between the sand grains.

The benthic fauna of the continental slope beyond ~450 m depth are poorly known, largely due to limited opportunities for sampling, and to date very few areas of the continental slope off the South Coast have been biologically surveyed. With little sea floor topography and hard substrate, such areas are likely to offer minimal habitat diversity or niches for animals to occupy. Detritus-feeding crustaceans, holothurians and echinoderms tend to be the dominant epi-benthic organisms of such habitats. Also associated with soft-bottom substrates are demersal communities that comprise bottom-dwelling invertebrate species, many of which are dependent on the invertebrate benthic macrofauna as a food source. Atkinson (2009) reported numerous species of urchins and burrowing anemones beyond 300 m depth off the West Coast.

In recent years there has also been increasing interest in deep-water corals and sponges because of their likely sensitivity to disturbance and their long generation times. These benthic filter-feeders generally occur at depths exceeding 150 m. Some coral species form reefs while others are smaller and remain solitary. 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 Agulhas Bank hosts a diversity of deep-water corals and sponges (Figure 7), that have establish 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. Substantial shelf areas should thus potentially be capable of supporting rich, deep-water benthic, filter-feeding communities.

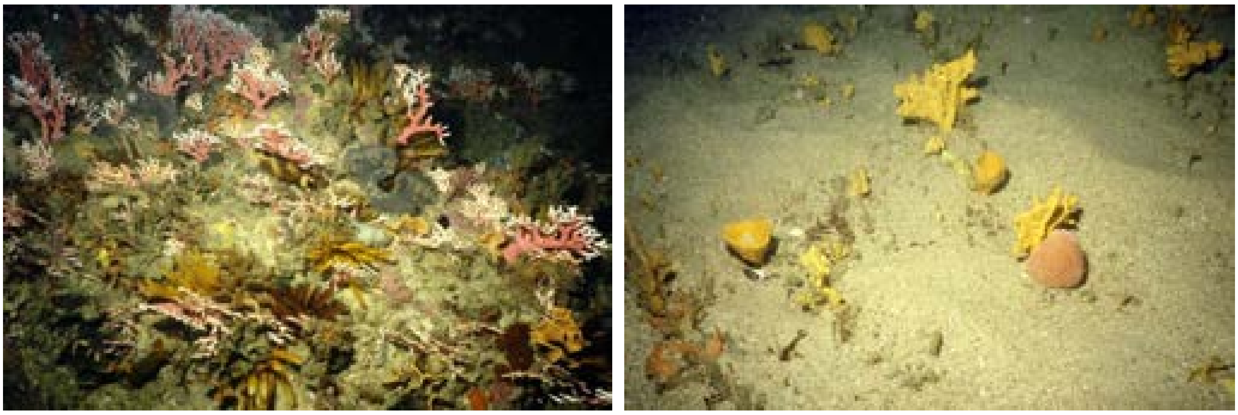

Figure 7: Offshore benthic communities occurring on reefs on the central Agulhas Bank include protected cold water porcelain coral *Allopora nobilis*, sponges, crinoids and bryozoans (Left; Photo: Andrew Penney), whereas a variety of habitat-forming sponges, colonial ascidians and hydroids occur on sandy seabed (Right; Photo: Andrew Penney).

### 3.2.5 Seamount Communities

Geological features of note in the proposed survey area include various banks, knolls and seamounts (referred to collectively here as “seamounts”). These seabed features protrude into the water column, and are subject to, and interact with, the water currents surrounding them. The effects of such seabed features on the surrounding water masses can include the up-welling of relatively cool, nutrient-rich water into nutrient-poor surface water thereby resulting in higher productivity (Clark *et al.* 1999), which can in turn strongly influences the distribution of organisms on and around seamounts. Evidence of enrichment of bottom-associated communities and high abundances of demersal fishes has been regularly reported over such seabed features.

The enhanced fluxes of detritus and plankton that develop in response to the complex current regimes around such seabed features lead to the development of detritivore-based food-webs, which in turn lead to the presence of seamount scavengers and predators. Seamounts provide an important habitat for commercial deepwater fish stocks such as orange roughy, oreos, alfonsino and Patagonian toothfish, which aggregate around these features for either spawning or feeding (Koslow 1996).

Such complex benthic ecosystems in turn enhance foraging opportunities for many other predators, serving as mid-ocean focal points for a variety of pelagic species with large ranges (turtles, tunas and billfish, pelagic sharks, cetaceans and pelagic seabirds) that may migrate large distances in search of food or may only congregate on seamounts at certain times (Hui 1985; Haney *et al.* 1995). Seamounts thus serve as feeding grounds, spawning and nursery grounds and possibly navigational markers for a large number of species (SPRFMA 2007).

Enhanced currents, steep slopes and volcanic rocky substrata, in combination with locally generated detritus, favour the development of suspension feeders in the benthic communities characterising seamounts (Rogers 1994). Deep- and cold-water corals (including stony corals, black corals and soft corals) (Figure 8, left) are a prominent component of the suspension-feeding fauna of many seamounts, accompanied by barnacles, bryozoans, polychaetes, molluscs, sponges, sea squirts, basket stars, brittle stars and crinoids (reviewed in Rogers 2004). There is also associated mobile benthic fauna that includes echinoderms (sea urchins and sea cucumbers) and crustaceans (crabs and lobsters) (reviewed by Rogers 1994). (Figure 8, right). Compared to the surrounding deep-sea environment, seamounts typically form biological hotspots with a distinct, abundant and diverse fauna, many species of which remain unidentified. Consequently, the fauna of seamounts is usually highly unique and may have a limited distribution restricted to a single geographic region, a seamount chain or even a single seamount location (Rogers *et al.* 2008). Levels of endemism on seamounts are also relatively high compared to the deep sea. As a result of conservative life histories (*i.e.* very slow growing, slow to mature, high longevity, low levels of recruitment) and sensitivity to changes in environmental conditions, such biological communities have been identified as Vulnerable Marine Ecosystems (VMEs). They are recognised as being particularly sensitive to anthropogenic disturbance (primarily deep-water trawl fisheries and mining), and once damaged are very slow to recover, or may never recover (FAO 2008).

It is not always the case that seamount habitats are VMEs, as some seamounts may not host communities of fragile animals or be associated with high levels of endemism. South Africa’s seamounts and their associated benthic communities have not been sampled by either geologists or biologists (Sink & Samaai 2009). Two important deep-water reefs within the proposed survey, namely Brown's Bank and the Southwest Indian Seamounts (see Figure 5).

Figure 8: Seamounts are characterised by a diversity of deep-water corals that add structural complexity to seabed habitats and offer refugia for a variety of invertebrates and fish (Photos: www.dfo-mpo.gc.ca/science/Publications/article/2007/21-05-2007-eng.htm, Ifremer & AWI 2003).

### 3.2.6 Pelagic and Demersal Fish

The South Coast ichthyofauna is diverse, comprising a mixture of temperate and tropical species. As a transition zone between the Agulhas and Benguela current systems, the South Coast ichthyofauna includes many species occurring also along the West and/or East Coasts. The seabed of the Agulhas Bank substrate is also diverse comprising areas of sand, mud and coral thereby contributing to increased benthic fauna and fish species.

Small pelagic shoaling species occurring along the South Coast include anchovy (*Engraulis encrasicolus*), pilchard (*Sardinops sagax*) (Figure 9, left), round herring (*Etrumeus japonicas*), chub mackerel (*Scomber japonicas*) and horse mackerel (*Trachurus trachurus capensis*) (Figure 9, right). Anchovies are usually located between the cool upwelling ridge and the Agulhas Current (Hutchings 1994), and are larger than those of the West Coast. Having spawned spawn 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. The Agulhas Bank area is, however, is not considered an important anchovy recruitment ground (Hampton 1992). Round herring spawn offshore of the 200 m contour on the western edge of the Agulhas Bank and northwards up the West Coast between August and October. Juveniles, however, 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. Spawning occurs on the Agulhas Bank during spring and summer (Crawford 1980), with recruits being found inshore along the South Coast (Hutchings 1994). It is thought that the Agulhas Bank may be a refuge for pilchard under low population levels, and therefore vital for the persistence of the species (CCA & CSIR 1998). During the winter months of June to August, the penetration of northerly-flowing cooler water along the Eastern Cape coast and up to southern KwaZulu-Natal effectively expands the suitable habitat available for this species, resulting in a 'leakage' of large shoals northwards along the coast in what has traditionally been known as the 'sardine run'. 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). Catch rates of several important species in the recreational shoreline fishery of KwaZulu-Natal have been shown to be associated with the timing of the sardine run (Fennessey *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*), which are all regular spawners within KwaZulu-Natal waters (Van der Elst 1988).

Figure 9: Cape fur seal preying on a shoal of pilchards (left). School of horse mackerel (right) (photos: www.underwatervideo.co.za; www.delivery.superstock.com).

Large migratory pelagic species that occur in offshore waters and beyond the shelf break include dorado (*Coryphaena hippurus*), sailfish (*Istiophorus platypterus*) (Figure 10, left) and black, blue and striped marlin (*Makaira indica, M. nigricans, Tetrapturus audax*), frigate tuna (*Auxis thazard*), skipjack (*Katsuwonus pelamis*), longfin tuna/albacore (*Thunnus alalunga*) (Figure 10, right), bigeye tuna (*Thunnus obesus*), yellowfin tuna (*Thunnus albacares*), Southern Bluefin tuna and Bluefin tuna (*Thunnus maccoyii* and *T. thynnus thynnus*, respectively) (Van der Elst 1988; Smale *et al*. 1994).


Figure 10: Large migratory pelagic fish such as sailfish (left) and longfin tuna (right) occur in offshore waters (photos: www.arkive.org; www.osfimages.com).

There is a high diversity of Teleosts (bony fish) and Chondrichthyans (cartilaginous fish) associated with the inshore and shelf waters of the South Coast, many of which are endemic to the Southern African coastline and form an important component of the demersal trawl and long-line fisheries. The Cape hake (*Merluccius capensis*), is distributed widely on the Agulhas Bank, while the deep-water hake (*Merluccius paradoxus*) is found further offshore in deeper water (Boyd *et al*. 1992; Hutchings 1994). 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 whole of the South Coast, especially on rocky substrate (Japp *et al*. 1994). They are reported to spawn in an isolated area beyond the 200 m isobaths between Cape St Francis and Port Elizabeth during spring (see Figure 4). Juveniles occur further inshore. 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*).

The shallower inshore areas (<100 m) along the South Coast comprise a varied habitat of rocky reefs and soft-bottom substrates, which support a high diversity of endemic sparid and other teleost species (Smale *et al*. 1994) (Figure 11), some of which move into inshore protected bays to spawn (Buxton 1990) or undertake spawning migrations up the coast to KwaZulu-Natal. Those species that undertake migrations along the South Coast 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 form an important component of the commercial and recreational linefishery (Table 3.1). Furthermore, there are numerous pelagic species that frequent nearshore waters and are targeted by line-fishermen (Table 3.1).

Figure 11: The South Coast 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 3.1: Some of the more important demersal and pelagic linefish species landed by commercial and recreational boat fishers and shore anglers along the South Coast (adapted from CCA & CMS 2001).

| Name | Species Name |
|---|---|
| Bank steenbras | Chirodactylus grandis |
| Belman | *Umbrina canariensis* |
| Blacktail | *Diplodus sargus* |
| Blue hottentot | *Pachymetopon aeneum* |
| Bronze bream | *Pachymetopon grande* |
| Cape bank steenbras | *Chirodactylus grandis* |
| Cape stumpnose | *Rhabdosargus holubi* |
| Carpenter | *Argyrozona argyrozona* |
| Dageraad | *Chrysoblephus christiceps* |
| Fransmadam | *Boopsoidea inornata* |
| Galjoen | *Dichistius capensis* |
| Grey chub | *Kyphosus biggibus* |
| Kob | *Argyrosomus hololepidotus* |
| Musselcracker | *Sparodon durbanensis* |
| Poenskop | *Cymatoceps nasutus* |
| Red roman | *Chrysoblephus laticeps* |
| Red steenbras | *Petrus rupestris* |
| Red stumpnose | *Chrysoblephus gibbiceps* |
| Rockcod | *Epinephalus* spp. |
| Sand steenbras | *Lithognathus mormyrus* |
| Santer | *Cheimerius nufar* |
| Seventyfour | *Polysteganus undulosus* |
| Spotted grunter | *Pomadasys commersonnii* |
| Steentjie | *Spondyliosoma emarginatum* |
| Strepie | *Sarpa salpa* |
| White steenbras | *Lithognathus lithognathus* |
| White stumpnose | *Rhabdosargus globiceps* |
| Wreckfish | *Polyprion americanus* |
| Zebra | *Diplodus cervinus* |

A wide variety of chondrichthyans occur in nearshore waters of the South Coast (Table 3.2), 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.

Table 3.2: Some of the chondrichthyan species occurring along the South Coast (adapted from CCA & CMS 2001).

| Name | Species Name |
|---|---|
| Great white shark | *Carcharodon carcharias* |
| Ragged-tooth shark | *Odontaspis taurus* |
| Bronze whaler shark | *Carcharhinus brachyurus* |
| Dusky shark | *Carcharhinus obscures* |
| Blacktip shark | *Carcharhinus limbatus* |
| Hammerhead shark | *Sphyrna* spp. |
| Lesser Sandshark | *Rhinobatus annulatus* |
| Milkshark | *Rhizoprionodon acutus* |
| Gully shark | *Triakis megalopterus* |
| Skates | Rajiformes |
| Stingrays | Dasyatidae |
| St Joseph shark | *Callorhincus capensis* |
| Soupfin shark | *Galeorhinus galeus* |
| Diamond ray | *Gymnura natalensis* |
| Tiger catshark | *Halaelurus natalensis* |
| Izak | *Halohalaelurus regani* |
| Puffadder shyshark | *Haploblepharus edwardsii* |
| Houndsharks | *Mustelus* spp. |
| Bullray | *Myliobatis aquilla* |
| Yellowspotted catshark | *Scyliorhinus capensis* |
| Spiny dogfish | *Squalus* spp. |
| Electric ray | *Torpedo fuscomaculata* |

### 3.2.7 Turtles

Three species of turtle occur along the South Coast, namely the leatherback (*Dermochelys coriacea*), and occasionally the loggerhead (*Caretta caretta*) and the green (*Chelonia mydas*) turtle. In the IUCN Red listing, the leatherback is described as "critically endangered", and the loggerhead and green turtles as "endangered" on a global scale. Leatherback Turtles are thus in the highest categories in terms of need for conservation in CITES (Convention on International Trade in Endangered Species), and CMS (Convention on Migratory Species). As a signatory of CMS, South Africa has endorsed and signed a CMS International Memorandum of Understanding specific to the conservation of marine turtles. South Africa is thus committed to conserve these species at an international level.

Leatherback turtles (Figure 12, left) 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 (Hays *et al*. 2004; Lambardi *et al*. 2008), thus making them difficult to observe from the surface and susceptible to seismic operations. They come into coastal bays and estuaries to mate, and lay their eggs on the adjacent beaches. Leatherback turtles from the east South African population have been satellite tracked swimming around the west coast of South Africa and remaining in the warmer waters west of the Benguela ecosystem (Lambardi *et al*. 2008).

Loggerheads (Figure 12, right) 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).

The green turtle is a non-breeding resident along the east coast of South Africa, and together with loggerhead turtles are expected to occur only as occasional visitors along the South Coast.

Both the leatherback and the loggerhead turtle nest on the beaches of the northern KwaZulu-Natal coastline between October and February, extending into March. The southern extremity of the nesting area is thus located over 1,000 km to the north of the proposed seismic area. Hatchlings are born from late January through to March when the Agulhas Current is warmest. Once hatchlings enter the sea, they move southward in the Agulhas Current and are thought to remain in the southern Indian Ocean gyre for the first five years of their lives, as there is an absence of turtles between 10 - 60 cm from the southern African East Coast. Beach strandings of juvenile loggerhead and leatherback turtles along the South African coast suggest juvenile turtles in the Agulhas Current between Algoa Bay and Mossel Bay (Hughes 1974).

Since concerted turtle conservation efforts began in KwaZulu-Natal in the early 1960, the average number of nesting leatherback females has risen from only five in 1966 to over 90 in the early 2000s. The number of loggerhead turtles has also risen from less than 100 in the early 1960s to ~2,000 currently nesting annually within the Maputaland Marine Reserve (Mann-Lang 2000; www.southafricablog.co.za/archives/loggerhead-turtle/).

Figure 12: Leatherback (left) and loggerhead turtles (right) occur along the South Coast of South Africa (Photos: Ketos Ecology 2009; www.aquaworld-crete.com).

#### 3.2.8 Seabirds

South Coast seabirds can be categorized into three categories: ‘breeding resident species’, ‘non-breeding migrant species’ and ‘rare vagrants’ (Shaughnessy 1977; Harrison 1978; Liversidge & Le Gras 1981; Ryan & Rose 1989). Overall, 60 species are known, or thought likely to occur, along the South Coast. Thirteen species breed within the South Coast region (Table

3.3), including Cape Gannets (Algoa Bay islands), African Penguins (Algoa Bay islands), Cape Cormorants (a small population at Algoa Bay islands and mainland sites), Whitebreasted Cormorant, Roseate Tern (Bird and St Croix Islands), Damara Tern (inshore between Cape Agulhas and Cape Infanta), Swift Term (Stag Island) and Kelp Gulls.

Table 3.3: Breeding resident seabirds present along the South Coast (adapted from CCA & CMS 2001).

| Species name | Common name | Global IUCN Status |
|---|---|---|
| *Spheniscus demersus* | African Penguin | Endangered |
| *Phalacrocorax carbo* | Great Cormorant | Least Concern |
| *Phalacrocorax capensis* | Cape Cormorant | Near Threatened |
| *Phalacrocorax neglectus* | Bank Cormorant | Endangered |
| *Phalacrocorax coronatus* | Crowned Cormorant | Least Concern |
| *Morus capensis* | Cape Gannet | Vulnerable |
| *Larus dominicanus* | Kelp Gull | Least Concern |
| *Larus cirrocephalus* | Greyheaded Gull | Least Concern |
| *Larus hartlaubii* | Hartlaub's Gull | Least Concern |
| *Hydroprogne caspia* | Caspian Tern | Vulnerable |
| *Sterna bergii* | Swift Tern | Least Concern |
| *Sterna dougallii* | Roseate Tern | Least Concern |
| *Sterna balaenarum* | Damara Tern | Near Threatened |

On the Agulhas Bank sea-birds at times intensively target shoals of pelagic fish. Small pelagic species such as anchovy and pilchard form important prey items for Agulhas Bank seabirds, particularly the Cape Gannet (Figure 13, left), the African Penguin (Figure 13, right) and the various cormorant species. Most of the breeding resident seabird species feed on fish (with the exception of the gulls, which scavenge, and feed on molluscs and crustaceans). 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.

African Penguin colonies along the South Coast occur at Dyer Island, Cape Recife, and on the Algoa Bay islands (St Croix Island, Jaheel Island, Bird Island, Seal Island, Stag Island and Brenton Rocks). This species forages at sea with most birds being found within 20 km of the coast. The majority of Algoa Bay penguins forage to the south of Cape Recife. 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.


Figure 13: Typical diving seabirds on the South Coast are the Cape Gannets (left) (Photo: NACOMA) and the flightless African Penguin (right) (Photo: Klaus Jost).

### 3.2.9 Marine Mammals

The marine mammal fauna of the South Coasts comprises between 35 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 (Table 3.4) and one seal species, the Cape fur seal (*Arctocephalus pusillus*) (Findlay 1989; Findlay *et al*. 1992; Ross 1984; Peddemors 1999). The offshore areas have been particularly poorly studied with almost all available information from deeper waters (>200 m) arising from historic whaling records. Information on smaller cetaceans in deeper waters is particularly poor. Of the migratory cetaceans listed in Table 5, the blue, sei and humpback whales are listed as "Endangered" and the Southern Right and fin whale as "Vulnerable" in the IUCN Red Data book.

The distribution of whales and dolphins on the South Coast can largely be split into those associated with the continental shelf and those that occur in deep, oceanic waters. Species from both environments may, however, be found associated with the shelf (200 – 1,000 m), making this 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 kilometres. The most common species within the proposed survey area (in terms of likely encounter rate not total population sizes) are likely to be the common bottlenose dolphin, long finned pilot whale, southern right whale and humpback whale.

Table 3.4: Cetaceans occurrence off the South Coast of South Africa, their seasonality and likely encounter frequency with proposed seismic survey operations.

| Common Name | Species | Shelf | Offshore | Seasonality | Likely encounter freq. |
|---|---|---|---|---|---|
| *Delphinids* | | | | | |
| Common bottlenose dolphin | *Tursiops truncatus* | Yes | Yes | Year round | Monthly |
| Indo-Pacific bottlenose dolphin | *Tursiops aduncus* | Yes | | Year round | Monthly |
| Common (short beaked) dolphin | *Delphinus delphis* | Yes | Yes | Year round | Monthly |
| Common (long beaked) dolphin | *Delphinus capensis* | Yes | | Year round | Monthly |
| Fraser's dolphin | *Lagenodelphis hosei* | | Yes | Year round | Occasional |
| Spotted dolphin | *Stenella attenuata* | Yes | Yes | Year round | Occasional |
| Striped dolphin | *Stenella coeruleoalba* | | Yes | Year round | Occasional |
| Indo-Pacific humpback dolphin | *Sousa chinensis* | Yes | | Year round | Monthly |
| Long-finned pilot whale | *Globicephala melas* | | Yes | Year round | <Weekly |
| Short-finned pilot whale | *Globicephala macrorhynchus* | | Yes | Year round | <Weekly |
| Killer whale | *Orcinus orca* | Occasional | Yes | Year round | Occasional |
| False killer whale | *Pseudorca crassidens* | Occasional | Yes | Year round | Monthly |
| Risso's dolphin | *Grampus griseus* | Yes (edge) | Yes | Year round | Occasional |
| Pygmy killer whale | *Feresa attenuata* | | Yes | Year round | Occasional |
| *Sperm whales* | | | | | |
| Pygmy sperm whale | *Kogia breviceps* | | Yes | Year round | Occasional |
| Dwarf sperm whale | *Kogia sima* | | Yes | Year round | Occasional |
| Sperm whale | *Physeter macrocephalus* | | Yes | Year round | Occasional |

| Common Name | Species | Shelf | Offshore | Seasonality | Likely encounter freq. |
|---|---|---|---|---|---|
| *Beaked whales* | | | | | |
| Cuvier's | *Ziphius cavirostris* | | Yes | Year round | Occasional |
| Arnoux's | *Beradius arnouxii* | | Yes | Year round | Occasional |
| Southern bottlenose | *Hyperoodon planifrons* | | Yes | Year round | Occasional |
| Hector's | *Mesoplodon hectori* | | Yes | Year round | Occasional |
| Layard's | *Mesoplodon layardii* | | Yes | Year round | Occasional |
| True's | *Mesoplodon mirus* | | Yes | Year round | Occasional |
| Gray's | *Mesoplodon grayi* | | Yes | Year round | Occasional |
| Blainville's | *Mesoplodon densirostris* | | Yes | Year round | Occasional |
| *Baleen whales* | | | | | |
| Minke | *Balaenoptera bonaerensis* | Yes | Yes | >Winter | Monthly |
| Dwarf minke | *B. acutorostrata* | Yes | | Year round | Occasional |
| Fin whale | *B. physalus* | | Yes | MJJ & ON, rarely in summer | Occasional |
| Blue whale | *B. musculus* | | Yes | MJJ | Occasional |
| Sei whale | *B. borealis* | | Yes | MJ & ASO | Occasional |
| Bryde's (inshore) | *B brydei (subspp)* | | Yes | Year round | Occasional |
| Pygmy right | *Caperea marginata* | Yes | | Year round | Occasional |
| Humpback | *Megaptera novaeangliae* | Yes | Yes | AMJJASOND | Daily |
| Southern right | *Eubalaena australis* | Yes | | JJASON | Daily |

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.

The majority of baleen whales fall into the family Balaenidae. Those occurring in the proposed survey area include the blue, fin, sei, minke, dwarf minke and two populations of Bryde's whale. Most of these species occur in pelagic waters, with only occasional visits into shelf waters. All of these species show some degree of migration either to, or through, the proposed survey 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 area. As whales follow geographic or oceanographic features, the northward and southward migrations may take place at difference 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.

Two types of Bryde's whales are recorded from South African waters - a smaller neritic form (of which the taxonomic status is uncertain) and a larger pelagic form described as *Balaenoptera brydei*. The migration patterns of Bryde's whales differ from those of all other baleen whales in the region as they are not linked to seasonal feeding patterns. 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 during winter. Sightings over the last two decades suggest that the distribution of this population has shifted eastwards, with sightings on the West Coast very rare compared to pre-1980s whaling records (Best 2001, 2007; Best *et al*. 1984). Although this is a very small population, which is possibly decreasing in size (Penry 2010), its current distribution implies that it is likely to be encountered in the proposed survey area.

The offshore population of Bryde's whale lives off the continental shelf (>200 m depth), and migrates between wintering grounds off equatorial West Africa (Gabon) and summering grounds off the South African West Coast (Best 2001). Its seasonality within South African waters is thus opposite to the majority of the balaenopterids, with abundance on the West Coast highest in January-February. This population of Bryde's whales is unlikely to be encountered in the proposed survey area.

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). Almost all information is based on whaling records 1958-1963 and there is no current information on abundance or distribution patterns in the region.

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.

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). However, scientific search effort (and thus information) in pelagic waters is very low. The chance of encountering the species in the proposed survey area is considered low.

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. Off Durban Minke whales are reported to increase in numbers in April and May, remaining at high levels through June to August and peaking in September (Best 2007).

The most abundant baleen whales off the coast of South Africa are southern right and humpback whales (Figure 14). Southern rights migrate to the southern Africa subcontinent to breed and calve, where they tend to have an extremely coastal distribution mainly in sheltered bays (90% <2 km from shore; Best 1990, Elwen & Best 2004). Winter concentrations have been recorded all along the southern and eastern coasts of South Africa as far north as Maputo Bay, with the most significant concentration currently on the South Coast between Cape Town and Port Elizabeth. They typically arrive in coastal waters off the South Coast between June and November each year, although animals may be sighted as early as April and as late as January. While in local waters, southern rights are found in groups of 1-10 individuals, with cow-calf pairs predominating in inshore nursery areas. From July to October, animals aggregate and become involved in surface-active groups, which can persist for several hours.

Best (2000) estimated that southern right population was increasing at approximately 7% per annum. The most recent abundance estimate for the South African Southern right whale population (2008) puts the population at approximately 4,600 individuals of all age and sex classes, which is thought to be at least 23% of the original population size (Brandão *et al*. 2011).

Figure 14: The humpback whale (left) and the southern right whale (right) migrate along the South Coast during winter (Photos: www.divephotoguide.com; www.aad.gov.au).

The majority of humpback whales on the south coast of South Africa are migrating past the southern African continent to their main winter concentration areas off Mozambique, Madagascar, Kenya and Tanzania. Three principal migration routes for Humpbacks in the south-west Indian Ocean have been proposed. On the first route up the East Coast, the northern migration reaches the coast in the vicinity of Knysna continuing as far north as central Mozambique. The second route approaches the coast of Madagascar directly from the south, possibly via the Mozambique Ridge. The third, less well established route, is thought to travel up the centre of the Mozambique Channel to Aldabra and the Comore Islands (Findlay *et al*. 1994; Best *et al*. 1998). Humpbacks have a bimodal distribution off the coast, most reaching southern African waters around April, continuing through to September/October when the southern migration begins and continues through to December. The calving season for Humpbacks extends from July to October, peaking in early August (Best 2007). Cow-calf pairs are typically the last to leave southern African waters on the return southward migration, although considerable variation in the departure time from breeding areas has been recorded (Barendse *et al*. 2010). Off Cape Vidal in KwaZUla Natal, whale abundances peak around June/July on their northward migration, although some have been observed still moving north as late as October. Southward moving animals on their return migration were first seen in July, peaking in August and continuing to late October (Findlay & Best 1996a, b).

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 are the largest of the toothed whales and have a complex, well-structured social system with adult males behaving differently from younger males and female groups. They live in deep ocean waters, occasionally coming into depths of 500-200 m on the shelf (Best 2007). Seasonality of catches off the East Coast suggest that medium- and large-sized males are more abundant during winter, while female groups are more abundant in summer, 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 in African waters. Sperm whales feed at great depth, during dives in excess of 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 15: Toothed whales that occur on the South Coast include the Bottlenose dolphin (left) and the Indo-pacific humpback dolphin (right) (Photos: www.fish-wallpapers.com; www.shutterstock.com).

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 south and east South Africa. 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 common bottlenose dolphin offshore and humpback dolphins are known to be resident on the shelf and offshore and are likely to be encountered in the survey area. Similarly, the long-finned pilot whale, which is usually associated with the shelf edge and is regularly reported by MMOs, fishermen and other observers (S. Elwen pers commn), is likely to be commonly encountered. False killer whales, killer whales, and the offshore form of the bottlenose dolphin are also likely to be encountered with some regularity in deeper waters (Findlay *et al*. 1992, Best 2007).

In summary, the majority of data available on the seasonality and distribution of large whales in the proposed survey area 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 behaviours (e.g. migration routes may be learnt behaviours). The large whale species for which there are current data available are the humpback and southern right whale, although with almost all data being limited to the continental shelf. Whaling data indicates that several other large whale species are also abundant on the South 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.

Of the migratory cetaceans, the Blue, Sei and Humpback whales are listed as "Endangered" and the Southern Right and Fin whale as "Vulnerable" in the IUCN Red Data book. 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[1], 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.

The Cape fur seal (*Arctocephalus pusillus pusillus*) is the only seal species that has breeding colonies along the South Coast (Figure 16), namely at Seal Island in Mossel Bay, on the northern shore of the Robberg Peninsula in Plettenberg Bay and at Black Rocks (Bird Island group) in Algoa Bay. 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, although limited tracking of Algoa Bay animals has suggested these seals to be

[1] In the Regulations for the management of boat-based whale watching and protection of turtles as part of the Marine Living Resources Act of 1998 the definition of "harassment" is given as "behaviour or conduct that threatens, disturbs or torments cetaceans".

feeding 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 16: Colony of Cape fur seals (Photo: Dirk Heinrich).

### 3.2.10 Marine Protected Areas

There are six marine protected areas (MPAs) within the broad study area namely De Hoop, Goukama, Robberg, Tsitsikama, Sardinia Bay and the Bird Island Group (Figure 17). These MPAs and closed areas extend offshore only a few nautical miles and thus do not overlap directly with the proposed seismic survey area. For the sake of completeness, however, they are described briefly below (http://mpa.wwf.org.za).

The De Hoop Marine Protected Area extends along 46 km of coastline between Skipskop in the west and Stilbaai Point in the east, and extends three nautical miles (5 km) out to sea. The MPA covers an area of approximately 25,300 ha (253 km²), making it one of the largest marine protected areas in Africa. The De Hoop MPA has been very successful in protecting populations of commercially targeted reef fishes, and in providing migrant recruits of over-fished species such as Red Steenbras to neighouring fishing areas. The MPA is also critically important for the conservation of the Southern Right whale and together with St. Sebastian Bay (at Cape Infanta) supports 70 - 80% of cow-calf pairs on the South African coast. Consequently it ranks as probably the most important nursery area for Southern Right whales in the world.

The Goukamma MPA has a coastline of approximately 14 km from Buffalo Bay to Platbank and stretches one nautical mile (1.85 km) out to sea. A specific objective of the Goukamma MPA is the protection of important offshore reefs that provide habitat for commercially threatened sparid species, particularly red steenbras and black musselcracker. Unfortunately, the seaward extent of the MPA does not adequately protect the reefs from utilisation by recreational or commercial fishers.

The Robberg MPA extends one nautical mile seawards around the Robberg Nature Reserve, which forms a peninsula with a single access point. The length of the Robberg MPA shoreline is 9 km and includes and includes a Cape Fur Seal colony.

The Tsitsikamma National Park, proclaimed in 1964, is the oldest and largest 'no-take' MPA in Africa. No extraction or collection of marine resources either living or dead (*i.e*. fishing from boats, angling, bait-collecting, spearfishing, shell collecting etc.) is permitted in the MPA. It extends along 57 km of coastline and ~ 6 km offshore, and is a biodiversity hotspot and being central in the distributional range of several South African endemic fish species provides excellent protection for many over-exploited fish species, including dageraad, red stumpnose, red steenbras, seventy-four, musselcracker, poenskop, white steenbras and dusky kob. Many of these species are slow growing and have life spans exceeding 20 years.

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.

Bird Island MPA was declared in 2004 for biodiversity conservation reasons, and declared as part of Addo Elephant National Park in 2005. The reserve boundaries of the Algoa Bay Island nature reserve extend 500 m offshore of the islands as MPAs. The Bird Island group (Bird, Seal, Stag and Black Rock) are situated at the north eastern end of Algoa Bay close to Woody Cape. 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. These islands together with St Croix, Jahleel and Brenton Islands (also in Algoa Bay) are classed as Important Bird Areas, because they regularly support significant numbers of globally threatened bird species as well as holding large concentrations of seabirds. Five keystone species occurring on the islands are African Penguin, Cape Gannet, Roseate Tern, Antarctic Tern and Kelp Gull.

The islands form ecological distinct subtidal habitats, containing many endemic species of invertebrates, seaweeds and fish, such as santer and red roman. The popular angling species seventy-four (*Polysteganus undulosus*), still maintains a nursery area around Bird Island, and up to half of the southern African population of the Humpback dolphin (*Sousa chinensis*) is thought to occur in Algoa Bay. Black Rocks is an important seal breeding colony, and is associated with a great white shark feeding area.

A larger MPA of an envisaged 120,000 hectares, which will form part of a national conservation area, the Greater Addo Elephant National Park (GAENP), has been proposed.

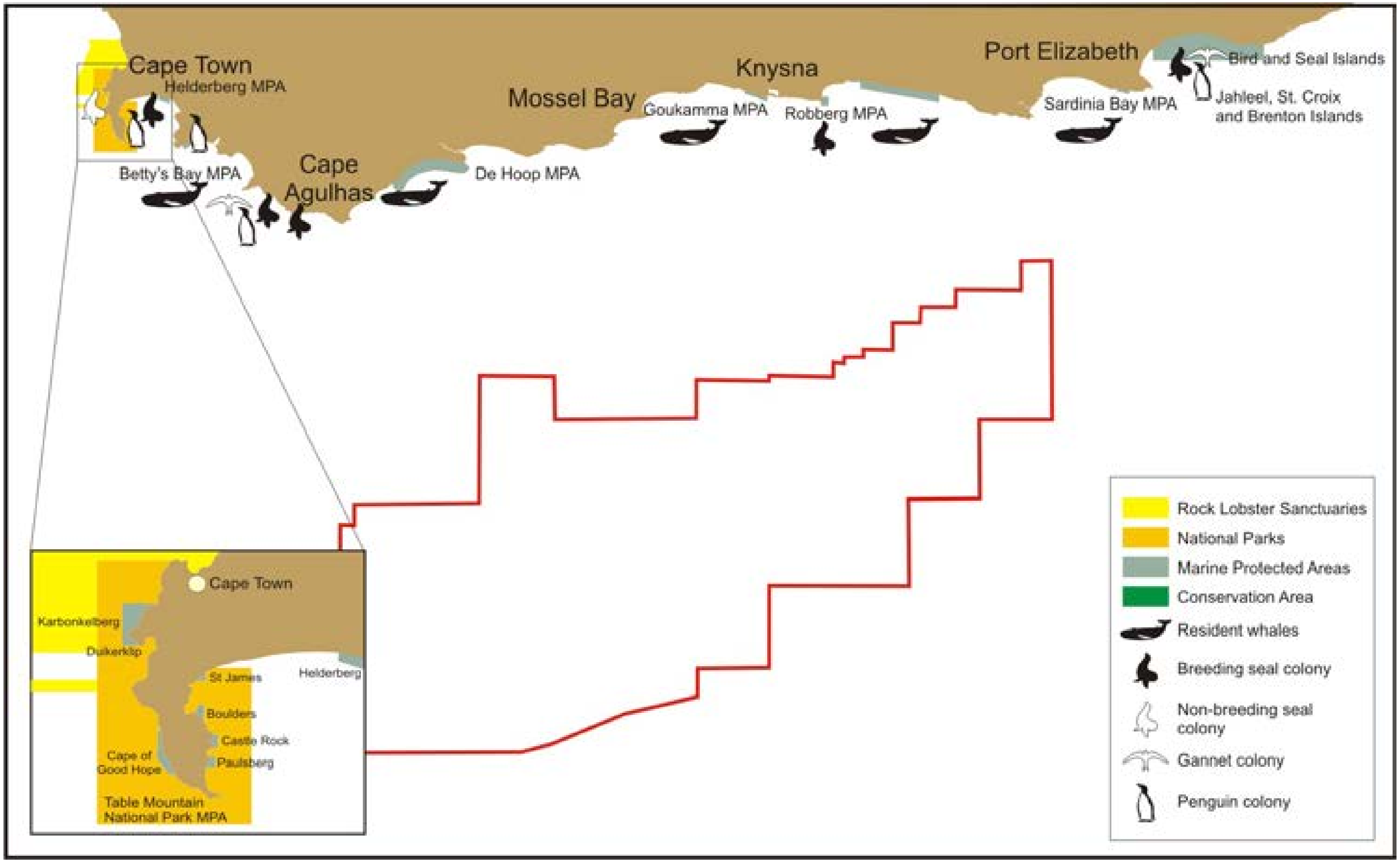


Figure 17: Project - environment interaction points on the South Coast, illustrating the location of seabird and seal colonies, seasonal whale populations, and reserves and marine protected areas in relation to the proposed survey area (red outline).

## 4. ACOUSTIC IMPACTS OF SEISMIC SURVEYS ON MARINE FAUNA

The ocean is a naturally noisy place and marine animals are continually subjected to both physically produced sounds from sources such as wind, rainfall, breaking waves and natural seismic noise, or biologically produced sounds generated during reproductive displays, territorial defence, feeding, or in echolocation (see references in McCauley 1994). Such acoustic cues are thought to be important to many marine animals in the perception of their environment as well as for navigation purposes, predator avoidance, and in mediating social and reproductive behaviour. Anthropogenic sound sources in the ocean can thus be expected to interfere directly or indirectly with such activities thereby affecting the physiology and behaviour of marine organisms (NRC 2003). Of all human-generated sound sources, the most persistent in the ocean is the noise of shipping. Depending on size and speed, the sound levels radiating from vessels range from 160 to 220 dB re 1 µPa at 1 m (NRC 2003). Especially at low frequencies between 5 to 100 Hz, vessel traffic is a major contributor to noise in the world's oceans, and under the right conditions, these sounds can propagate 100s of kilometres thereby affecting very large geographic areas (Coley 1994, 1995; NRC 2003; Pidcock *et al.* 2003).

Seismic and sonar surveys are another source of anthropogenic noise. The airguns used in modern seismic surveys produce some of the most intense non-explosive sound sources used by humans in the marine environment (Gordon *et al*. 2004). However, the transmission and attenuation of seismic sound is probably of equal or greater importance in the assessment of environmental impacts than the produced source levels themselves, as transmission losses and attenuation are very site specific, and are affected by propagation conditions, distance or range, water and receiver depth and bathymetrical aspect with respect to the source array. In water depths of 25 - 50 m airgun arrays are often audible to ranges of 50 -75 km, and with efficient propagation conditions such as experienced on the continental shelf or in deep oceanic water, detection ranges can exceed 100 km and 1,000 km, respectively (Bowles *et al*. 1991; Richardson *et al*. 1995; see also references in McCauley 1994). The signal character of seismic shots also changes considerably with propagation effects. Reflective boundaries include the sea surface, the sea floor and boundaries between water masses of different temperatures or salinities, with each of these preferentially scattering or absorbing different frequencies of the source signal. This results in the received signal having a different spectral makeup from the initial source signal. In shallow water (<50 m) at ranges exceeding 4 km from the source, signals tend to increase in length from <30 milliseconds, with a frequency peak between 10-100 Hz and a short rise time, to a longer signal of 0.25-0.75 seconds, with a downward frequency sweep of between 200 - 500 Hz and a longer rise time (McCauley 1994; McCauley *et al*. 2000).

In contrast, in deep water received levels vary widely with range and depth of the exposed animals, and exposure levels cannot be adequately estimated using simple geometric spreading laws (Madsen *et al.* 2006). These authors found that the received levels fell to a minimum between 5 - 9 km from the source and then started increasing again at ranges between 9 – 13 km, so that absolute received levels were as high at 12 km as they were at 2 km, with the complex sound reception fields arising from multi-path sound transmission.

Acoustic pressure variation is usually considered the major physical stimulus in animal hearing, but certain taxa are capable of detecting either or both the pressure and particle velocity components of a sound (Turl 1993). An important component of hearing is the ability to detect sounds over and above the ambient background noise. Auditory masking of a sound occurs when its' received level is at a similar level to background noise within the same frequencies. The signal to noise ratio required to detect a pure tone signal in the presence of background noise is referred to as the critical ratio.

The auditory thresholds of many species are affected by the ratio of the sound stimulus duration to the total time (duty cycle) of impulsive sounds of <200 millisecond duration. The lower the duty cycle the higher the hearing threshold usually is. Although seismic sound impulses are extremely short and have a low duty cycle at the source, received levels may be longer due to the transmission and attenuation of the sound (as discussed above).

Below follows a brief review of the impacts of seismic surveys on marine faunal communities. This information is largely drawn from McCauley (1994), McCauley *et al*. (2000), the Generic EMPR for Oil and Gas Prospecting off the Coast of South Africa (CCA & CMS 2001) and the very comprehensive review by Cetus Projects (2007), compiled as part of the Environmental Impact Assessment for the Ibhubesi Gas Field. While the effects on pelagic and benthic invertebrates, fish, turtles and seabirds is covered briefly, the discussion and assessments focus primarily on marine mammals.

## 4.1. Impacts on Plankton

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

Zooplankton comprises meroplankton (organisms which spend a portion of their life cycle as plankton, such as fish and invertebrate larvae and eggs) and holoplankton (organisms that remain planktonic for their entire life cycle, such as siphonophores, nudibranchs and barnacles). The abundance and spatial distribution of zooplankton is highly variable and dependent on factors such as fecundity, seasonality in production, tolerances to temperature, length of time spent in the water column, hydrodynamic processes and natural mortality. Zooplankton densities are generally low and patchily distributed. The amount of exposure to the influence of seismic airgun arrays is thus dependent on a wide range of variables. Invertebrate members of the plankton that have a gas-filled flotation aid, may be more receptive to the sounds produced by seismic airgun arrays, and the range of effects may extend further for these species than for other plankton. However, for a large seismic array, a physiological effect out to 10 m from the array is considered a generous value with known effects demonstrated to 5 m only (Kostyuchenko 1971).

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

Due to their importance in commercial fisheries, numerous studies have been undertaken experimentally exposing the eggs and larvae of various ichthyoplankton species to airgun sources (reviewed in McCauley 1994). These are discussed further in Section 4.3.

## 4.2. Impacts on Marine Invertebrates

Many marine invertebrates have tactile organs or hairs (termed mechanoreceptors), which are sensitive to hydro-acoustic near-field disturbances, and some have highly sophisticated statocysts, which have some resemblance to the ears of fishes (Offutt 1970; Hawkins & Myrberg 1983; Budelmann 1988, 1992; Packard *et al*. 1990; Popper *et al*. 2001) and are thought to be sensitive to the particle acceleration component of a sound wave in the far-field. However, information on hearing by invertebrates, and noise impacts on them is sparse. Although many invertebrates cannot sense the pressure of a sound wave or the lower amplitude component of high frequency sounds, low frequency high amplitude sounds may be detected *via* the mechanoreceptors, particularly in the near-field of such sound sources (McCauley 1994). Sensitivity to near-field low-frequency sounds or hydroacoustic disturbances has been recorded for the lobster *Homarus americanus* (Offut 1970), and various other invertebrate species (Horridge 1965, 1966; Horridge & Boulton 1967; Moore & Cobb 1986; Packard *et al*. 1990; Turnpenney & Nedwell 1994).

Despite no quantitative records of invertebrate mortality from seismic sound exposure under field operating conditions, lethal and sub-lethal effects have been observed under experimental conditions where invertebrates were exposed to airguns up to five metres away. These include reduced growth and reproduction rates and behavioural changes in crustaceans (DFO 2004; McCauley 1994; McCauley *et al.* 2000). The effects of seismic survey energy on snow crab (*Chionoecetes opilo*) on the Atlantic coast of Canada, for example ranged from no physiological damage but effects on developing fertilized eggs at 2 m range (Christian *et al*. 2003) to possible bruising of the heptopancreas and ovaries, delayed embryo development, smaller larvae, and indications of greater leg loss but no acute or longer term mortality and no changes in embryo survival or post hatch larval mobility (DFO 2004). The ecological significance of sub-lethal or physiological effects could thus range from trivial to important depending on their nature.

Giant squid strandings coincident with seismic surveys have been reported (Guerra *et al*. 2004). Although animals showed no external damage, all had severe internal injuries (including disintegrated muscles and unrecognisable organs) indicative of having ascended from depth too quickly. The causative link to seismic surveys has, however, not been established with certainty.

Behavioural responses of invertebrates to particle motion of low frequency stimulation has been measured by numerous researchers (reviewed in McCauley 1994). Again a wide range of responses are reported ranging from no avoidance by free ranging invertebrates (crustaceans, echinoderms and molluscs) of reef areas subjected to pneumatic airgun fire (Wardle *et al*. 2001), and no reduction in catch rates of brown shrimp (Webb & Kempf 1998), prawns (Steffe & Murphy 1992, in McCauley, 1994) or rock lobsters (Parry & Gasson 2006) in the near-field during or after seismic surveys.

Cephalopods, in contrast, may be receptive to the far-field sounds of seismic airguns, although responses are unknown. Behavioural response range from attraction at 600 Hz pure tone (Maniwa 1976), through startle responses at received levels of 174 dB re 1 µPa, to increase levels of alarm responses once levels had reached 156 – 161 dB re 1 μPa (McCauley *et al*. 2000). Based on the results of caged experiments, McCauley *et al.* (2000) therefore suggest that squid would significantly alter their behaviour at an estimated 2 - 5 km from an approaching large seismic source.

## 4.3. Impacts on Fish

Fish hearing has been reviewed by numerous authors including Popper and Fay (1973), Hawkins (1973), Tavolga *et al.* (1981), Lewis (1983), Atema *et al.* (1988), and Fay (1988). Fish have two different systems to detect sounds namely 1) the ear (and the otolith organ of their inner ear) that is sensitive to sound pressure and 2) the lateral line organ that is sensitive to particle motion. Certain species utilise separate inner ear and lateral line mechanisms for detecting sound; each system having its own hearing threshold (Tavolga & Wodinsky 1963), and it has been suggested that fish can shift from particle velocity sensitivity to pressure sensitivity as frequency increases (Cahn *et al.* 1970, in Turl 1993).

In fish, the proximity of the swim-bladder to the inner ear is an important component in the hearing as it acts as the pressure receiver and vibrates in phase with the sound wave. Vibrations of the otoliths, however, result from both the particle velocity component of the sound as well as stimulus from the swim-bladder. The resonant frequency of the swim-bladder is important in the assessment of impacts of sounds as species with swim-bladders of a resonant frequency similar to the sound frequency would be expected to be most susceptible to injury. Although the higher frequency energy of received seismic impulses needs to be taken into consideration, the low frequency sounds of seismic surveys would be most damaging to swim-bladders of larger fish. The lateral line is sensitive to low frequency (between 20 and 500 Hz) stimuli through the particle velocity component of sound.

Most species of fish and elasmobranchs are able to detect sounds from well below 50 Hz (some as low as 10 or 15 Hz) to upward of 500 - 1,000 Hz (Popper & Fay 1999; Popper 2003; Popper *et al.* 2003), and consequently can detect sounds within the frequency range of most widely occurring anthropogenic noises. Within the frequency range of 100 - 1,000 Hz at which most fish hear best, hearing thresholds vary considerably (50 and 110 dB re 1 μPa). They are able to discriminate between sounds, determine the direction of a sound, and detect biologically relevant sounds in the presence of noise. In addition, some clupeid fish can detect ultrasonic sounds to over 200 kHz (Popper & Fay 1999; Mann *et al.* 2001; Popper *et al.* 2004). Fish that possess a coupling between the ear and swim-bladder have probably the best hearing of fish species (McCauley 1994). Consequently, there is a wide range of susceptibility among fish to seismic sounds, with those with a swim-bladder will be more susceptible to anthropogenic sounds than those without this organ.

Studies have shown that fish can be exposed directly to the sound of seismic survey without lethal effects, outside of a very localised range of physiological effects. Physiological effects of impulsive airgun sounds on fish species include swim-bladder damage (Falk & Lawrence 1973), transient stunning (Hastings 1990, in Turnpenney & Nedwell 1994), short-term biochemical variations in different tissues typical of primary and secondary stress response (Santulli *et al.* 1999; Smith *et al.* 2004), and temporary hearing loss due to destruction of the hair cells in the hearing maculae (Enger 1981; Lombarte *et al*. 1993; Hastings *et al.* 1996; McCauley *et al.* 2000; Scholik & Yan 2001, 2002; McCauley *et al.* 2003; Popper *et al.* 2005;

Smith *et al.* 2006). Popper (2008) concludes that as the vast majority of fish exposed to seismic sounds will in all likelihood be some distance from the source, where the sound level has attenuated considerably, only a very small number of animals in a large population will ever be directly killed or damaged by sounds from seismic airgun arrays.

Behavioural responses to impulsive sounds are varied and include leaving the area of the noise source (Suzuki *et al.* 1980; Dalen & Rakness 1985; Dalen & Knutsen 1987; Løkkeborg 1991; Skalski *et al.* 1992; Løkkeborg & Soldal 1993; Engås *et al.* 1996; Wardle *et al.* 2001; Engås & Løkkeborg 2002; Hassel *et al.* 2004), changes in depth distribution (Chapman & Hawkins 1969; Dalen 1973; Pearson *et al.* 1992; Slotte *et al*. 2004), spatial changes in schooling behaviour (Slotte *et al.* 2004), and startle response to short range start up or high level sounds (Pearson *et al.* 1992; Wardle *et al.* 2001). In some cases behavioural responses were observed at up to 5 km distance from the firing airgun array (Santulli *et al*. 1999; Hassel *et al*. 2004). Behavioural effects are generally short-term, however, with duration of the effect being less than or equal to the duration of exposure, although these vary between species and individuals, and are dependent on the properties of the received sound. In some cases behaviour patterns returned to normal within minutes of commencement of surveying indicating habituation to the noise. Disturbance of fish is believed to cease at noise levels below 160 dB re 1μPa. The ecological significance of such effects is therefore expected to be low, except in cases where they influence reproductive activity.

Although the effects of airgun noise on spawning behaviour of fish have not been quantified to date, it is predicted that if fish are exposed to powerful external forces on their migration paths or spawning grounds, they may be disturbed or even cease spawning altogether. The deflection from migration paths may be sufficient to disperse spawning aggregations and displace spawning geographically and temporally, thereby affecting recruitment to fish stocks. The magnitude of effect in these cases will depend on the biology of the species and the extent of the dispersion or deflection. Dalen *et al*. (1996), however, recommended that in areas with concentrated spawning or spawning migration seismic shooting be avoided at a distance of ~50 km from these areas.

Indirect effects of seismic shooting on fish include reduced catches resulting from changes in feeding behaviour or vertical distribution (Skalski *et al.* 1992), but information on feeding success of fish (or larger predators) in association with seismic survey noise is lacking.

The physiological effects of seismic sounds from airgun arrays will mainly affect the younger life stages of fish such as eggs, larvae and fry, many of which form a component of the meroplankton and thus have limited ability to escape from their original areas in the event of various influences. Numerous studies have been undertaken experimentally exposing the eggs and larvae of various fish species to airgun sources (Kostyuchenko 1971; Dalen & Knutsen 1987; Holliday *et al*. 1987; Booman *et al.* 1992; Kosheleva 1992; Popper *et al*. 2005, amongst others). These studies generally identified mortalities and physiological injuries at very close range (<5 m) only. For example, increased mortality rates for fish eggs were proven out to ~5 m distance from the air guns. A mortality rate of 40-50% was recorded for yolk sac larvae (particularly for turbot) at a distance of 2-3 m (Booman *et al*. 1996), although mortality figures for yolk sac larvae of anchovies at the same distances were lower (Holliday *et al*. 1987). Yolk sac larvae of cod experienced significant eye injuries (retinal stratification) at a distance of 1 m from an air gun array (Matishov 1992), and Booman *et al*. (1996) report damage to brain cells and lateral line organs at <2 m distance from an airgun array. Increased mortality rates (10-20%) at later stages (larvae, post-larvae and fry) were proven for several species at distances of 1-2 m. Changes have also been observed in the buoyancy of the organisms, in their ability to avoid predators and effects that affect the general condition of larvae, their growth rate and thus their ability to survive. Temporary disorientation juvenile fry was recorded for some species (McCauley 1994). Fish larvae with swim-bladders may be more receptive to the sounds produced by seismic airgun arrays, and the range of effects may extend further for these species than for others.

From a fish resource perspective, these effects may potentially contribute to a certain diminished net production in fish populations. However, Sætre & Ona (1996) calculated that under the "worst case" scenario, the number of larvae killed during a typical seismic survey was 0.45% of the total larvae population. When more realistic "expected values" were applied to each parameter of the calculation model, the estimated value for killed larvae during one run was equal to 0.03% of the larvae population. If the same larval population was exposed to multiple seismic runs, the effect would add up for each run. For species such as cod, herring and capelin, the natural mortality is estimated at 5-15% per day of the total population for eggs and larvae. This declines to 1-3% per day once the species reach the 0 group stage *i.e.* at approximately 6 months (Sætre & Ona 1996). Consequently, Dalen *et al*. (1996) concluded that seismic-created mortality is so low that it can be considered to have an inconsequential impact on recruitment to the populations.

## 4.4. Impacts on Seabirds

Among the marine avifauna of South African waters, it is only the diving birds, or birds which rest on the water surface, that may be affected by the underwater noise of seismic surveys. The African penguin (*Spheniscus demersus*), which is flightless and occurs along the South Coast, would be particularly susceptible to impacts from underwater seismic noise. In African penguins the best hearing is in the 600 Hz to 4 kHz range with the upper limit of hearing at 15 kHz and the lower limit at 100 Hz (Wever *et al*. 1969). No critical ratios have, however, been measured. Principal energy of vocalisation of African penguins was found at <2 kHz, although some energy was measured at up to 6 kHz (Wever *et al*. 1969).

The continuous nature of the intermittent seismic survey pulses suggest that African penguins and other diving birds would hear the sound sources at distances where levels would not induce mortality or injury, and consequently be able to flee an approaching sound source. Consequently, the potential for injury to seabirds from seismic surveys in the open ocean is deemed to be low (see also Stemp 1985, in Turnpenny & Nedwell 1994), particularly given the extensive feeding range of the potentially affected seabird species.

## 4.5. Impacts on Turtles

The potential effects of seismic surveys on turtles include:

- Physiological injury (including disorientation), mortality from seismic noise or collision with or entanglement in towed seismic apparatus;
- Behavioural avoidance of seismic survey areas;

- Masking of environmental sounds and communication; and
- Indirect effects due to effects on prey.

Available data on marine turtle hearing is limited, but suggest highest auditory sensitivity at frequencies of 250 – 700 Hz, and some sensitivity to frequencies at least as low as 60 Hz (Ridgway *et al.* 1969; Wever *et al*. 1978, in McCauley 1994; O'Hara & Wilcox, 1990; Moein-Bartol *et al*. 1999). The overlap of this hearing sensitivity with the higher frequencies produced by airguns, suggest that turtles may be considerably affected by seismic noise.

No information on physiological injury to turtle hearing could be sourced in the literature. If subjected to seismic sounds at close range, temporary or permanent hearing impairment may result, but it is unlikely to cause death or life-threatening injury. As with other large mobile marine vertebrates, it is assumed that sea turtles will avoid seismic noise at levels/distances where the noise is a discomfort. Juvenile turtles may be unable to avoid seismic sounds in the open ocean, and consequently may be more susceptible to seismic noise.

Behavioural changes in response to anthropogenic sounds have been reported for some sea turtles and include startle response (Lenhardt *et al.* 1983), an increase in swim speed and erratic behaviour indicative of avoidance (O'Hara & Wilcox 1990; McCauley *et al*. 2000). Further trials carried out on caged loggerhead and green turtles indicated that significant avoidance response occurred at received levels ranging between 172 and 176 dB re 1 µPa at 24 m, and repeated trails several days later suggest either temporary reduction in hearing capability or habituation with repeated exposure. Hearing however returned after two weeks (Moein *et al.* 1994; McCauley *et al*. 2000).

Observations of marine turtles during a ten-month seismic survey in deep water (1,000-3,000 m) off Angola found that turtle sighting rate during guns-off was double that of full-array seismic activity, although these results should be treated with caution since a large proportion of the sightings occurred during unusually calm conditions and during peak diurnal abundance of turtles when the airguns were inactive (Weir 2007). In contrast, Parente *et al*. (2006), working off Brazil found no significant differences in turtle sightings with airgun state. It is possible that during deep water surveys turtles only detect airguns at close range or are not sufficiently mobile to move away from approaching airgun arrays (particularly if basking for metabolic purposes when they may be slow to react) (Weir 2007). This is in marked contrast to previous assessments that assumed that the impact of seismic noise on behaviour of adult turtles in the open ocean environment is of low significance given the mobility of the animals (CSIR 1998; CCA & CMS 2001). In the study by Weir (2007) a confident assessment of turtle behaviour in relation to seismic status was hindered, however, by the apparent reaction of individual animals to the survey vessel and towed equipment rather than specifically to airgun sound. As these reactions occurred at close range (usually <10 m) to approaching objects, they appeared to be based principally on visual detection.

Although collisions between turtles and vessels are not limited to seismic ships, the large amount of equipment towed astern of survey vessels does increase the potential for collision, or entrapped within seismic equipment and towed surface floats. Basking turtles are particularly slow to react to approaching objects may not be able to move rapidly away from approaching airguns. In the past, almost all reported turtle entrapments were associated with the subsurface structures ('undercarriage') of the tail buoys attached to the end of each seismic cable. Towing points are located on the leading edge of each side of the undercarriage, and these are attached by chains to a swivel leading to the end of the seismic cable (Ketos Ecology 2009). Entrapment occurs either as a result of 'startle diving' in front of towed equipment or following foraging on barnacles and other organisms growing along seismic cables and surfacing to breathe immediately in front of the tail buoy (primarily loggerhead and Olive Ridley turtles). In the first case the turtle becomes stuck within the angled gap between the chains and the underside of the buoy, lying on their sides across the top of the chains and underneath the float with their ventral surface facing the oncoming water thereby causing the turtle to be held firmly in position (Figure 18, left). Depending on the size of the turtle, they can also become stuck within the gap below a tail buoy, which extends to 0.8 m below water level and is ~0.6 m wide. The animal would need to be small enough to enter the gap, but too big to pass all the way through the undercarriage. Furthermore, the presence of the propeller in the undercarriage of some buoy-designs prohibits turtles that have entered the undercarriage from travelling out of the trailing end of the buoy (Figure 18, right). Once stuck inside or in front of a tail buoy, the water pressure generated by the 4–6 knot towing speed, would hold the animal against/inside the buoy with little chance of escape due to the angle of its body in relation to the forward movement of the buoy. For a trapped turtle this situation will be fatal, as it will be unable to reach the surface to breathe (Ketos Ecology 2009). To prevent entrapment, the seismic industry has implemented the use of “turtle guards” on all tailbuoys.

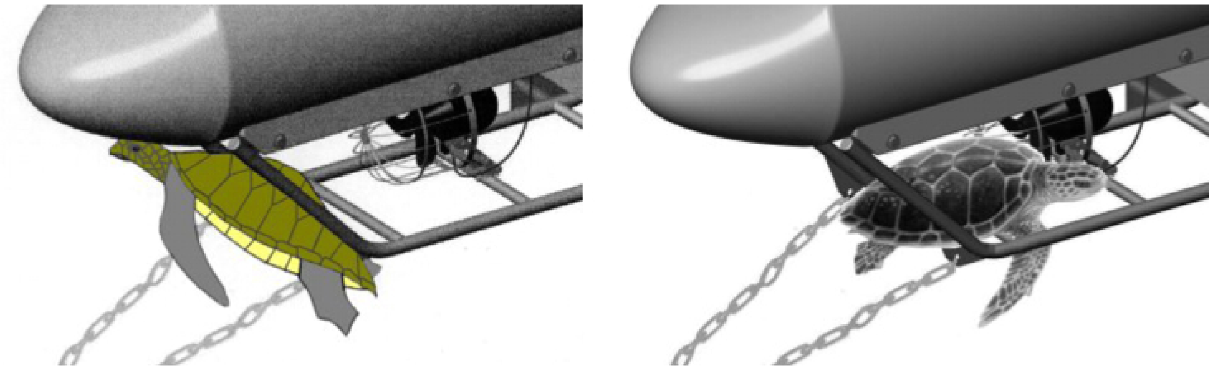

Figure 18: Turtles commonly become trapped in front of the undercarriage of the tail buoy in the area between the buoy and the towing chains (left), and inside the 'twin-fin' undercarriage structure (right) (Ketos Ecology 2009).

Breeding adults of sea turtles undertake large migrations between distant foraging areas and their nesting sites (within the summer months October to March, with peak nesting during December and January). Although Lenhardt *et al*. (1983) speculated that turtles may use acoustic cues for navigation during migrations, information on turtle communication is lacking. The effect of seismic noise in masking environmental cues such as surf noise (150-500 Hz), which overlaps the frequencies of optimal hearing in turtles (McCauley 1994), is unknown and speculative.

## 4.6. Impacts on Seals

The Cape fur seal forages over the continental shelf to depths of over 200 m and would consequently be expected to occur within the proposed seismic survey area.

Underwater behavioural audiograms have been obtained for two species of Otariidae (sea lions and fur seals), but no audiograms have been measured for Cape fur seals. Extrapolation of these audiograms to below 100 Hz would result in hearing thresholds of approximately 140-150 dB re 1 µPa for the California sea lion and well above 150 dB re 1 µPa for the Northern fur seal. The range of greatest sensitivity in fur seals lies between the frequencies of 2-32 kHz (McCauley 1994). Underwater critical ratios have been measured for two northern fur seals and averaged ranged from 19 dB at 4 kHz to 27 dB at 32 kHz. The audiograms available for otariid pinnipeds suggest they are less sensitive to low frequency sounds (<1 kHz) than to higher frequency sounds (>1 kHz). The range of low frequency sounds (30-100 Hz) typical of seismic airgun arrays thus falls below the range of greatest hearing sensitivity in fur seals. This generalisation should, however, be treated with caution as no critical ratios have been measured for Cape fur seals.

Seals produce underwater sounds over a wide frequency range, including low frequency components. Although no measurement of the underwater sounds have been made for the Cape fur seal, such measurements have been made for a con-generic species *Arctocephalus philippii*, which produced narrow-band underwater calls at 150 Hz. Aerial calls of seals range up to 6 Hz, with the dominant energy in the 2-4 kHz band. However, these calls have strong tonal components below 1 kHz, suggesting some low frequency hearing capability and therefore some susceptibility to disturbance from the higher frequency components of seismic airgun sources (Goold & Fish 1998; Madsen *et al*. 2006).

The potential impact of seismic survey noise on seals could include physiological injury to individuals, behavioural avoidance of individuals (and subsequent displacement from key habitat), masking of important environmental or biological sounds and indirect effects due to effects on predators or prey.

The physiological effects of loud low frequency sounds on seals are not well documented, but include cochlear lesions following rapid rise time explosive blasts (Bohne *et al*. 1985; 1986), temporary threshold shifts (TTS) following exposure to octave-band noise (frequencies ranged from 100 Hz to 2000 Hz, octave-band exposure levels were approximately 60–75 dB, while noise-exposure periods lasted a total of 20–22 min) (Kastak *et al*. 1999), with recovery to baseline threshold levels within 24 h of noise exposure.

Using measured discomfort and injury thresholds for humans, Greenlaw (1987) modelled the pain threshold for seals and sea lions and speculated that this pain threshold was in the region of 185 – 200 dB re 1 µPa. The impact of physiological injury to seals from seismic noise is deemed to be low as it is assumed that highly mobile creatures such as fur seals would avoid severe sound sources at levels below those at which discomfort occurs. However, noise of moderate intensity and duration may be sufficient to induce TTS under water in pinniped species (Kastak *et al*. 1999). Reports of seals swimming within close proximity of firing airguns should thus be interpreted with caution in terms of the impacts on individuals as such individuals may well be experiencing hearing threshold shifts.

Information on the behavioural response of fur seals to seismic exploration noise is lacking (Richardson *et al*. 1995; Gordon *et al*. 2004). Reports of studies conducted with Harbour and Grey seals include initial startle reaction to airgun arrays, and range from partial avoidance of the area close to the vessel (within 150 m) (Harris *et al*. 2001) to fright response (dramatic reduction in heart rate), followed by a clear change in behaviour, with shorter erratic dives, rapid movement away from the noise source and a complete disruption of foraging behaviour (Gordon *et al*. 2004). In most cases, however, individuals quickly reverted back to normal behaviour once the seismic shooting ceased and did not appear to avoid the survey area. Seals seem to show adaptive responses by moving away from airguns and reducing the risk of sustaining hearing damage. Potential for long-term habitat exclusion and foraging disruption over longer periods of exposure (*i.e*. during full-scale surveys conducted over extended periods) is however a concern.

Cape fur seals generally appear to be relatively tolerant to noise pulses from underwater explosives, which are probably more invasive than the slower rise-time seismic sound pulses. There are also reports of Cape fur seals approaching seismic survey operations and individuals biting hydrophone streamers (CSIR 1998). This may be related to their relative insensitivity to sound below 1 kHz and their tendency to swim at or near the surface, exposing them to reduced sound levels. It has also been suggested that this attraction is a learned response to towed fishing gear being an available food supply.

## 4.7. Impacts on Whales and Dolphins

The cetaceans comprise baleen whales (mysticetes) and toothed whales and dolphins (odontocetes). The potential impact of seismic survey noise on cetaceans includes a) physiological injury to individuals, b) behavioural disturbance (and subsequent displacement from key habitat), c) masking of important environmental or biological sounds, or d) effects due to indirect effects on prey. Reactions of cetaceans to anthropogenic sounds have been reviewed by McCauley (1994), Richardson *et al.* (1995), Gordon & Moscrop (1996) and Perry (1998). More recently reviews have focused specifically on the effects of sounds from seismic surveys on marine mammals (DFO 2004; NRC 2005; Nowacek *et al.* 2007; Southall *et al*. 2007; Abgrall *et al*. 2008, amongst others).

### 4.7.1 Cetacean vocalisations

Cetacean are highly reliant on acoustic channels for orientation in their environment, feeding and social communication (Tyack & Clark 2000). Baleen whales produce a wide repertoire of sounds ranging in frequencies from 12 Hz to 8 kHz (Richardson *et al.* 1995). Vocalisations may be produced throughout the year (Dunlop *et al*. 2007; Mussoline *et al.* 2012; Vu *et al.* 2012), with peaks in call rates during breeding seasons in some species, most notably humpback whales (Winn & Winn 1978).

Odontocetes produce a spectrum of vocalizations including whistles, pulsed sounds and echolocation clicks (Popper 1980). Whistles play a key role in social communication, they are concentrated in the 1-30 kHz frequency range but may extend up to 75 kHz (Samarra *et al.* 2010) and contain high frequency harmonics (Lammers *et al.* 2003). The characteristics of burst pulsed sounds are highly variable, concentrated in the mid frequency for killer whales

(Richardson *et al*. 1995), but extending well into the ultrasonic frequency range for other dolphin species (Lammers *et al.* 2003). Although most odontocete vocalizations are predominantly in mid and high frequency bands, there are recent descriptions of dolphins producing low frequency moans (150-240 Hz) and low frequency modulated tonal calls (990 Hz) (van der Woude 2009; Simrad *et al.* 2012), the function of which remains unclear but may be related to social behaviours.

Clicks are high intensity, short sounds associated with orientation and feeding. The frequency composition of echolocation clicks varies with species. Most delphinids produce broad band echolocation clicks with frequencies which extend well up into the ultra-sonic range > 100 kHz (Richardson *et al.* 1995). Sperm whales produce broadband echolocation clicks reaching up to 40 kHz in frequency (Backus & Schevill 1966; Madsen *et al.* 2002). Neonatal sperm whales produce lower frequency sounds at 300-1700 Hz (Madsen *et al.* 2003). Porpoise, Kogiids and dolphins in the genus *Cephalorhynchus* (including the Heaviside's dolphin) produce characteristic narrow band, high frequency (NBHF) echolocation clicks with a central frequency around 125 kHz (Madsen *et al.* 2005a; Morisaka *et al.* 2011). Beaked whales produce low frequency sounds (Richardson *et al.*, 1995) and mid frequency echolocation clicks, burst pulse vocalisations and frequency modulated pulses with energy concentrated at 10 kHz and above (Madsen *et al.* 2005b; Rankin *et al.* 2011).

#### 4.7.2 Cetacean hearing

Cetacean hearing has received considerable attention in the international literature, and available information has been reviewed by several authors including Popper (1980), Fobes & Smock (1981), Schusterman (1981), Ridgway (1983), Watkins & Wartzok (1985), Johnson (1986), Moore & Schusterman (1987) and Au (1993).

Marine mammals as a group have wide variations in ear anatomy, frequency range and amplitude sensitivity. The hearing threshold is the amplitude necessary for detection of a sound and varies with frequency across the hearing range (Nowacek *et al*. 2007). Considerable differences also exist between the hearing sensitivities of baleen and toothed whales and dolphins and between individuals, resulting in different levels of sensitivity to sounds at varying frequencies.

The factors that affect the response of marine mammals to sounds in their environment include the sound level and other properties of the sound, the physical and behavioural state of the animal and its prevailing acoustic characteristics, and the ecological features of the environment in which the animal encounters the sound. The responses of cetaceans to noise sources are often also dependent on the perceived motion of the sound source, as well as the nature of the sound itself. For example, many whales are more likely to tolerate a stationary source than they are one that is approaching them (Watkins 1986; Leung-Ng & Leung 2003), or are more likely to respond to a stimulus with a sudden onset than to one that is continuously present (Malme *et al*. 1985).

For most species the best frequency sensitivity corresponds closely to the frequencies at which they vocalise. Consequently, baleen whale hearing is centred at below 1 kHz (Fleischer 1976, 1978; Norris & Leatherwood 1981), while toothed whale and dolphin hearing is centred at frequencies of between 10 and 100 kHz (Richardson *et al.*1995). The combined information strongly suggests that baleen whales are likely to be most sensitive to sounds from 10's of Hz to around 10 kHz (Southall *et al.,* 2007), while toothed whale and dolphin hearing is centred at frequencies of between 10 and 100 kHz (Richardson *et al.*1995). However, no psycho-acoustical or electrophysical work on the sensitivity of baleen whales to sound has been conducted (Richardson *et al.*, 1995) and hypotheses regarding the effects of sound in baleen whales are extrapolations from what is known to affect odontocetes or other marine mammals and from observations of behavioural responses. A partial response "audiogram" exists for the gray whale based on the avoidance of migrating whales to a pure tone source (Dahlheim & Ljungblad 1990). Frankel *et al.* (1995), in Perry 1998) found humpback whales in the wild to detect sounds ranging from 10 Hz to 10 kHz at levels of 102 to 106 dB re 1 μPa. Blue whales reduce calling in the presence of mid-frequency sonar (1-8 kHz) providing evidence that they are receptive to sound in this range (Melcón *et al.* 2012). Based on the low frequency calls produced by larger toothed whales, and anatomical and paleaontological evidence for baleen whales, it is predicted that these whales hear best in the low frequencies (Fleischer 1976, 1978; McCauley 1994), with hearing likely to be most acute below 1 kHz (Fleischer 1976, 1978; Norris & Leatherwood 1981). The available information demonstrates that the larger toothed whales and baleen whales will be very receptive to the sound produced by seismic airgun arrays and consequently this group may be more affected by this type of disturbance than toothed whales (Nowacek *et al.*, 2007).

Behavioural and electrophysical audiograms are available for several species of small- to medium-sized toothed whales (killer whale: Hall & Johnson 1972; Bain *et al.* 1993, false killer whale: Thomas *et al.* 1988, bottlenose dolphins: Johnson 1967, beluga: White *et al.* 1978; Awbrey *et al.* 1988, Harbour porpoise: Andersen 1970, Chinese river dolphin: Ding Wang *et al.* 1992 and Amazon river dolphin: Jacobs & Hall 1972; Risso's dolphin: Nachtigall *et al.* 1995, 1996, Harbour porpoise: Luke *et al*. 2009). In these species, hearing is centered at frequencies between 10 and 100 kHz (Richardson *et al.*1995). The high hearing thresholds at low frequency for those species tested implies that the low frequency component of seismic shots (10 - 300 Hz) will not be audible to the small to medium odontocetes at any great distance. However, the higher frequency of an airgun array shot, which can extend to 15 kHz and above (Madsen *et al.* 2006) may be audible from tens of kilometres away, due to the very low sensitivity thresholds of many toothed whales at frequencies exceeding 1 kHz. Although the match is poor, overlap nonetheless exists between the frequency spectra of seismic shots and the hearing threshold curve with frequency for some toothed whale species, suggesting that these may react to seismic shots at long ranges, but that hearing damage from seismic shots is only likely to occur at close range. They will thus not be affected as severely as many fish, and possibly sea turtles and baleen whales that have their greatest hearing sensitivity at low frequencies (McCauley 1994).

#### 4.7.3 Physiological injury

Exposure to high sound levels can result in physiological injury to cetaceans through a number of avenues, including shifts of hearing thresholds (as either permanent (PTS) or temporary threshold shifts (TTS)) (Richardson *et al.* 1995; Au *et al.* 1999; Schlundt *et al.* 2000; Finneran *et al.* 2000, 2001, 2003), tissue damage (Lien *et al.* 1993; Ketten *et al.* 1993), acoustically induced decompression sickness particularly in beaked whales (Crum & Mao 1996; Cox *et al.*

2006), and non-auditory physiological effects including elevated blood pressures, increased heart and respiration rates, and temporary increases in blood catecholamines and glucocorticoids (Bowles & Thompson 1996), which may have secondary impacts on reproduction. Most studies conducted on sound-related injuries in cetaceans, however, investigated the effects of explosive pulses (Bohne *et al.* 1985, 1986; Lien *et al.* 1993; Ketten *et al.* 1993) and mid-frequency sonar pulses (Simmonds & Lopez-Jurado 1991; Crum & Mao 1996; Frantzis 1998; Balcomb & Claridge 2001; Evans & England 2001; Jepson *et al.* 2003; Cox *et al.* 2006), and the results are thus not directly applicable to non-explosive seismic sources such as those from airgun arrays.

Noise induced stress resulting from exposure to sources of marine sound can cause detrimental changes in blood hormones, including cortisol (Romano *et al.* 2004). However, quantifying stress caused by noise in wild populations is difficult as it is not possible to determine the physiological responses of an animal to a noise stressor based on behavioural observations alone (Wright *et al*. 2007). The timing of the stressor relative to seasonal feeding and breeding cycles (such as those observed in migrating baleen whales) may also influence the degree of stress induced by noise exposure (Tyack 2008)

There are no data on received levels that would induce permanent threshold shifts (PTS) in cetaceans, although Richardson *et al.* (1995) speculated that very prolonged exposure to noise levels of about 120 dB re 1μPa may induce PTS in beluga whales. Gradual PTS in marine mammals is highly unlikely to occur from seismic surveys. However, permanent hearing damage does not always develop gradually, but may result from brief exposure to high sound levels.

Experiments to induce threshold shifts have only recently been conducted on captive marine mammals (Au *et al.* 1999; Schlundt *et al.* 2000, Finneran *et al.* 2000, 2001, 2002, 2003). Temporary threshold shifts (TTS) became evident at received levels of 194 - 201 dB re 1 μPa at 3 kHz, 193-196 dB at 20 kHz and 192-194 dB at 75 kHz in a bottlenose dolphin exposed to 1-second pulses underwater. However, the relatively long 1-second pulse that elicited the TTS response supplies considerably more energy to the water column than a very much shorter seismic pulse. Finneran *et al.* (2003) found a 226 dB re 1 μPa (peak) was required to create TTS in a beluga, and no TTS was observed in a dolphin at up to 230 dB (peak) using a water gun. Airgun stimuli played back to harbor porpoise (a NBHF species with similar vocal characteristics and body size to Heaviside's dolphin) generated a TTS in the 4 kHz band at a received sound pressure level of 199.7 $db_{pk\text{-}pk}$ re 1 μPa and a sound exposure level of of 164.3 dB re 1 $\_Pa^2$ s. Avoidance of the sound source was also observed (Luke *et al.* 2009). Based on statistical simulations accounting for uncertainty in the available data and variability in individual hearing thresholds, Gedamke *et al.* (2011) conclude that the possibility of seismic activity leading to TTS in baleen whales must be considered at distances up to several kilometers. As cetaceans are highly reliant on sound, hearing damage leading to TTS and PTS are likely to result in a reduction in foraging efficiency, reproductive potential, social cohesion and ability to detect predators (Weilgart 2007).

Overlap between the frequency spectra of seismic shots and the hearing threshold curve with frequency for some toothed whale species, suggests that these may react to seismic shots at long ranges, but that hearing damage from seismic shots is only likely to occur at close range. They will thus not be affected as severely as many fish, and possibly sea turtles and baleen whales that have their greatest hearing sensitivity at low frequencies (McCauley 1994). Richardson *et al.* (1995) speculated that the Damage Risk Criteria (DRC) (*i.e.* the tolerable limits for noise exposure) for a marine mammal exposed to 100 seismic pulses might be in the order of 178 – 208 dB re 1µPa. They note, however, that as the duration of peak pressure is less than 200 ms, hearing damage is unlikely unless peak to peak pressure is several dB above these.

#### 4.7.4 Behavioural disturbance

Typical behavioural response in cetaceans to seismic airgun noise include initial startle responses (Malme *et al.* 1985; Ljungblad *et al.* 1988; McCauley *et al.* 2000), changes in surfacing behaviour (Ljungblad *et al.* 1988; Richardson *et al.* 1985a; McCauley *et al.* 1996, 2000), shorter dives (Ljungblad *et al.* 1988), changes in respiration rate (Ljungblad *et al.* 1988; Richardson *et al.* 1985a, 1985b, 1986; Malme *et al.* 1983, 1985,1986), slowing of travel (Malme *et al.* 1983, 1984), and changes in vocalisations (McDonald *et al.* 1993, 1995) and call rate (Di Iorio & Clarke 2010). These subtle changes in behavioural measures are often the only observable reaction of whales to reception of anthropogenic stimuli, and there is no evidence that these changes are biologically significant for the animals (see for example McCauley 1994). Possible exceptions are impacts at individual (through reproductive success) and population level through disruption of feeding within preferred areas (as reported by Weller *et al.* (2002) for Western gray whales). For continuous noise, whales begin to avoid sounds at exposure levels of 110 dB, and more than 80% of species observed show avoidance to sounds of 130 dB. For seismic noise, most whales show avoidance behaviour above 160 dB (Malme *et al.* 1983, 1984; Ljungblad *et al.* 1988; Pidcock *et al*. 2003). Behavioural responses are often evident beyond 5 km from the sound source (Ljungblad *et al.* 1988; Richardson *et al.* 1986, 1995), with the most marked avoidance response recorded by Kolski and Johnson (1987) who reported bowhead whales swimming rapidly away from an approaching seismic vessel at a 24 km distance.

In an analysis of marine mammals sightings recorded from seismic survey vessels in United Kingdom waters, Stone (2003) reported that responses to large gun seismic activity varied between species, with small odontocetes showing the strongest avoidance response. Responses of medium and large odontocetes (killer whales, pilot whales and sperm whales) were less marked, with sperm whales showing no observable avoidance effects (see also Rankin & Evans 1998; Davis *et al.* 2000; Madsen *et al*. 2006). Baleen whales showed fewer responses to seismic survey activity than small odontocetes, and although there were no effects observed for individual baleen whale species, fin and sei whales were less likely to remain submerged during firing activity. All baleen whales showed changes in behavioural responses further from the survey vessel (see also Ljungblad *et al.* 1988; McCauley 2000; Abgrall *et al*. 2008), and both orientated away from the vessel and altered course more often during shooting activity. The author suggests that different species adopt different strategies in response to seismic survey disturbance, with faster smaller odontocetes fleeing the survey area (e.g. Weir 2008), while larger slower moving baleen whales orientate away from and move slowly from the firing guns, possibly remaining on the surface as they do so (see also Richardson *et al.* 1985a, 1985b, 1986, 1995). Responses to small airguns were less, and although no difference in distance to firing and non-firing small airguns were recorded, there were fewer sightings of small odontocetes in association with firing airguns. Other reports suggest that there is little effect of seismic surveys on small odontocetes such as dolphins, as these have been reported swimming near operating seismic vessels (Duncan 1985; Evans & Nice 1996; Abgrall *et al*. 2008; but see also Schlundt *et al.* 2000).

McCauley *et al.* (1996, 2000) found no obvious evidence that humpback whales were displaced by 2D and 3D seismic surveys and no apparent gross changes in the whale's migratory path could be linked to the seismic survey. Localised avoidance of the survey vessel during airgun operation was however noted. Whales which are not migrating but using the area as a calving or nursery ground may be more seriously affected through disturbance of suckling or resting. Potential avoidance ranges of 7-12 km by nursing animals have been suggested, although these might differ in different sound propagation conditions (McCauley *et al.* 2000). Disturbance of mating behaviour (which could involve a high degree of acoustic selection) by seismic noise could be of consequence to breeding animals.

The speed of sound increases with increasing temperature, salinity and pressure (Richardson *et al.* 1995) and stratification in the water column affects the rate of propagation loss of sounds produced by an airgun array. As sound travels, acoustic shadow and convergence zones may be generated as sound is refracted towards areas of slower sound speed. These can lead to areas of high and low noise intensity (shadow zones) so that exposure to different pulse components at distances of 1-13 km from the seismic source does not necessarily lessen (attenuate) with increasing range. In some cases this can lead to received levels at 12 km being as high as those at 2 km (Madsen *et al.* 2006). Depending on the propagation conditions of the water column, animals may need to move closer to the sound source or apply vertical rather than horizontal displacement to reduce their exposure. Although such movement may reduce received levels in the short-term it may prolong the overall exposure time and accumulated sound exposure level (SEL) (Madsen *et al.* 2006).

### 4.7.5 Masking of important environmental or biological sounds

Potential interference of seismic emissions with acoustic communication in cetaceans includes direct masking of the communication signal, temporary or permanent reduction in the hearing capability of the animal through exposure to high sound levels or limited communication due to behavioural changes in response to the seismic sound source. Baleen whales generally appear to vocalise almost exclusively within the frequency range of the maximum energy of seismic sounds, while toothed whales vocalise at much higher frequencies, and it is likely that clicks are not masked by seismic survey noise (Goold & Fish 1998). However, due to multi-path propagation, receivers (cetaceans) can be subject to several versions of each airgun pulse, which have very different temporal and spectral properties (Madsen *et al.* 2006). High frequency sound is released as a by-product of airgun firing and this can extend into the mid- and high-frequency range (up to and exceeding 15 kHz) so that the potential for masking of these sound sources should be also considered (Madsen *et al.* 2006).

### 4.7.6 Indirect effects on prey species

The majority of baleen whales will undertake little feeding within breeding ground waters on the South Coast and rely on blubber reserves during their migrations. Although the fish and cephalopod prey of toothed whales and dolphins may be affected by seismic surveys, impacts will be highly localised and small in relation to the feeding ranges of cetacean species.

# 5. ASSESSMENT OF ACOUSTIC IMPACTS ON MARINE FAUNA

## 5.1. Assessment Procedure

The following convention was used to determine significance ratings in the assessment:

| Rating | Definition of Rating |
|---|---|
| *Extent – defines the physical extent or spatial scale of the impact* | |
| Local | Extending only as far as the activity, limited to the site and its immediate surroundings |
| Regional | Limited to the South Coast |
| National | Limited to the coastline of South Africa |
| International | Extending beyond the borders of South Africa |
| *Duration – the time frame over which the impact will be experienced* | |
| Short-term | 0 – 5 years |
| Medium-term | 6 – 15 years |
| Long-term | Where the impact would cease after the operational life of the activity, either because of natural processes or by human intervention |
| Permanent | Where mitigation either by natural processes or by human intervention would not occur in such a way or in such time span that the impact can be considered transient |
| *Intensity – establishes whether the magnitude of the impact is destructive or benign in relation to the sensitivity of the receiving environment* | |
| Low | Where natural environmental functions and processes are not affected |
| Medium | Where the affected environment is altered, but natural functions and processes continue, albeit in a modified way |
| High | Where environmental functions and processes are altered to the extent that they temporarily or permanently cease |

Using the core criteria above, the significance of the impact is determined:

| | |
|---|---|
| *Significance – attempts to evaluate the importance of a particular impact, and in doing so incorporates extent, duration and intensity* | |
| VERY HIGH | Impacts could be EITHER:<br>of high intensity at a regional level and endure in the long term;<br>OR of high intensity at a national level in the medium term;<br>OR of medium intensity at a national level in the long term. |
| HIGH | Impacts could be EITHER:<br>of high intensity at a regional level enduring in the medium term;<br>OR of high intensity at a national level in the short term;<br>OR of medium intensity at a national level in the medium term;<br>OR of low intensity at a national level in the long term;<br>OR of high intensity at a local level in the long term;<br>OR of medium intensity at a regional level in the long term. |

| *Significance – attempts to evaluate the importance of a particular impact, and in doing so incorporates extent, duration and intensity* | |
|---|---|
| MEDIUM | Impacts could be EITHER:<br>of high intensity at a local level and endure in the medium term;<br>OR of medium intensity at a regional level in the medium term;<br>OR of high intensity at a regional level in the short term;<br>OR of medium intensity at a national level in the short term;<br>OR of medium intensity at a local level in the long term;<br>OR of low intensity at a national level in the medium term;<br>OR of low intensity at a regional level in the long term. |
| LOW | Impacts could be EITHER<br>of low intensity at a regional level, enduring in the medium term;<br>OR of low intensity at a national level in the short term;<br>OR of high intensity at a local level and endure in the short term;<br>OR of medium intensity at a regional level in the short term;<br>OR of low intensity at a local level in the long term;<br>OR of medium intensity at a local level, enduring in the medium term. |
| VERY LOW | Impacts could be EITHER<br>of low intensity at a local level and endure in the medium term;<br>OR of low intensity at a regional level and endure in the short term;<br>OR of low to medium intensity at a local level, enduring in the short term. |
| INSIGNIFICANT | Impacts with:<br>Zero intensity with any combination of extent and duration. |
| UNKNOWN | Where it is not possible to determine the significance of an impact. |

| *Status of the Impact – describes whether the impact would have a negative, positive or zero effect on the affected environment* | |
|---|---|
| Positive | The impact benefits the environment |
| Negative | The impact results in a cost to the environment |
| Neutral | The impact has no effect |
| *Probability – the likelihood of the impact occurring* | |
| Improbable | Possibility very low either because of design or historic experience |
| Probable | Distinct possibility |
| Highly Probable | Most likely |
| Definite | Impact will occur regardless of preventive measures |
| *Degree of confidence in predictions – in terms of basing the assessment on available information and specialist knowledge* | |
| Low | Less than 35% sure of impact prediction. |
| Medium | Between 35% and 70% sure of impact prediction. |
| High | Greater than 70% sure of impact prediction |

Additional criteria to be considered, which could "increase" the significance rating are:

- Permanent / irreversible impacts (as distinct from long-term, reversible impacts);
- Potentially substantial cumulative effects; and
- High level of risk or uncertainty, with potentially substantial negative consequences.

Additional criteria to be considered, which could "decrease" the significance rating are:

- Improbable impact, where confidence level in prediction is high.

The relationship between the significance ratings after mitigation and decision-making can be broadly defined as follows:

| *Significance after Mitigation - considering changes in intensity, extent and duration after mitigation and assuming effective implementation of mitigation measures* | |
|---|---|
| Very Low; Low | Will not have an influence on the decision to proceed with the proposed project, provided that recommended measures to mitigate negative impacts are implemented. |
| Medium | Should influence the decision to proceed with the proposed project, provided that recommended measures to mitigate negative impacts are implemented. |
| High; Very High | Would strongly influence the decision to proceed with the proposed project. |

## 5.2. Assessment of Impacts

Total anticipate a source volume of between 4,000 and 5,000 cubic inches would be used for the proposed survey with a low range of operational frequency, mostly below 100 Hz. The survey would use an output volume typical of general worldwide exploration practice and standards and in the neighbourhood of 250 dB re 1 mPa at 1 m.

### 5.2.1 Impacts to Plankton (including ichthyoplankton)

Potential impacts of seismic pulses on plankton and fish eggs and larvae would include mortality or physiological injury in the immediate vicinity of the airgun sound source. Impacts will thus be of high intensity at very close range (<5 m from the airguns) only, and no more significant than the effect of the wash from ships propellers and bow waves. The proposed survey area overlaps to some degree with hake and anchovy, pilchard, round herring, and horse mackerel spawning areas on the Agulhas Bank (see Figure 4). However, as plankton distribution is naturally temporally and spatially variable and natural mortality rates are high, any impacts would be of low to negligible intensity across the survey area and for the duration of the survey (short-term). The potential impact of seismic noise on plankton is consequently deemed to be of **VERY LOW** significance both with and without mitigation. No mitigation measures for potential impacts on plankton and fish egg and larval stages are feasible or deemed necessary.

**Mitigation**

Dalen *et al.* (1996) recommended that seismic survey activities should avoid areas of concentrated spawning or spawning migration paths by 50 km, particularly areas subjected to repeated, high intensity surveys. For the current proposed seismic survey, there is potential overlap of the target area with the spawning grounds of various small pelagic and demersal species on the Agulhas Bank. No overlap is, however, expected with squid spawning grounds in the Cape St Francis to Port Elizabeth area, or with the distribution of pilchard and anchovy eggs north of Port Elizabeth. Various reef fish are also reported to spawn on deep-water reefs along the South Coast and undertake spawning migrations eastwards along the coast to KwaZulu-Natal. The extreme offshore location of the proposed survey area, however, suggests that overlap will be minimal. Furthermore, considering the spatial extent of the spawning areas, the limited overlap of the proposed survey area with these, and the low frequency of seismic surveys in the area, mitigation is not deemed necessary.

| *Impacts of seismic noise to plankton and ichthyoplankton* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | Low | Low |
| **Significance** | Very Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Probable | Probable |
| **Confidence** | Medium | Medium |

### 5.2.2 Impacts to Marine Invertebrates

Although some marine invertebrates have mechanoreceptors or statocyst organs that are sensitive to hydroacoustic disturbances, most do not possess hearing organs that perceive sound pressure. Potential impacts of seismic pulses on invertebrates include physiological injury and behavioural avoidance of seismic survey areas. Masking of environmental sounds and indirect impacts due to effects on predators or prey have not been documented and are highly unlikely.

**Physiological injury and mortality**

There is little published information on the effects of seismic surveys on invertebrate fauna. It has been postulated, however, that shellfish, crustaceans and most other invertebrates can only hear seismic survey sounds at very close range, such as less than 15 m away. This implies that only surveys conducted in very shallow water will have any detrimental effects on invertebrates associated with the seabed. A species of potential concern in the proposed survey area is the commercially fished deep-water rock lobster (*Palinurus gilchristi*), which occurs on rocky substrate in depths of 90 - 170 m. However, as the survey would be conducted in excess of 100 m depth the received noise at the seabed would be within the far-field range, and outside of distances at which physiological injury of benthic invertebrates would be expected.

Although causative links to seismic surveys have not been established with certainty, giant squid strandings coincident with seismic surveys have been reported (Guerra *et al*. 2004). The animals showed no external damage, but all had severe internal injuries (including disintegrated muscles and unrecognisable organs) indicative of having ascended from depth too quickly.

The potential impact of seismic noise on physiological injury or mortality of invertebrates is, however, deemed of low to negligible intensity across the survey area and for the survey duration and is considered to be of **VERY LOW** significance both with and without mitigation. No mitigation measures for potential impacts on marine invertebrates and their larvae are feasible or deemed necessary.

**Behavioural avoidance**

Similarly, there is little published information on the effects of seismic surveys on the response of invertebrate fauna to seismic impulses. Limited avoidance of airgun sounds may occur in mobile neritic and pelagic invertebrates and is deemed to be of low intensity. As the received noise at the seabed would be within the far-field range, and outside of distances at which avoidance of benthic invertebrates would be expected, the potential impact of seismic noise on invertebrate behaviour is consequently deemed of low to negligible intensity across the survey area and for the survey duration and is considered to be of **VERY LOW** significance both with and without mitigation, and no mitigation measures are deemed necessary.

The squid (*Loligo vulgaris reynaudii*) occurs extensively on the Agulhas Bank out to the shelf edge (500 m depth contour). Adults are normally distributed in waters >100 m, except along the eastern half of the South Coast where they also occur inshore, forming dense seasonal spawning aggregations at depths between 20 - 130 m. As squid are reported to significantly alter their behaviour at an estimated 2 - 5 km from an approaching large seismic source (McCauley *et al.* 2000), avoidance of airgun sounds by squid may thus occur when surveying in the north-eastern corner of the block. Avoidance is deemed to be of medium intensity across the survey area and for the survey duration and is considered to be of **LOW** significance without mitigation and **VERY LOW** significance with mitigation. A possible mitigation measure would be to avoid surveying in the area off Port Elizabeth in November and December during the peak spawning aggregations. This is also the time when the highest catches are made by the commercial fishery. Interaction with the fleet is likely to be minimal, however, as they focus fishing efforts in nearshore waters.

| *Impacts of seismic noise to marine invertebrates resulting in physiological injury* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | Low | Low |
| **Significance** | Very Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Probable | Probable |
| **Confidence** | Medium | Medium |

| *Impacts of seismic noise to marine invertebrates resulting in behavioural avoidance* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | Low | Low |
| **Significance** | Very Low – Low (squid) | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Probable | Probable |
| **Confidence** | Medium | Medium |

### 5.2.3 Impacts to Fish

A review of the available literature suggests that potential impacts of seismic pulses to fish (including sharks) species could include physiological injury and mortality, behavioural avoidance of seismic survey areas, masking of environmental sounds and communication, and indirect impacts due to effects on predators or prey.

**Physiological injury and mortality**

The greatest risk of physiological injury from seismic sound sources is for species that establish home ranges on shallow-water reefs or congregate in inshore waters to spawn or feed, and those displaying an instinctive alarm response to hide on the seabed or in the reef rather than flee. Large demersal or reef-fish species with swim-bladders are also more susceptible than those without this organ. Such species may suffer physiological injury or severe hearing damage and adverse effect may intensify and last for a considerable time after the termination of the sound source. However, as the proposed survey will be located more than 100 km offshore in water depths in excess of 200 m, the received noise by demersal species at the seabed would be within the far-field range, and outside of distances at which physiological injury or avoidance would be expected. Given the high mobility of most fish that occur offshore of the 200 m isobath, particularly the highly migratory pelagic species likely to be encountered in deeper water, it is assumed that the majority of fish species would avoid seismic noise at levels below those where physiological injury or mortality would result. In many of the large pelagic species, however, the swim-bladders are either underdeveloped or absent, and the risk of physiological injury through damage of this organ is therefore lower. Possible injury or mortality in pelagic species could occur on initiation of a sound source at full pressure in the immediate vicinity of fish, or where reproductive or feeding behaviour override a flight response to seismic survey sounds. As there are various seamounts and important fishing banks in the survey area, the likelihood of encountering feeding aggregations of large pelagic species is high. The potential physiological impact on migratory pelagic species, would be of high intensity, but the duration of the impact on the population would be limited to the short-term. The potential physiological impact on demersal and deep-water reef species would, however, be insignificant as they would only be affected in the far-field range. The impact on the population would be of high intensity but limited to the short-term. The impact is therefore considered to be of **LOW** significance without the implementation of mitigation measures, and of **VERY LOW** significance with mitigation measures.

**Behavioural avoidance**

Behavioural responses such as avoidance of seismic survey areas and changes in feeding behaviours of some fish to seismic sounds have been documented at received levels of about 160 dB re 1 μPa. Behavioural effects are generally short-term, however, with duration of the effect being less than or equal to the duration of exposure, although these vary between species and individuals, and are dependent on the properties of the received sound. The potential impact on fish behaviour could therefore be of high intensity (particularly in the near-field of the airgun array), over the short term, but limited to the survey area. Consequently it is considered to be of **LOW** significance without mitigation and **VERY LOW** significance with mitigation.

**Reproductive success / spawning**

Fish populations can be further impacted if behavioural responses result in deflection from migration paths or disturbance of spawning. If fish on their migration paths or spawning grounds are exposed to powerful external forces, they may be disturbed or even cease spawning altogether thereby affecting recruitment to fish stocks. The magnitude of effect in these cases will depend on the biology of the species and the extent of the dispersion or deflection. Considering the wide range over which the potentially affected species occur, the relatively short duration of the proposed survey and that the migration routes do not constitute narrow restricted paths, the impact is considered to be of **LOW** significance without the implementation of mitigation measures, and of **VERY LOW** significance with mitigation measures.

Indirect effects of mortality to ichthyoplankton (assessed in Section 5.2.1) on recruitment to adult fish populations is also considered to be of **VERY LOW** significance both with and without mitigation.

**Masking of environmental sounds and communication**

Communication and the use of environmental sounds by fish in the offshore environment off the South African South Coast are unknown. Some nearshore reef species, however, are likely to produce isolated sounds or to call in choruses. Impacts arising from masking of sounds are expected to be of low intensity due to the duty cycle of seismic surveys in relation to the more continuous biological noise. Furthermore, as the survey would be conducted at depths in excess of 200 m, any effects on demersal fish species would be in the far field. Such impacts would occur across the survey area and for the duration of the survey and are consequently considered of **VERY LOW** significance both with and without mitigation.

**Indirect impacts due to effects on predators or prey**

The assessment of indirect effects of seismic surveys on fish is limited by the complexity of trophic pathways in the marine environment. The impacts are difficult to determine, and would depend on the diet make-up of the fish species concerned and the effect of seismic surveys on the diet species. Indirect impacts of seismic surveying could include attraction of predatory species such as sharks and tunas to pelagic fish stunned by seismic noise. In such cases where feeding behaviour overrides a flight response to seismic survey sounds, injury or mortality could result if the seismic sound source is initiated at full power in the immediate vicinity of the feeding predators. Little information is available on the feeding success of large migratory species in association with seismic survey noise. Considering the extensive range over which large pelagic fish species feed in relation to the survey area the impact is likely to be of **VERY LOW** significance both with and without mitigation.

**Mitigation**

Recommendations for mitigation include:

- All initiation of airgun firing be carried out as "soft-starts" of at least 20 minutes duration, allowing fish to move out of the survey area and thus avoid potential physiological injury as a result of seismic noise.
- No survey-related activities are to take place within Marine Protected Areas.

| *Impacts of seismic noise on fish resulting in physiological injury* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | High | Low to Medium |
| **Significance** | Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Probable | Improbable |
| **Confidence** | Medium | Medium |

| *Impacts of seismic noise on fish resulting in behavioural avoidance* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | High | Low to Medium |
| **Significance** | Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Probable | Improbable |
| **Confidence** | Medium | Medium |

| *Impacts of seismic noise on reproductive success and spawning* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | High | Low to Medium |
| **Significance** | Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Probable | Improbable |
| **Confidence** | Medium | Medium |

| *Impacts of seismic noise on fish resulting in masking of sounds* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey. | Short-term |
| **Intensity** | Low | Low |
| **Significance** | Very Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Improbable | Improbable |
| **Confidence** | Low | Low |

| *Impacts of seismic noise on fish resulting in indirect impacts on food sources* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey. | Short-term |
| **Intensity** | Low | Low |
| **Significance** | Very Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Improbable | Improbable |
| **Confidence** | Low | Low |

### 5.2.4 Impacts to Seabirds

Among the marine avifauna occurring along the South Coast of South Africa, it is only the species that feed by plunge-diving or that rest on the sea surface, which may be affected by the underwater noise of seismic surveys. Potential impacts of seismic pulses to diving birds could include physiological injury, behavioural avoidance of seismic survey areas and indirect impacts due to effects on prey. The seabird species are all highly mobile and would be expected to flee from approaching seismic noise sources at distances well beyond those that could cause physiological injury, but initiation of a sound source at full power in the immediate vicinity of diving seabirds could result in injury or mortality where feeding behaviour override a flight response to seismic survey sounds. The potential for physiological injury or behavioural avoidance in non-diving seabird species is considered **INSIGNIFICANT** and will not be discussed further here.

**Physiological injury**

The continuous nature of the intermittent seismic survey pulses suggest that African penguins and other diving birds would hear the sound sources at distances where levels would not induce mortality or injury, and consequently be able to flee an approaching sound source. The potential for physiological impact of seismic noise on diving birds and African penguins could be of high intensity but would be limited to the survey area and survey duration (short term). In the vicinity of Cape St Francis, the inshore boundary of the proposed survey area is located ~100 km offshore. Of the plunge diving species that occur along the coastline, only the Cape Gannet regularly feeds as far offshore as 100 km, the rest foraging within 20 km of the shore. There is thus a very low likelihood of the survey encountering foraging penguins, but Cape gannets may be encountered. The potential physiological impact on diving species is, however, considered to be of **LOW** significance without mitigation, and **VERY LOW** significance with mitigation.

**Behavioural avoidance**

Behavioural avoidance by diving seabirds would be limited to the vicinity of the operating airgun within the survey area over the duration of the survey period. The impact is likely to be of medium to high intensity. The potential impact on the behaviour of diving seabirds is considered to be of **LOW** significance without mitigation, and **VERY LOW** significance with mitigation.

**Indirect impacts due to effects on prey**

As with other vertebrates, the assessment of indirect effects of seismic surveys on diving seabirds is limited by the complexity of trophic pathways in the marine environment. The impacts are difficult to determine, and would depend on the diet make-up of the bird species concerned and the effect of seismic surveys on the diet species. No information is available on the feeding success of seabirds in association with seismic survey noise. Most plunge-diving birds, however, forage on small shoaling fish prey species relatively close to the shore and are unlikely to feed extensively in offshore waters that would be targeted during the seismic survey. The broad ranges of potential fish prey species (in relation to potential avoidance patterns of seismic surveys of such prey species) and extensive ranges over which most seabirds feed suggest that indirect impacts would be **VERY LOW** with and without mitigation.

**Mitigation**

Recommendations for mitigation include:

- All initiation of airgun firing be carried out as “soft-starts” of at least 20 minutes duration.

- An area of radius of 500 m be scanned by an independent observer for the presence of diving seabirds prior to the commencement of "soft starts" and that these be delayed until such time as this area is clear of seabirds.
- Seabird incidence and behaviour should be recorded by an onboard Independent Observer. Any obvious mortality or injuries to seabirds as a direct result of the survey should result in temporary termination of operations.
- Any attraction of predatory seabirds (by mass disorientation or stunning of fish as a result of seismic survey activities) and incidents of feeding behaviour among the hydrophone streamers should be recorded by an onboard Independent Observer.

| *Impacts of seismic noise on diving seabirds resulting in physiological injury* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | High | Low |
| **Significance** | Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Probable | Improbable |
| **Confidence** | Medium | Medium |

| *Impacts of seismic noise on diving seabirds resulting in behavioural avoidance* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | Medium to High | Low |
| **Significance** | Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Probable | Improbable |
| **Confidence** | Medium | Medium |

| *Impact: Impacts of seismic noise on seabirds resulting in indirect impacts on food sources* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey. | Short-term |
| **Intensity** | Low | Low |
| **Significance** | Very Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Improbable | Improbable |
| **Confidence** | Low | Low |

### 5.2.5 Impacts to Turtles

Three species of turtles occur on the South Coast of South Africa. Although loggerhead and leatherback turtles nest on the beaches of northern KwaZulu-Natal, this is over 1,000 km to the north of the proposed survey area, and abundances in the survey area are thus likely to be extremely low comprising occasional vagrants or hatchlings moving southwards in the Agulhas Current. The most likely impacts to turtles from seismic survey operations include physiological injury (including disorientation) or mortality from seismic noise or collision with or entanglement in towed seismic apparatus, behavioural avoidance of seismic survey areas, and indirect effects due to the effects of seismic sounds on prey species.

**Physiological injury (including disorientation) or mortality**

Although no information could be sourced on physiological injury to turtle hearing as a result of seismic sounds, the overlap of their hearing sensitivity with the higher frequencies produced by airguns, suggest that turtles may be considerably affected by seismic noise. Recent evidence, however, suggests that turtles only detect airguns at close range (<10 m) or are not sufficiently mobile to move away from approaching airgun arrays (particularly if basking). Initiation of a sound source at full power in the immediate vicinity of a swimming or basking turtle would be expected to result in physiological injury. This applies particularly to hatchlings and juveniles as they are unable to avoid seismic sounds whilst being transported in the Agulhas Current, and consequently are more susceptible to seismic noise. The potential impact could therefore be of high intensity, but remain within the short-term. However, the abundance of adult turtles and hatchlings along the South Coast is low, the likelihood of encountering turtles during the proposed survey is thus also expected to be low. The potential physiological impact on turtles is considered to be of **LOW** significance without mitigation, and **VERY LOW** significance with mitigation.

The potential for collision between adult turtles and the seismic vessel, or entanglement of turtles in the towed seismic equipment and surface floats, is highly dependent on the abundance and behaviour of turtles in the survey area at the time of the survey. Turtles encountered occasionally during the survey are likely to be migrating vagrants and impacts through collision or entanglement would be of low intensity and short-term. The impacts on turtles through collision or entanglement of seismic equipment is thus considered to be of **LOW** significance without mitigation and **VERY LOW** significance with mitigation.

**Behavioural avoidance**

Behavioural changes by turtles in response to seismic sounds range from apparent lack of movement away from active airgun arrays through to startle response and avoidance by fleeing an operating sound source. The impact of seismic sounds on turtle behaviour is of high intensity, but would persist only for the duration of the survey, and be restricted to the survey area. Given the general extent of turtle migrations relative to seismic survey target grids, the impact of seismic noise on turtle migrations is deemed to be of **LOW** significance without mitigation and **VERY LOW** with mitigation.

**Reproductive success**

Following their emergence on the beaches of northern KwaZulu-Natal between January and March, hatchlings maintain mostly a pelagic existence offshore in the Agulhas Current. As hatchlings are weak swimmers they are more vulnerable to collision with the towed equipment, and to direct seismic noise impacts from the airguns, which may stun them and render them more vulnerable to predation. The proposed survey area is located in deep waters of the Agulhas Current and hatchling survival may thus be affected. The effect of seismic surveys on recruitment success will be of high intensity but will vary with the distance offshore and timing of the specific survey. If recruitment success is affected, this could impact population size beyond the short-term to the medium-term However, the likely low encounter rates would result in the impact of seismic noise or potential collision on hatchling survival to be of **LOW** significance without mitigation and **VERY LOW** with mitigation.

**Indirect effects due to the effects of seismic sounds on prey species**

The diets of the three common South African turtle species are remarkably diverse. As the majority of the proposed survey area is located in deep waters away from any shallow water habitats known to be important for turtle feeding, destruction or adverse modification of critical habitat would thus be insignificant, and the effects of seismic surveys on the feeding behaviour of turtles is thus expected to be **VERY LOW** both with and without mitigation.

**Masking of environmental sounds and communication**

Breeding adult loggerhead and leatherback turtles undertake large migrations between distant foraging areas and their nesting sites on the beaches of northern KwaZulu-Natal during the summer months October to March, with peak nesting during December and January. Although it is speculated that turtles may use acoustic cues for navigation during migrations, information on turtle communication is lacking. There is no information available in the literature on the effect of seismic noise in masking environmental cues and communication in turtles, but their expected low abundance in the survey area during the proposed scheduling of the survey (November - March) would suggest that the potential significance of this impact (should it occur) would be **INSIGNIFICANT**.

**Mitigation**

A number of mitigation measures are recommended for potential impacts of seismic surveys on turtles:

- All initiation of airgun firing be carried out as “soft-starts” of at least 20 minutes duration.
- An area of radius of 500 m be scanned by an independent observer for the presence of turtles prior to the commencement of “soft starts” and that these be delayed until such time as this area is clear of turtles.
- Daylight observations of the survey region should be carried out by onboard Independent Observers and incidence of turtles and their responses to seismic shooting should be recorded.
- Seismic shooting should be terminated when obvious negative changes to turtle behaviour is observed from the survey vessel, or animals are observed within the

immediate vicinity (within 500 m) of operating airguns and appear to be approaching firing airgun.

- Any obvious mortality or injuries to turtles as a direct result of the survey should result in temporary termination of operations.
- Ensure that 'turtle-friendly' tail buoys are used by the survey contractor or that existing tail buoys are fitted with either exclusion or deflector 'turtle guards'.

| *Impacts of seismic noise on turtles resulting in physiological injury, or collision and entanglement with towed equipment* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | High | Low |
| **Significance** | Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Probable to Highly Probably | Probable |
| **Confidence** | Medium | Medium |

| *Impacts of seismic noise on turtles resulting in behavioural avoidance* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey. | Short-term |
| **Intensity** | High | Low |
| **Significance** | Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Highly Probable | Probable |
| **Confidence** | High | High |

| *Impacts on recruitment success of turtles through seismic noise or collision* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Medium-term | Short-term |
| **Intensity** | High | Low |
| **Significance** | Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Improbable | Improbable |
| **Confidence** | High | High |

| *Impacts of seismic noise on turtles resulting in indirect impacts on food sources* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey. | Short-term |
| **Intensity** | Low | Low |
| **Significance** | Very Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Improbable | Improbable |
| **Confidence** | Low | Low |

| *Impacts of seismic noise on turtles resulting in masking of sounds* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey. | Short-term |
| **Intensity** | Very Low | Very Low |
| **Significance** | Insignificant | Insignificant |
| **Status** | Negative | Negative |
| **Probability** | Improbable | Improbable |
| **Confidence** | Low | Low |

### 5.2.6 Impacts to Seals

**Physiological injury or mortality**

The physiological effects of loud low frequency sounds on seals have not been well documented. The potential for physiological injury to seals from seismic noise is expected to be low as being highly mobile, fur seals would avoid severe sound sources at levels well below those at which discomfort occurs. Past studies suggest that noise of moderate intensity and duration is sufficient to induce TTS in seals, as individuals did not appear to avoid the survey area. Their tendency to swim at or near the surface will also expose them to reduced sound levels when in close proximity to an operating airgun array. Seal colonies in the vicinity of the proposed survey area are located at Seal Island in Mossel Bay, on the northern shore of the Robberg Peninsula in Plettenberg Bay and at Black Rocks (Bird Island group) in Algoa Bay. As seals are known to forage up to 120 nautical miles (~220 km) offshore, the proposed survey area therefore potentially falls within the foraging range of seals from the nearby colonies, particularly in the Algoa Bay area. There is a likelihood of the survey encountering seals. The potential impact of physiological injury to seals as a result of seismic noise is therefore deemed to be of medium intensity and would be limited to the survey area, although injury could extend beyond the survey duration. The significance of the impact without mitigation is **VERY LOW** with and without mitigation.

**Behavioural avoidance**

Although partial avoidance (to less than 250 m) of operating airguns has been recorded for some seals species, Cape fur seals appear to be relatively tolerant to loud noise pulses and, despite an initial startle reaction, individuals quickly reverted back to normal behaviour. The potential impact of seal foraging behaviour changing in response to seismic surveys is thus considered to be of low to medium intensity and limited to the survey area and duration. The significance of behavioural avoidance impacts are consequently deemed **VERY LOW**, both with and without mitigation.

**Masking of environmental sounds and communication**

The use of underwater sounds for environmental interpretation and communication by Cape fur seals is unknown, although masking is likely to be limited by the low duty cycle of seismic pulses (one firing every 10 to 15 seconds). The impacts of masking are considered **VERY LOW**, both with and without mitigation.

**Indirect effects due to the effects of seismic sounds on prey species**

As with other vertebrates, the assessment of indirect effects of seismic surveys on Cape fur seals is limited by the complexity of trophic pathways in the marine environment. The impacts are difficult to determine, and would depend on the diet make-up of the species (and the flexibility of the diet), and the effect of seismic surveys on the diet species. The broad ranges of fish prey species (in relation to the avoidance patterns of seismic surveys of such prey species) and the extended foraging ranges of Cape fur seals suggest that indirect impacts due to effects on predators or prey would be **VERY LOW**, both with and without mitigation.

**Mitigation**

Mitigation measures recommended for potential impacts of seismic surveys on seals are:

- All initiation of airgun firing be carried out as “soft-starts” of at least 20 minutes duration.
- An area of radius of 500 m be scanned by an independent observer for the presence of seals prior to the commencement of “soft starts” and that these be delayed until such time as this area is clear of seals. If after a period of 30 minutes seals are still within 500 m of the airguns, the normal “soft start” procedure should be allowed to commence for at least a 20-minutes duration.
- Daylight observations of the survey region should be carried out by onboard Marine Mammal Observers (MMOs) and incidence of seals and their responses to seismic shooting should be recorded.
- Seismic shooting should be terminated when obvious negative changes to seal behaviour is observed from the survey vessel.
- Any obvious mortality or injuries to seals as a direct result of the survey should be recorded.

| *Impacts of seismic noise on seals resulting in physiological injury* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | Medium | Low |
| **Significance** | Very Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Probable | Probable |
| **Confidence** | Medium | Medium |

| *Impacts of seismic noise on seals resulting in behavioural avoidance* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey. | Short-term |
| **Intensity** | Low to medium | Low |
| **Significance** | Very Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Probable | Probable |
| **Confidence** | High | High |

| *Impacts of seismic surveys on seals resulting in masking of sounds and communication* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | Low | Low |
| **Significance** | Very Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Probable | Probable |
| **Confidence** | Medium | Medium |

| *Impacts of seismic surveys on seals resulting from indirect effects on their prey* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | Low | Low |
| **Significance** | Very Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Probable | Probable |
| **Confidence** | High | High |

### 5.2.7 Impacts to Whales and Dolphins

A wide diversity of cetaceans (whales and dolphins) occur off the South Coast of South Africa. The majority of migratory cetaceans in South African waters are baleen whales (mysticetes), while toothed whales (odontocetes) may be resident or migratory. Potential impacts of seismic pulses to whales and dolphins could include physiological injury, behavioural avoidance of seismic survey areas, masking of environmental sounds and communication, and indirect impacts due to effects on prey.

The factors that affect the response of marine mammals to sounds in their environment include the sound level and its prevailing acoustic characteristics, the ecological features of the environment in which the animal encounters the sound and the physical and behavioural state of the animal. When discussing the potential effects of seismic surveys on marine mammals we should bear in mind the lack of data (uncertainty) concerning the auditory capabilities and thresholds of impacts on the different species encountered and the individual variability in hearing thresholds and behavioural responses which are likely to influence the degree of impact (Luke *et al.* 2009; Gedamke *et al.* 2011). This uncertainty and variability can have a large impact on how risk to marine mammals is assessed. Assessing the impact of seismic activity on populations in the Agulhas system is further hampered by a poor understanding of the abundance and distribution of many of the species found here.

Marked differences occur in the hearing of baleen whales (mysticete cetaceans) and toothed whales and dolphins (odontocete cetaceans). The vocalisation and estimated hearing range of baleen whales (centred at below 1 kHz) overlap the highest peaks of the power spectrum of airgun sounds and consequently these animals may be more affected by disturbance from seismic surveys (Nowacek *et al.* 2007). In contrast, the hearing of toothed whales and dolphins is centred at frequencies of between 10 and 100 kHz, suggesting that these may react to seismic shots at long ranges, but that hearing damage from seismic shots is only likely to occur at close range. Mysticete and odontocete cetaceans are thus assessed separately below.

**Physiological injury**

There is little information available on the levels of noise that would potentially result in physiological injury to cetaceans, and no permanent threshold shifts have been recorded. Available information suggests that the animal would need to be in close proximity to operating airguns to suffer physiological injury, and being highly mobile it is assumed that they would avoid sound sources at distances well beyond those at which injury is likely to occur. Deep-diving cetacean species (e.g. sperm whales) may, however, be more susceptible to acoustic injury, particularly in the case of seafloor-focussed seismic surveys, where the downward focussed impulses could trap deep diving cetaceans within the survey pulse, as escaping towards the surface would result in exposure to higher sound level pulses.

The majority of baleen whales migrate to the southern African subcontinent to breed during winter months. Humpback whales are reported to reach the coast in the vicinity of Knysna on their northern migrations around April, continuing through to September/October when the southern migration begins and continues through to December. Southern right whales arrive in coastal waters on the South Coast in June, building up to a maximum in September/October and departing again in December. The proposed survey areas thus lies within the migration paths of Humpback whales, but well offshore of areas frequented by Southern Right whales. As the survey is proposed for the summer months (November to March) encounters with migrating whales should be minimal, although some humpbacks on their return journey in November/December may still be encountered. However, the survey is likely to frequently encounter resident odontocetes such as common dolphins and pilot whales which are present year-round, and may encounter sperm whales in offshore areas.

The impact of potential physiological injury to both mysticete and odontocete cetaceans as a result of high-amplitude seismic sounds is deemed to be of high intensity, but would be limited to the immediate vicinity of operating airguns within the survey area. The impact is therefore considered to be of **MEDIUM** significance without mitigation for resident odontocetes, and of **MEDIUM** significance without mitigation for mysticetes (mainly Humpbacks in November/December). Significance would reduce to **LOW** with mitigation.

**Behavioural avoidance**

Avoidance of seismic survey activity by cetaceans, particularly mysticete species, begins at distances where levels of approximately 150 to 180 dB are received. More subtle alterations in behaviour may occur at received levels of 120 dB. Although behavioural avoidance of seismic noise in the proposed survey area by baleen whales is highly likely, such avoidance is generally considered of minimal impact in relation to the distances of migrations of the majority of baleen whale species.

The timing of the survey relative to seasonal breeding cycles (such as those observed in migrating baleen whales) may influence the degree of stress induced by noise exposure (Tyack 2008). Displacement from critical habitat is particularly important if the sound source is located at an optimal feeding or breeding ground or areas where mating, calving or nursing occurs. It is likely that the proposed survey area overlaps with migration routes of both humpback and southern right whales to and from their breeding grounds. The humpback whale has its winter breeding concentrations on the east coast of Africa, from northern KwaZulu-Natal northwards and therefore over 1000 km to the north-east of the northern boundary of the proposed survey areas. Southern right whales, however, currently have their most significant winter concentrations on the South African South Coast between Port Elizabeth and Cape Town. The nearshore areas of the De Hoop MPA and St. Sebastian Bay at Cape Infanta ranks as probably the most important nursery area for Southern Right whales in the world, containing 70-80% of the cow-calf pairs on the South African coast. The proposed survey area, which is mostly located beyond the 200 m isobath and ~100 km offshore at its closest point, therefore does not overlap with such known areas. However the paucity of fine scale data from offshore waters on the distribution and seasonal occurrence of most cetacean species prevents prediction where such critical habitat might be with any certainty.

The potential impact of behavioural avoidance of seismic survey areas by mysticete cetaceans is considered to be of high intensity, across the survey area and for the duration of the survey. Considering the distribution ranges of most species of cetaceans, the impact of seismic surveying is considered of **LOW** (Southern Rights) and **MEDIUM** (Humpbacks in November/December) significance before mitigation. Limiting seismic surveys to outside of the winter/spring (June to December) migration would reduce the intensity of potential impacts to low resulting in **VERY LOW** significance with mitigation. As the survey is likely to commence before the end of the return migration of humpbacks (November/December), and take place in offshore waters where sperm whales are likely to be encountered, additional mitigation measures (PAM) will need to be implemented, and although the intensity of potential impacts would remain high, significance with mitigation would be **LOW**.

Information available on behavioural responses of toothed whales and dolphins to seismic surveys is more limited than that for baleen whales. No seasonal patterns of abundance are known for odontocetes occupying the proposed study area and information on breeding and calving areas and seasons is also lacking. Furthermore, as there is less evidence of avoidance of seismic surveys by toothed whales (including dolphins), a precautionary approach to avoiding impacts is thus recommended. Consequently the impact of seismic survey noise on the behaviour of toothed whales is considered to be of medium intensity over the survey area and duration. A number of toothed whale species have a more pelagic distribution and are thus likely to be encountered further offshore. The overall significance will therefore vary between species, and consequently ranges between **LOW** and **VERY LOW** before mitigation and **VERY LOW** with mitigation.

**Masking of environmental sounds and communication**

Baleen whales appear to vocalise almost exclusively within the frequency range of the maximum energy of seismic survey noise, while toothed whales vocalise at frequencies higher than these. As the by-product noise in the mid-frequency range can travel far, masking of communication sounds produced by whistling dolphins and blackfish[2] is likely. In the migratory baleen whale species, vocalisation increases once they reach the breeding grounds and on the return journey in November/December when accompanied by calves. However, masking of communication signals is likely to be limited by the low duty cycle of seismic pulses. Consequently, the intensity of impact on baleen whales is likely to be low over the survey area and duration, but high in the case of toothed whales. Whereas for mysticetes the significance is rated as **VERY LOW,** both with and without mitigation, for odontocetes it is rated as **LOW** without mitigation and **VERY LOW** with mitigation.

**Indirect impacts due to effects on prey**

As with other vertebrates, the assessment of indirect effects of seismic surveys on resident odontocete cetaceans is limited by the complexity of trophic pathways in the marine environment. However, it is likely that both fish and cephalopod prey of toothed whales and dolphins may be affected over limited areas, although the impacts are difficult to determine. The broad ranges of prey species (in relation to the avoidance patterns of seismic surveys of such prey species) suggest that indirect impacts due to effects on prey would be of **VERY LOW** significance with and without mitigation. Baleen whales do not feed while in the proposed survey area so the significance of indirect effects on their food source is **VERY LOW**.

[2] The term blackfish refers to the delphinids: Melon-headed whale, Killer whale, Pygmy Killer Whale, False Killer Whale, Long-finned Pilot Whale, Short-finned Pilot Whale.

**Other potential impacts**

Given the slow speed (about 4 - 6 kts) of the vessel while towing the seismic array, ship strikes are also unlikely. Entanglement in gear is, however, possible.

**Mitigation**

Mitigation measures to reduce the impact of seismic survey impulses on cetaceans include:

- As far as possible, avoid planning seismic surveys during the movement of migratory cetaceans (particularly baleen whales) from their southern feeding grounds into low latitude waters (June to November), and ensure that migration paths are not blocked by seismic operations. In addition, avoid surveying during December when humpback whales may still be moving through the area on their return migrations. If surveying during this time cannot be avoided all other mitigation measures must be stringently enforced, and PAM technology, which detects cetaceans through their vocalisations, must be implemented 24-hours a day.
- As no seasonal patterns of abundance are known for odontocetes occupying the proposed study area, a precautionary approach to avoiding impacts throughout the year is recommended.
- Survey vessels should accommodate dedicated independent MMOs with experience in seabird, turtle and marine mammal identification and observation techniques, to carry out daylight observations of the survey region and record incidence of marine mammals, and their responses to seismic shooting. Data collected should include position, distance from the vessel, swimming speed and direction, and obvious changes in behaviour (e.g. startle responses or changes in surfacing/diving frequencies, breathing patterns). Both the identification and the behaviour of the animals must be recorded accurately along with current seismic noise levels.
- All initiations of seismic surveys must be carried out as “soft-starts” for a minimum of 20 minutes (JNCC 2010). This requires that the sound source be ramped from low to full power, thus allowing a flight response to outside the zone of injury or avoidance. The rational for the 20 minute “soft-start” period is based on the flight speeds of cetacean species.
- Initiation of firing is only to begin after observations by MMOs have deemed the visual area around the vessel to a distance of 500 m to be clear of all large cetacean species for at least 30 minutes prior to firing, so that deep- or long-diving species can be detected. In the case of small cetacean (particularly dolphins), which are common in inshore waters and often attracted to survey vessels, “soft start” procedures should, if possible, only commence once it has been confirmed that there is no small cetacean activity within 500 m of the airguns. If after a period of 30 minutes small cetaceans are still within 500 m of the airguns, the normal “soft start” procedure should be allowed to commence for at least a 20-minutes duration. The MMO should monitor small cetacean behaviour during “soft starts” to determine if the animals display any obvious negative responses to the airguns and gear or if there are any signs of injury or mortality as a direct result of seismic shooting operations.
- All breaks in airgun firing of longer than 20 minutes must be followed by a “soft-start” procedure of at least 20 minutes prior to the survey operation continuing. Breaks shorter than 20 minutes should be followed by a “soft-start” of similar duration.

- Seismic shooting should be terminated when obvious negative changes to cetacean behaviour is observed from the survey vessel, or animals are observed within the immediate vicinity (within 500 m) of operating airguns and appear to be approaching firing airgun.
- During night-time line changes low level warning airgun discharges should be fired at regular intervals in order to keep animals away from the survey operation while the vessel is repositioned for the next survey line.
- All data recorded by MMOs should at minimum form part of a survey close–out report. Furthermore, daily or weekly reports should be forwarded to the necessary authorities to ensure compliance with the mitigation measures.
- Marine mammal incidence data and seismic source output data arising from surveys should be made available on request to the Marine Mammal Institute, Department of Agriculture, Fisheries and Forestry, and the Petroleum Agency of South Africa for analyses of survey impacts in local waters.
- Should the survey schedules overlap with the start of the sensitive period in terms of large mammals migrating through the area, ensure that PAM technology is implemented to confirm that no cetaceans are present in the vicinity of the vessel. PAM is also to be used when surveying at night or during adverse weather conditions and thick fog. During the commencement of night-time operations, visual watches should be maintained using night-vision/infra-red binoculars.
- The use of PAM is encouraged by most international guidelines as a mitigation tool to detect marine mammals through their vocalisations, *particularly if species of particular conservation importance are likely to be encountered in the proposed survey area*, or where a given species or group is difficult to detect by visual observation alone. Such monitoring can provide distance and bearing of the animals from the survey vessel. Although PAM would only identify animals that are calling or vocal, it has the advantage of 24 hour per day availability as opposed to visual monitoring, which can only be confidently carried out during daylight hours, or under adequate visibility conditions. Considering that most of the offshore migrating baleen whale species likely to be encountered are listed as "Endangered", every effort should be made to ensure that the vessel is fitted with PAM technology[3].
- The use of the lowest practicable airgun volume should be defined and enforced, and airgun use should be prohibited outside of the licence area.
- No seismic survey-related activities are to take place within declared Marine Protected Areas.

[3] As much of the 2D survey is taking place in deep waters (>1,000 m) where sperm whales and beaked whales are likely to be encountered, the use of PAM is highly recommended for this survey.

*Potential impact of seismic noise to mysticete cetaceans.*

| *Impacts of seismic noise on baleen whales resulting in physiological injury* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | High | Low to Medium |
| **Significance** | Low – Medium (Humbacks) | Very Low – Low (Humpbacks) |
| **Status** | Negative | Negative |
| **Probability** | Probable | Probable |
| **Confidence** | Medium | Medium |

| *Impacts of seismic noise on baleen whales resulting in behavioural avoidance* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey. | Short-term |
| **Intensity** | High | Low |
| **Significance** | Low – Medium (Humpbacks) | Very Low – Low (Humpbacks) |
| **Status** | Negative | Negative |
| **Probability** | Probable | Probable |
| **Confidence** | High | High |

| *Impacts of seismic surveys on baleen whales resulting in masking of sounds and communication* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | Low | Low |
| **Significance** | Very Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Probable | Probable |
| **Confidence** | Medium | Medium |

| *Impacts of seismic surveys on baleen whales resulting from indirect effects on their prey* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | Very low | Very low |
| **Significance** | Very Low | Very Low |
| **Status** | Neutral | Neutral |
| **Probability** | Improbable | Improbable |
| **Confidence** | High | High |

*Potential impact of seismic noise to odontocete cetaceans.*

| *Impacts of seismic noise on toothed whales and dolphins resulting in physiological injury* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | High | Low to Medium |
| **Significance** | Medium | Low |
| **Status** | Negative | Negative |
| **Probability** | Probable | Probable |
| **Confidence** | Medium | Medium |

| *Impacts of seismic noise on toothed whales and dolphins resulting in behavioural avoidance* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey. | Short-term |
| **Intensity** | Medium to High | Low to Medium |
| **Significance** | Very Low – Low (species specific) | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Probable | Probable |
| **Confidence** | High | High |

| *Impacts of seismic surveys on toothed whales and dolphins resulting in masking of sounds and communication* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | High | Low |
| **Significance** | Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Probable | Probable |
| **Confidence** | Medium | Medium |

| *Impacts of seismic surveys on toothed whales and dolphins resulting from indirect effects on their prey* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to survey area. | Local |
| **Duration** | Short-term: for duration of survey | Short-term |
| **Intensity** | Low | Low |
| **Significance** | Very Low | Very Low |
| **Status** | Negative | Negative |
| **Probability** | Probable | Probable |
| **Confidence** | Medium | Medium |

### 5.2.8 Impacts of Drop-Core Sampling

The proposed core sampling activities are expected to result in the disturbance and loss of benthic macrofauna through removal of sediments and potential crushing of benthic epifauna in the trigger weight footprint.

Assuming a core diameter of 100 mm, each drop-core sample will remove a surface area of ~0.008 $m^2$. Core barrels are typically 6 – 9 m in length thus resulting in the removal of 0.048 $m^3$ or 0.072 $m^3$ of sediment , respectively per sample at maximum penetration. It is proposed to take in the order of 100 cores, thereby impacting a total cumulative area of 0.8 $m^2$ and removing a maximum of 7.2 $m^3$ of sediment.

As benthic fauna typically inhabit the top 20 - 30 cm of sediment, and removal of the sediment samples will result in the elimination of the benthic infaunal and epifaunal biota in the sample footprints. Considering the available area of similar habitat on the Agulhas Bank and off the edge of the continental shelf, this reduction in benthic biodiversity can be considered negligible.

Depending on the texture of the sediments at the target sites, slumping of adjacent unconsolidated sediments into the excavation can be expected over the very short-term. Although this may result in localised disturbance of macrofauna associated with these sediments and alteration of sediment structure, it also serves as a means of natural recovery of the excavations. Studies have shown that some mobile benthic animals are capable of actively migrating vertically through overlying sediment thereby significantly affecting the recolonization of impacted areas and the subsequent recovery of disturbed areas of seabed (Maurer *et al*. 1979, 1981a, 1981b, 1982, 1986; Ellis 2000; Schratzberger *et al*. 2000; but see Harvey *et al.* 1998; Blanchard & Feder 2003).

Natural rehabilitation of the seabed following sampling or dredging operations, through a process involving influx of sediments and recruitment of invertebrates, has been demonstrated on the southern African continental shelf (Penney & Pulfrich 2004; Steffani 2007b, 2009a, 2009b, 2010a, 2010c). Recovery rates of impacted communities are variable and dependent on the sampling/dredging/mining approach, sediment influx rates and the influence of natural disturbances on succession communities. Ellis (1996) gives typical recovery rates for different grained deposits based on several sources (Table 6). These average time scales conform to those from other studies (see Newell *et al.* 1998).

The structure of the recovering communities is also highly spatially and temporally variable confirming the high natural variability in benthic communities in the region. The community developing after an impact depends on (1) the nature of the impacted substrate, (2) differential re-settlement of larvae in different areas, and (3) environmental factors such as bedload transport, near-bottom dissolved oxygen concentrations etc. Indications of significant recruitments and natural mortalities in recovering succession communities has provided evidence of natural disturbances (Pulfrich & Penney 1999). Savage *et al*. (2001) noted similarities in apparent levels of disturbance between mined and unmined areas off the southern African west coast, and areas of the Oslofjord in the NE Atlantic Ocean, which is known to be subject to periodic low oxygen events. They concluded that the lack of clear separation of impacted from reference samples suggests that short-term physical disturbance resulting from mining or dredging is no more stressful than the regular naturally occurring anoxic events typical of the West Coast continental shelf area.

The high-intensity negative impact of sediment removal is unavoidable, but as it will be extremely localised (*i.e.* confined to the core footprints) the impact can confidently be rated as being **INSIGNIFICANT**.

Table 6: Timing for recovery of seabed habitats after dredging (after Ellis 1996).

| Sediment type | Recovery time |
|---|---|
| *Fine-grained deposits*:<br>muds, silts, clays, which can contain some rocks and boulders | 1 year |
| *Medium-grained deposits*:<br>sand, which can contain some silts, clay and gravel | 1-3 years |
| *Coarse-grained deposits*:<br>gravels, which can contain some finer fraction and some rock and boulders | 5 years |
| *Coarse-grained deposits*:<br>gravels with many rocks and boulders | >5 years |

Some disturbance or loss of adjacent benthic biota can also be expected as a result of the placement on the seabed of the trigger weight. Epifauna and infauna beneath the footprint of the weight may be smothered or crushed resulting in a reduction in benthic biodiversity. Crushing is likely to primarily affect soft-bodied species as some molluscs and crustaceans may be robust enough to survive (see for example Savage *et al*. 2001). The impacts will be of medium to high intensity but highly localised, and short-term as recolonization will occur rapidly from adjacent undisturbed sediments. The potential impact is consequently deemed to **INSIGNIFICANT**.

| *Impacts of drop-core survey on benthic macrofauna through removal or crushing* | | |
|---|---|---|
| | **Without Mitigation** | **Assuming Mitigation** |
| **Extent** | Local: limited to core area or trigger weight footprint | Local |
| **Duration** | Short-term | Short-term |
| **Intensity** | Medium to High | Medium to High |
| **Significance** | Insignificant | Insignificant |
| **Status** | Negative | Negative |
| **Probability** | Definite | Definite |
| **Confidence** | High | High |

**Mitigation**

No mitigation measures are possible, or considered necessary for the direct loss of macrobenthos due to core sampling or indirect loss due to crushing by the trigger weight.

# 6. CONCLUSIONS AND RECOMMENDATIONS

## 6.1. Conclusions

If all environmental guidelines, and appropriate mitigation measures advanced in this report, and the EMP for the proposed project as a whole, are implemented, there is no reason why the proposed seismic survey should not proceed. The proposal to undertake the survey outside the cetacean migration period has mitigated the potential impact on migratory cetaceans to a large extent. Data collected by independent onboard observers should form part of a survey close-out report to be forwarded to the necessary authorities, and any incidence data and seismic source output data arising from surveys should be made available for analyses of survey impacts in Southern African waters.

The assessments of impacts of seismic sounds provided in the scientific literature usually consider short-term responses at the level of individual animals only, as our understanding of how such short-term effects relate to adverse residual effects at the population level are limited. Data on behavioural reactions acquired over the short-term could, however, easily be misinterpreted as being less significant than the cumulative effects over the long-term, *i.e.* what is initially interpreted as an impact not having a detrimental effect and thus being of low significance, may turn out to result in a long-term decline in the population. A significant adverse residual environmental effect is considered one that affects marine biota by causing a decline in abundance or change in distribution of a population(s) over more than one generation within an area. Natural recruitment may not re-establish the population(s) to its original level within several generations or avoidance of the area becomes permanent. However, the southern right whale population is reported to be increasing by 7% per annum (Best 2000) over a time when seismic surveying frequency has increased, suggesting that, for the southern right population at least, there is no evidence of long-term negative change to population size as a direct result of seismic survey activities.

Reactions to sound by marine fauna depend on a multitude of factors including species, state of maturity, experience, current activity, reproductive state, time of day (Wartzok *et al*. 2004; Southall *et al.* 2007). If a marine animal does react briefly to an underwater sound by changing its behaviour or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the population as a whole (NRC 2005). However, if a sound source displaces a species from an important feeding or breeding area for a prolonged period, impacts at the population level could be significant.

The significance of the impacts both before and after mitigation are summarised overleaf.

## 6.2. Recommended Mitigation Measures

Detailed mitigation measures for seismic surveys in other parts of the world are provided by Weir *et al*. (2006), Compton *et al*. (2007) and US Department of Interior (2007). Many of the international guidelines presented in these documents are extremely conservative as they are designed for areas experiencing repeated, high intensity surveys and harbouring particularly sensitive species, or species with high conservation status. The guidelines currently applied for seismic surveying in South African waters are those proposed in the Generic EMPR (CCA & CMS 2001), and to date these have not resulted in any known or recorded mortalities of marine

| Impact | Significance (before mitigation) | Significance (after mitigation) |
|---|---|---|
| **Plankton and ichthyoplankton** | | |
| Mortality and/or physiological injury | Very Low | Very Low |
| **Marine invertebrates** | | |
| Mortality and/or physiological injury | Very Low | Very Low |
| Behavioural avoidance | Very Low | Very Low |
| **Fish** | | |
| Mortality and/or physiological injury | Low | Very Low |
| Avoidance behaviour | Low | Very Low |
| Reproductive success / spawning | Low | Very Low |
| Masking of sounds | Very Low | Very Low |
| Indirect impacts on food sources | Very Low | Very Low |
| **Seabirds** | | |
| Physiological injury | Low | Very Low |
| Avoidance behaviour | Low | Very Low |
| Indirect impacts on food sources | Very Low | Very Low |
| **Turtles** | | |
| Physiological injury, collision and entanglement | Low | Very Low |
| Avoidance behaviour | Low | Very Low |
| Reproductive success | Low | Very Low |
| Indirect impacts on food sources | Very Low | Very Low |
| Masking of sounds | Insignificant | Insignificant |
| **Seals** | | |
| Physiological injury | Very Low | Very Low |
| Avoidance behaviour | Very Low | Very Low |
| Masking of sounds | Very Low | Very Low |
| Indirect impacts on food sources | Very Low | Very Low |
| **Whales and dolphins** | | |
| *Baleen whales* | | |
| Physiological injury | Medium | Low |
| Avoidance behaviour | Low - Medium | Very Low - Low |
| Masking of sounds and indirect impacts on food sources | Very Low | Very Low |
| Indirect impacts on food sources | Very Low | Very Low |
| *Toothed whales and dolphins* | | |
| Physiological injury | Medium | Low |
| Avoidance behaviour | Very Low - Low | Very Low |
| Masking of sounds and indirect impacts on food sources | Low | Very Low |
| Indirect impacts on food sources | Very Low | Very Low |
| **Drop-core sampling** | | |
| Injury and loss of benthic macrofauna | Insignificant | Insignificant |

mammals, turtles or seabirds. The mitigation measures proposed below are based largely on the guidelines currently accepted for seismic surveys in South Africa, but have been revised to include salient points from international guidelines discussed in the documents cited above.

- Seismic surveys should as far as possible be planned to avoid cetatean migration periods or winter breeding concentrations (June to November), and ensure that migration paths are not blocked. In addition, avoid surveying during December when humpback whales may still be moving through the area on their return migrations. If surveying during this time cannot be avoided all other mitigation measures must be stringently enforced, and PAM technology, which detects cetaceans through their vocalisations, must be implemented 24-hours a day. PAM is also to be used when surveying at night or during adverse weather conditions and thick fog.
- As no seasonal patterns of abundance are known for odontocetes occupying the proposed study area, a precautionary approach to avoiding impacts throughout the year is recommended.
- The use of the lowest practicable airgun volume should be defined and enforced, and airgun use should be prohibited outside of the licence area.
- During night-time line changes low level warning airgun discharges should be fired at regular intervals in order to keep animals away from the survey operation while the vessel is repositioned for the next survey line
- Prior to the commencement of "soft starts" an area of 500-m radius around the survey vessel (exclusion zone) should be scanned for the presence of diving seabirds, turtles, seals and cetaceans. There should be a dedicated pre-shoot watch of at least 30 minutes for deep-diving species. "Soft starts" should be delayed until such time as this area is clear of individuals of diving seabirds, seals, turtles and cetaceans. Soft-start should not begin until 30 minutes after the animals depart the exclusion zone or 30 minutes after they are last seen. In the case of fur seals and small odontocetes, which may occur commonly around the vessel, the presence of seals and small odontocetes (including number and position / distance from the vessel) and their behaviour should be recorded prior to "soft start" procedures. If possible, "soft starts" should only commence once it has been confirmed that there is no seal and small odontocetes activity within 500 m of the airguns. However, if after a period of 30 minutes they are still within 500 m of the airguns, the normal "soft start" procedure should be allowed to commence for at least a 20-minute duration (JNCC 2010). Their activity should be carefully monitored during "soft starts" to determine if they display any obvious negative responses to the airguns and gear or if there are any signs of injury or mortality as a direct result of the seismic activities.
- The implementation of "soft-start" procedures of a minimum of 20 minutes' duration on initiation of seismic surveying would mitigate any extent of physiological injury in most mobile vertebrate species as a result of seismic noise and is consequently considered a mandatory management measure for the implementation of the proposed seismic survey. "Soft start" procedures should not be initiated during times of poor visibility or darkness without the use of existing PAM technology to confirm that no cetaceans are present.

- An onboard independent MMO must be appointed for the duration of the seismic survey. The MMO should have experience in seabird, turtle and marine mammal identification and observation techniques. The duties of the MMO would be to:
  - Record initiation of seismic firing activity and associated "soft starts", airgun activities and seismic noise levels;
  - Observe and record responses of marine fauna to seismic shooting, including seabird, turtle, seal and cetacean incidence and behaviour and any mortality or injuries of marine fauna as a result of the seismic survey. Data captured should include species identification, position (latitude/longitude), distance from the vessel, swimming speed and direction (if applicable) and any obvious changes in behaviour (e.g. startle responses or changes in surfacing/diving frequencies, breathing patterns) as a result of the seismic activities. Both the identification and the behaviour of the animals must be recorded accurately along with current seismic sound levels. Any attraction of predatory seabirds, large pelagic fish or cetaceans (by mass disorientation or stunning of fish as a result of seismic survey activities) and incidents of feeding behaviour among the hydrophone streamers should also be recorded;
  - Sightings of any injured or dead protected species (marine mammals and sea turtles) should be recorded, regardless of whether the injury or death was caused by the seismic vessel itself. If the injury or death was caused by a collision with the seismic vessel, the date and location (latitude/longitude) of the strike, and the species identification or a description of the animal should be recorded.
  - Record meteorological conditions;
  - Request the temporarily termination of the seismic survey or adjusting of seismic shooting, as appropriate. It is important that MMOs have a full understanding of the financial implications of terminating firing, and that such decisions are made confidently and expediently. A log of all termination decisions must be kept (for inclusion in both daily and "close-out" reports);
  - Prepare daily reports of all observations, to be forwarded to the necessary authorities on a daily or weekly basis to ensure compliance with the mitigation measures.
- All breaks in airgun firing of longer than 20 minutes must be followed by a "soft-start" procedure of at least 20 minutes prior to the survey operation continuing. Breaks of shorter than 20 minutes should be followed by a "soft-start" of similar duration.
- Ensure that 'turtle-friendly' tail buoys are used by the survey contractor or that existing tail buoys are fitted with either exclusion or deflector 'turtle guards'.
- Seabird, turtle and marine mammal incidence data and seismic source output data arising from surveys should be made available on request to the Marine Mammal Institute, Department of Agriculture, Fisheries and Forestry, and the Petroleum Agency of South Africa for analyses of survey impacts in local waters.

[4] One observer is the norm, but in high latitudes two are required during summer months due to the longer daylight hours. Brazilian guidelines in contrast require at least three observers to be aboard, in order to allow efficient rotation of duties and maintain full coverage.

- Seismic shooting should be terminated on observation of any obvious mortality or injuries to cetaceans, turtles, seals or large mortalities of invertebrate and fish species as a direct result of the survey. Such mortalities would be of particular concern where a) commercially important species are involved, or b) mortality events attract higher order predator and scavenger species into the seismic area during the survey, thus subjecting them to acoustic impulses. Seismic shooting should also be terminated when obvious changes to turtle, seal or cetacean behaviours are observed from the survey vessel, or turtles and cetaceans (not seals) are observed within the immediate vicinity (within 500 m) of operating airguns and appear to be approaching firing airgun[5]. The rationale for this is that animals at close distances (i.e. where physiological injury may occur) may be suffering from reduced hearing as a result of seismic sounds, that frequencies of seismic sound energy lies below best hearing frequencies (certain toothed cetaceans and seals), or that animals have become trapped within the ensonified area through diving behaviour.
- Should the survey schedules overlap with the start of the sensitive period in terms of large mammals migrating through the area, ensure that PAM technology is implemented to confirm that no cetaceans are present in the vicinity of the vessel, particularly when surveying at night or during adverse weather conditions and thick fog. During the commencement of night-time operations, visual watches should be maintained using night-vision/infra-red binoculars. The use of PAM is encouraged by most international guidelines as a mitigation tool to detect marine mammals through their vocalisations, *particularly if species of particular conservation importance are likely to be encountered in the proposed survey area*, or where a given species or group is difficult to detect by visual observation alone. Such monitoring can provide distance and bearing of the animals from the survey vessel. Although PAM would only identify animals that are calling or vocal, it has the advantage of 24 hour per day availability as opposed to visual monitoring, which can only be confidently carried out during daylight hours, or under adequate visibility conditions. Considering that most of the offshore migrating baleen whale species likely to be encountered are listed as “Endangered”, every effort should be made to ensure that the vessel is fitted with PAM technology.
- No seismic survey-related activities are to take place within declared Marine Protected Areas.
- Avoid surveying in the area off Port Elizabeth in November and December during the peak squid spawning aggregations, and when interaction with the commercial fishing fleet is most likely.

[5] Recommended safety zones in some of the international guidelines include implementation of an observation zone of 3 km radius, low-power zone of 1.5 - 2 km radius (to cater for cow-calf pairs), and safety shut-down zone of 500 m radius around the survey vessel. Alternatively, a safety zone of 160 dB root mean squared (rms) can be calculated based on site-specific sound speed profiles and airgun parameters. The application of propagation loss models to calculate safety radii based on sound pressure levels represents a more scientific approach than the arbitrary designation of a 500 m radius (see Compton *et al*. (2007) for details).

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# APPENDIX 4

# FINANCIAL PROVISION

<u>**Cost Estimate – Financial Provision**</u>

| **Activity** | **Quantity** | **Rate(US$)** | **Cost (US$)** |
|---|---|---|---|
| | | | |
| **Mobilisation** | | | |
| Mobilisation of personnel, vessel and equipment | | 100 000 | 100 000 |
| | | | |
| **Removal of miscellaneous objects from the sea** | | | |
| Retrieving of lost equipments/items through the use of divers/ appointment of specialized contractor, etc. | | 1 200 000 | 1 200 000 |
| | | | |
| **Clean-up of oil spillages** | | | |
| Oil recovery equipment and absorbent material hire/ purchase. | | 1 800 000 | 1 800 000 |
| | | | |
| **Waste Management** | | | |
| Handling, storage and final disposal at licensed landfill site onshore. | | 800 000 | 800 000 |
| | | | |
| **Liabilities to other users** | | | |
| Compensation, damage claims etc. to marine, mining, fishing industry, marine transport route. | | 1 600 000 | 1 600 000 |
| | | | |
| **Monitoring and Maintenance** | | | |
| Project Management | | | |
| Travel, sundries, appointment of contractors, monitoring, etc. | | 600 000 | 600 000 |
| | | | |
| **subtotal** | | | **6 100 000** |
| | | | |
| **Contingencies (10% of the total coast)** | | | 610 000 |
| | | | |
| **subtotal** | | | 6 710 000 |
| | | | |
| | | | |
| VAT @ 14% | | | 939 400 |
| **Grand Total** | | | **7 649 400** |
| **INSURANCE PROVISION FOR** | | | **10 000 000** |

# APPENDIX 5

# ENVIRONMENTAL POLICY

# SAFETY HEALTH ENVIRONMENT QUALITY CHARTER

## Total has based its policy in matters pertaining to safety, health, environment and quality on the following ten principles:

**ARTICLE 1**
Total considers people safety and health protection, safety in regard to operations, respect for the environment, customer satisfaction and listening to stakeholders as paramount priorities.

**ARTICLE 2**
Total strives to comply with applicable laws and regulations wherever it conducts its business and supplements them, when appropriate, with its own specific requirements.

**ARTICLE 3**
Total promotes among its employees a shared culture whose core components are skills management, incident feedback, information and dialogue. This process is driven by the leadership and exemplary conduct of management.

**ARTICLE 4**
Total favors the selection of its industrial and business partners on the basis of their ability to comply with its policy on safety, health, environment and quality.

**ARTICLE 5**
Total implements, for all its operations, appropriate management policies regarding safety, health, environment and quality risks which are regularly assessed. No project development or product launch may be undertaken without a risk assessment covering the entire life of the project or product.

**ARTICLE 6**
Appropriate safety, health, environment and quality management systems for each business undergo regular assessment involving measurement of performance, setting milestones, formulating relevant action plans and instituting suitable control procedures.

**ARTICLE 7**
In order to respond effectively in the event of accidents, Total equips itself appropriately and establishes emergency procedures that are periodically reviewed and regularly tested during exercises.

**ARTICLE 8**
Each person, at all levels, must be conscious in his or her job of his or her personal responsibility, giving due consideration to the prevention of risks of accident, harm to health, environmental damage or adverse impacts on product and service quality. Vigilance and professionalism in these fields are important criteria in evaluating the performance of each member of personnel, in particular for those in positions of responsibility.

**ARTICLE 9**
In matters of safety, health, environment and quality, Total adopts a constructive attitude based on open dialogue with stakeholders and outside parties. Through its social commitment, It focuses on developing its activities in harmony with the neighbouring communities.

**ARTICLE 10**
Total monitors and controls the Group's energy consumption, greenhouse gas emissions, production of final waste and impact on biodiversity. The Group develops new processes, products and customer services in order to enhance energy efficiency and reduce environmental footprints. The Group is engaged in exploring for and developing additional energy resources. Total thus actively contributes to sustainable development.

**Christophe de Margerie**
Chairman and CEO

September 2009

# APPENDIX 6

# EXTRACT FROM
# EMERGENCY RESPONSE PLAN

TOTAL

Exploration & Production

# Extract from GM EP ENV 092

# Minimum requirements for OIL SPILL CONTIGENCY PLAN (OSCP)


Document prepared by

Mario Antonio Manuel: TOTAL S.A. – EP/HSE/ENV May 2012

TOTAL Group has adopted the internationally recognized tiered approach to the oil spill response. The affiliate OSCP document should be prepared in accordance with the national/local, international relevant regulations as well as company standard. A well developed, operational, clear and easily understandable document shall be expected.

The preparation and finalization of the affiliate OSCP as a minimum required content should encompass the following layout (extract from Total GM EP ENV 092, Guide on recommendation of minimum structure and contents of the affiliate OSCP):

**Volume 1 - ACTION PLAN** *(operational document)*

Provide introduction and explanations with respect to what the action plan is about and its relevance in the OSCP (OSCP layout); as an operational document as well as information on its application.
Other contents that should be developed include the following:

- **Alert Procedure and immediate actions**- this should cover alert notification, mobilization process throughout the various levels and hierarchies and for the applicable tiers (quantified in spilled volumes). A one page Tier level flowchart showing key members and key actions for alerting should be provided.
- **Response Options/strategies-** offshore/onshore, coastal, port, harbour and decision trees with cross references to the response handbook and a table summarizing definition of each tier level and the resources available.
- **Oil Spill Response Organization**- within affiliate (on sites, office and Headquarters)
- **Action checklists**- initial, further and final actions - for all functions/roles on site and on the affiliate headquarter.
- **Termination and Post spill Monitoring**- Criteria used in determining cessation of response, post spill rehabilitation of response equipments, post incident briefings, environmental sampling and modelling.
- **Forms and template** – all forms and templates needed

**Volume 2 - RESPONSE HANDBOOK** *(operational document)*

Provide introduction and explanations with respect to what the response handbook is about and its relevance in the OSCP (OSCP lay out); as an operational document as well as information on its application.
Further contents that should be developed include the following:

- **Facilities and products**
  - Brief description of facilities (including coordinates and pictures or maps)
  - Transit times and distances (helicopters and vessels from the logistic base, drilling rig or any other places useful for an oil spill response - i.e. other operators' facilities, heliport ...)
  - Characteristics of products handled (including properties useful for an oil spill response, brief description of fate and behaviour) and all MSDS.

- **Environmental sensitivities-** maps showing environmental and socio-economical sensitivities overlaid on aerial photographs + detailed maps zoomed on specific sensitivity areas overlaid on aerial photographs showing access roads and recommended strategies to protected the area (if any) – maps can be made from Google earth) and offshore (maps combined on nautical charts)

  *TOTAL requires that environmental sensitivity maps should be performed according to the IPIECA and internal Guide. The sensibilities maps should be include on GIS.*

  **Social sensitivity –** local communities, local stakeholders, local government, need to be also consider in the separate chapter of document.

- **Response technical guidelines and limitation-** for monitoring and evaluation (aerial observation, tracking buoy, satellite imageries, Modelling*…), chemical dispersion (surface and subsea), physical dispersion, containment & recovery(inland, wetland, rivers and banks, lakes shores...), in situ burning, shoreline protection, clean up of oiled vessel and equipments, shoreline clean up and waste management, sampling and any other strategy identified as useful – tier resources available, mobilization of external assistance (including custom formalities), communications, Health and protecting people, management of volunteers, media management and other considerations / techniques to be presented for each guideline.

  ***** Oil spill Modelling**:** *The modelling approach shall be incorporated both stochastic and trajectory and fates modes for all spill scenarios. The stochastic mode generates multiple simulations within a time window to determine the most likely paths released condensate and shall follow under the influence of winds and currents. While the trajectory and fates mode shall evaluate the worst-case trajectory from the stochastic simulations. Oil spill trajectory modelling (OSTM), shall includes the following;*

  *- Stochastic Model Predictions*

  *- Trajectory and Fate Model Predictions*

  *A subsea modelling should also be considered for a work case scenario.*

  *TOTAL recommend use OSCAR for all modelling but if required it could be proposed other modelling tools.*

**Volume 3 - GENERAL CONTEXT (**non operational document as support)

Provide introduction and explanations with respect to what the general context is about and its relevance in the OSCP (OSCP lay out), as a non-operational but equally important strategic & support document; as well as information on its application.

- **Basic information-** detailed description of the affiliate activities and facilities; statutory and regulatory framework with international conventions, regional agreements and trans-boundary incidents; national/local legislations - Oil Spill Response Arrangements; company reference documents; interface with other plans.

- **Environmental context-** Climatology and Meteorology, Oceanography, description of main coastlines features including facieses, fauna, flora and human activities, description of offshore human activities and environmental sensitivities..
- **Risk assessment-** methodology (according at least to the GS EP SAF 041-quantitavive risk assessment or semi quantitative risk assessment base on IMO Manual 2012 edition) for
  - identification of scenarios and frequencies including work case scenario,
  - evaluation of oil spill risks
  - historical spills from industry,
  - risk assessment matrix

Furthermore, oil spill scenarios identified and oil spill fate/behaviour including modelling should be provided and discussed.

- **Response strategies-** justifications of main strategies available & envisaged for affiliate oil types & volumes. Justifications for Tier 1 capabilities
- **OSCP Maintenance-** Provide the:
  - OSCP Review process: review schedule (generic/fixed e.g. annually or when there are changes to some information or after drills.
  - Training and exercises: Training needs requirement (type of training vs. population);Training plan & implementation; Drills- schedule and implementation
  - Audit
  - Reporting
  - Feedback Notice

**Volume 4 - Additional information to be provided in addition to the three documents require above** *(living documents).*

- **Emergency Directory:** provide the expected contacts useful in case of an oil spill with could be merged by the Affiliate Emergency Directory: government agencies, local organisation / stakeholders, Response organisations, contractors …
- **Equipment Inventory:** provide an inventory of recommended Tier 1 oil spill response equipments. It should be highlighted that this inventory is expected to be a living document listing all tier 1, 2 and 3 resources available within the affiliate and therefore will be kept as a separate document. Cross references will be provided in the Action plan and Response Handbook.
- **Response equipment and maintenance/Inspection Plan:** provide technical guidelines for response equipments and maintenance and inspection of the affiliate response equipment.

# APPENDIX 7

# UNDERTAKING BY APPLICANT

# LETTER OF UNDERTAKING

UNDERTAKING in terms of Regulation 51(b)(viii) of the Minerals and Petroleum Resources Development Act, 2002 (No. 28 of 2002; MPRDA):

**TOTAL E AND P SOUTH AFRICA (PTY) LTD.** (Registration Number 2011/133483/07) hereby undertakes to:

1. Comply with the specifications in the forgoing Environmental Management Plan;

2. Comply with the provisions of the MPRDA and the Regulations thereto.

Signed on the 26th day of October 2012.

For and on behalf of Total E and P South Africa (Pty) Ltd.,

Name: **RENAUD SEBASTIEN LIONS**
Designation: **Attorney-in-fact**

**Total Exploration and Production (South Africa) (Pty) Ltd**

Registration Number (2011/133483/07)

**RESOLUTION**

(Hereinafter the "Company")

The Board of Directors of the Company hereby record that the Company is in the process of applying to the South African Agency for Promotion of Petroleum Exploration and Exploitation (SOC) Ltd for an exploration right in terms of section 81 of the Mineral and Petroleum Resources Development Act No 28 of 2002 over an area situated in the Outeniqua Basin, offshore the south coast of the Republic of South Africa as appears from a copy of the plan annexed hereto, marked Annexure A (hereinafter the "Application").

The board hereby resolves and approves **RENAUD SEBASTIEN LIONS**, attorney-in-fact of the Company, in his representative capacity, is hereby appointed and authorized to apply for, settle the terms of and sign the aforesaid exploration right, including each and every document required to be executed by the Company by and about such permit and its recorded at the Mineral and Petroleum Titles Registration Office.

This resolution of the Board of Directors of the Company has been made and signed in France on this 26th day of October 2012.

Chagnoux

DIRECTOR

**HERVE JACK DENIS CHAGNOUX**

# ANNEXURE A

## Location Map