

AN ASSESSMENT OF THE SUCCESS OF MAINSTREAMING OF MARINE BIODIVERSITY INFORMATION INTO EIAs FOR THE OIL AND GAS SECTOR

PRIDEEL AYN MAJIEDT

Thesis presented in fulfilment of the requirements for the degree of
Master of Philosophy in Environmental Management in the Faculty of
Economic and Management Sciences at Stellenbosch University



SUPERVISORS: DR TAMARA ROBINSON AND DR KERRY SINK

March 2016

Prideel Majiedt

Stellenbosch University

DECLARATION

By submitting this thesis electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

Date: 6 November 2015.

Signed-----

P.A. MAJIEDT

ABSTRACT

The mining sector has played a critical role in the development and growth of South Africa's economy but is also one of the main contributors to environmental impacts. There has been a substantial increase in the number and size of applications for marine petroleum exploration rights, with 30 new exploration wells planned by 2024. In the absence of offshore marine protected areas and no-go areas for mining, the need for mainstreaming of biodiversity information is critical. Biodiversity mainstreaming is the internalisation of the goals of biodiversity conservation and sustainable use of biological resources into economic and public sectors. The EIA framework is the regulatory tool used to ensure the implementation of sustainable development in the marine mining sector and the petroleum sector is a key stakeholder for mainstreaming engagement to support the inclusion of high level biodiversity products in environmental management decision-making. Three products aim to influence such decision making; the National Spatial Biodiversity Assessment (NSBA) 2004, the National Biodiversity Assessment 2011 and the Offshore Marine Protected Areas Project (OMPA) 2011. The aim of this study was to assess how well marine biodiversity products were integrated into the EIA process in the last four years.

A total of 21 EIAs and associated specialist studies from the petroleum sector were analysed using content analysis. Data was captured on the presence of selected biodiversity products, and where present, the level of influence these products had on mitigation recommendations. The success of a product was measured based on utilisation and influence, with the latter being assessed on whether products formed the basis for mitigation recommendations. A case study on an EIA for seabed mining is presented as an example of how the aforementioned biodiversity products could be used to inform the project plan through mitigation recommendations.

The study showed that the NSBA 2004 was the most utilised of the biodiversity products, followed by the OMPA. Information on threatened ecosystems was often omitted. The products were used to set the context of impact studies rather than to inform environmental management. No mitigation recommendations were directly linked to the biodiversity products examined, even when applications had overlap with threatened ecosystem types and when methods involving high risk of habitat destruction were included in project plans. The age of the product and the terms of reference of specialist studies were identified as potential factors affecting use of the biodiversity products. This study concluded that mainstreaming of these products was unsuccessful as no evidence of their influence on proposed mining projects could be detected. The lack of influence of these documents was attributed to the low level of legislative support for threatened marine ecosystems. It is recommended that (1) marine ecosystems are included in the legislated list of threatened and protected ecosystems (2) capacity is developed to ensure appropriate consideration of environmental impacts in marine EIAs, and (3) studies such as this one are carried out at regular intervals to identify where mainstreaming interventions are most needed and where further training is required.

OPSOMMING

Die mynbousektor speel 'n kritieke rol in die ontwikkeling en uitbreiding van die Suid-Afrikaanse ekonomie maar dit is ook een van die grootste bydraers tot habitat impakte. Daar was 'n grootskaalse toename in die aantal en grootte van aansoeke vir mariene petroleum eksplorasieregte, met 30 nuwe eksplorasieregte beplan by 2024. In die afwesigheid van diepsee mariene beskermde gebiede en verbode areas vir mynbou, die behoefte aan die hoofstroom van biodiversiteit inligting is van kritieke belang. Biodiversiteit hoofstroom is die internalisering van die doelwitte van bewaring van biodiversiteit en volhoubare gebruik van biologiese hulpbronne in die ekonomiese en openbare sektore. Die OIE raamwerk is die regulerende instrument wat gebruik word om implementering van volhoubare ontwikkeling in die mariene mynbousektor te verseker. Die petroleum sektor is 'n belangrike rolspeler vir hoofstroming betrokke om die insluiting van hoë vlak biodiversiteit produkte in omgewingsbestuur besluitneming te ondersteun. Drie produkte doel om sodanige besluitneming te beïnvloed; die Nasionale Ruimtelike Biodiversiteit Assessering (NSBA) 2004, Nasionale Biodiversiteit Assessering 2011, en Diepsee Mariene Beskermde Gebiede Projek (DMBG) 2011. Die doel van hierdie studie was om te bepaal hoe goed mariene biodiversiteit produkte in die OIB-proses geïntegreer is in die laaste vier jaar.

'n Totaal van 21 dokumente en gepaardgaande spesialis studies uit die petroleumsektor is ontleed met inhoud analise. Data was vasgelê op die teenwoordigheid van gekose biodiversiteit produkte en die vlak van invloed wat hierdie produkte gehad het op versagtende aanbevelings binne hierdie dokumente. Die sukses van 'n produk is eerstens gemeet volgens die gebruik en tweedens invloed daarvan. Invloed was gekwantifiseer gebaseer op of die produk die basis gevorm het vir versagtende aanbevelings. 'n Gevallestudie van 'n OIE vir seebodem mynbou word aangebied as 'n voorbeeld van hoe die bogenoemde biodiversiteit produkte gebruik kan word om projekte te beïnvloed deur versagting aanbevelings.

Hierdie studie het getoon dat die NSBA 2004 die mees benutte van al die biodiversiteits produkte was, gevolg deur die DMBG. Inligting oor bedreigde ekosisteme is dikwels uitgelaat. Alle biodiversiteits inligting is voorgehou as aanvullende inligting en geen versagtende aanbevelings wat direk met die gekose biodiversiteits produkte verbind kan word is gevind nie, selfs wanneer aansoeke oorvleuel met bedreigde ekosisteme en wanneer metodes wat 'n hoë risiko na ekosisteme in die projek planne ingesluit was. Die ouderdom van 'n produk en die verwysingsraamwerk aan spesialiste is geïdentifiseer as potensiële faktore wat die gebruik van die biodiversiteit produkte beïnvloed het. Hierdie studie het bevind dat die hoofstroming van hierdie produkte onsuksesvol was aangesien

geen bewyse van hul invloed op die voorgestelde mynbou projekte gevind kon word nie. Die gebrek aan invloed van hierdie dokumente is toegewys van die lae vlak van wetgewende ondersteuning wat voorsiening maak vir bedreigde mariene habitatte. Dit word aanbeveel (1) mariene ekosistels word ingesluit in die wetlike lys van bedreigde en beskermde ekosisteme (2) kapasiteit ontwikkel is om toepaslike oorweging van omgewingsimpakte in mariene OIB's te verseker, en (3) studies soos hierdie een gereeld uitgevoer word om te identifiseer waar die hoofstroom ingrypings meeste nodig is en waar verdere opleiding word vereis.

ACKNOWLEDGEMENTS

I would like to extend my heartfelt thanks to my supervisors, Dr Tamara Robinson and Dr Kerry Sink for their support and assistance. Thanks go to my colleagues at the SA National Biodiversity Institute with special reference to Ms Kirsty McQuaid, Ms Mari-Lise Franken, Ms Sizo Sibanda for their assistance in compiling references and transferring data, as well as my family and friends for their support and understanding throughout my “silence”. My studies would not have been possible without the financial support of the GreenMatter Fellowship and Canon Collins Trust, who provided more than just an opportunity to further my education but also to grow as an individual.

I dedicate this thesis to my best friends, Mrs Julien “Me-Julie” Amansure and Ms Shasheen “Sheenibopeeni” Walton, who over oceans and time zones kept me motivated.

List of Acronyms and Abbreviations

CR	Critically Endangered
EAP	Environmental Assessment Practitioner
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMP	Environmental Management Programme
GIS	Geographic Information System
MLRA	Marine Living Resources Act
MPA	Marine Protected Area
MPRDA	Mineral and Petroleum Development Act
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act
NSBA	Nationals Spatial Biodiversity Assessment
OMPA	Offshore Marine Protected Area Project

List of Figures, Tables and Boxes

Figure 1: Map of southern Africa showing the major currents (Branch and Branch 1981) ..	17
Figure 2: Map of South African Marine Protected Areas (Sink et al. 2012a)	18
Figure 3: Map of mining activity in 2006 (www.petroleumagencysa.com).....	19
Figure 4: Map of mining activity for 2015 (www.petroleumagencysa.com).	20
Figure 5: Image of the map of areas of high biodiversity value and the potential impacts to mining (Mining and Biodiversity Guidelines 2013).	24
Figure 6: The three pillars of sustainable development (adapted from Adams 2006).	30
Figure 7: Sustainable Development shown as the overlap of social, economic and environmental imperatives (adapted from Adams 2006).	31
Figure 8: Graphic depiction of the systems approach to sustainability used in South Africa (taken from DEAT 2008).	34
Figure 9: Components and Outcomes of Mainstreaming (adapted from Cohen 2010)	37
Figure 10: Commonly used tools in the Integrated Environmental Management toolbox (adapted from DEAT 2004)	48
Figure 11: Flowchart depicting the basic elements in good EIA practice (ELAW 2010)	50
Figure 12: Basic steps of biodiversity planning and its relationship to the planning tools: a cyclical and adaptive process (IUCN, UNEP and WRI, 1995)	57
Figure 13: The map of bioregions as defined in the NSBA 2004 (Lombard et al. 2005).....	58
Figure 14: The 34 marine biozones used in this study. Biozones are created by subdividing the depth strata with the bioregions (Lombard et al. 2005).	59
Figure 15: The threat status map used in the NSBA 2004 marine component (Lombard et al. 2005).	60
Figure 16: The map of ecoregions used in the NBA 2011 (Sink et al. 2012a).....	62
Figure 17: NBA 2011 Marine and Coastal Benthic Ecosystem Map (Sink et al. 2012a).....	64
Figure 18: Pelagic ecosystem types nested within pelagic bioregions and biozones (taken from Sink et al. 2014). A description for each of the pelagic ecosystem types is provided in Appendix III.	65
Figure 19: NBA 2011 map of marine and coastal benthic ecosystem protection level (Sink et al. 2012a).....	66
Figure 20: NBA 2011 Marine and Coastal Benthic Ecosystem Threat Status Map (Sink et al. 2012a).	67
Figure 21: NBA 2011 Marine and Coastal Pelagic Ecosystem Threat Status Map (Sink et al. 2012a).	67
Figure 22: NBA 2011 map of marine and coastal benthic ecosystem type condition (Sink et al. 2012a).....	68

Figure 23: <i>The 10 focus areas identified in the OMPA project for marine protection and/or other spatial management areas (Sink et al. 2011).</i>	70
Figure 24: <i>Proposed prospecting area for Green Flash Trading application (Green Flash 2012).</i>	72
Figure 25: <i>Potential priority areas for sampling in relation to OMPA Focus Areas (Green Flash 2012).</i>	73
Figure 26: <i>Ecosystem threat status map in relation to potential sampling sites (Green Flash 2012).</i>	74
Figure 27: <i>Line graph depicting presence-absence for the NSBA 2004 Bioregions in the EMP and the specialist study. Specialist studies are chronologically listed from left to right.</i>	91
Figure 28: <i>Line graph depicting presence-absence of the NBA 2011 Benthic and Coastal Ecosystem information in the EMP and specialist study. EMPs are chronologically listed from left to right.</i>	92
Figure 29: <i>Line graph depicting presence-absence of the NBA 2011 Benthic Threat Status information in the EMP and specialist study. EMPs are chronologically listed from left to right.</i>	92
Figure 30: <i>Chart depicting how proposed projects that included ecosystem degrading methods sourced biodiversity information in the EMP. EMPs are chronologically listed from left to right.</i>	93
Figure 31: <i>Chart depicting how specialist studies associated with EMPs that included ecosystem degrading methods sourced biodiversity information (listed chronologically from left to right). Biodiversity information with a value of 1 capture in-text referencing, whilst a value of 2 showed in-text referencing and display of associated map.</i>	94
Figure 32: <i>Illustration of a typical offshore seismic survey displaying the position of sound wave source and acoustic receivers (source: Sarah Wilkinson of Capfish Fisheries Monitoring).</i>	125
Figure 33: <i>Examples of seafloor heat measurement instrumentation (Fisher and Harris 2010).</i>	126
Figure 34: <i>An image of a CTD being deployed from a ship (www.wikipedia.com).</i>	127
Figure 35: <i>Graphic depiction of the coring action of a typical piston corer for marine sediment sampling (WHOI 2014)</i>	128
Figure 36: <i>Graphic depiction of a ship collecting swath bathymetry data using a multibeam echo sounder with the 3D data imposed on the seafloor (NIWA 2005).</i>	129
Figure 37: <i>Image of a typical side-scan sonar fish (Penrose et al. 2005).</i>	129
Figure 38: <i>Map of EMP P7 Area overlap with NBA 2011 threatened benthic ecosystems.</i>	155
Figure 39: <i>Map of EMP P9 Area overlap with NBA 2011 threatened benthic ecosystems.</i>	156

Figure 40: Map of EMP P10 Area overlap with NBA 2011 threatened benthic ecosystems.	157
Figure 41: Map of EMP P11 Area overlap with NBA 2011 threatened benthic ecosystems.	158
Figure 42: Map of EMP P12 Area overlap with NBA 2011 threatened benthic ecosystems.	159
Figure 43: Map of EMP P20 Area overlap with NBA 2011 threatened benthic ecosystems.	160
Table 1: List of known impacts of mining with associated references.	23
Table 2: Environmental laws for the marine environment.	43
Table 3: Data template with heading definitions.....	80
Table 4: List of documents used in the study. Documents were numbered in order of analysis.....	81
Table 5: Table of visual data detected using content analysis.	83
Table 6: Presence-absence data for the different exploration activities collected from the study EMPs which are listed in chronological order. Highlighting is used to draw attention to activities with direct impacts or disturbance to benthic ecosystems.....	87
Table 7: Presence-absence data for inclusion of SANBI biodiversity data in the EMPs from 2010 to 2014. A value of 1 indicates the presence of a specific biodiversity report with associated map (highlighted), and a value of 0 used to capture those that were excluded. Grey highlighting is used to indicate the exclusion of a document from analysis as it was prepared before the publication of the NBA 2011.....	88
Table 8: Presence-absence data for inclusion of SANBI biodiversity products in the specialist studies on marine faunal impacts. A value of 0 was given where no reference or map could be detected for the selected biodiversity information. A value of 1 was given where a reference was detected (orange highlighting). A value of 2 was given where a reference and associated map was detected (green highlighting). Grey highlighting is used to indicate the exclusion of a document from analysis as it was prepared before the publication of the NBA 2011. Totals are omitted to avoid pseudo-quantification.....	90
Box 1: Example of criteria to be scored in an assessment of effectiveness of mainstreaming (adapted from Dalal-Clayton and Bass 2009).....	41
Box 2: Zoomed in Map of Ecosystems for the Cape Town Region	61
Box 3: Mitigation recommendations provided in the Green Flash application	75

Table of Contents

DECLARATION	2
ABSTRACT.....	3
OPSOMMING	4
ACKNOWLEDGEMENTS	6
List of Acronyms and Abbreviations	7
List of Figures, Tables and Boxes	8
Table of Contents.....	11
1 CHAPTER 1: INTRODUCTION.....	15
1.1 Background to this Study:	15
1.2 Study Area: The South African Exclusive Economic Zone	16
1.3 Problem Statement	18
1.4 Rationale for this Study:.....	24
1.4.1 Monitoring of Biodiversity Management	24
1.4.2 Effectiveness of EIAs	25
1.4.3 Monitoring the Impact of SANBI's Marine Programme	25
1.5 Aims, Research Questions and Research Methods:	26
1.5.1 Aim	26
1.5.2 Research Questions	26
1.5.3 Research Methods.....	26
1.6 Outline of Thesis:.....	27
1.7 Limitations of the Study:.....	27
2 CHAPTER 2: SUSTAINABLE DEVELOPMENT AND THE ROLE OF BIODIVERSITY INFORMATION IN EIA.....	29
2.1 Introduction to Sustainable Development:.....	29
2.2 Mainstreaming and Biodiversity Management:.....	36
2.2.1 What is Mainstreaming?	36
2.2.2 Components of Mainstreaming	36
2.2.3 Determining the effectiveness of environmental mainstreaming.....	39

2.2.4	Focus of the Current Study	42
2.3	South Africa's Environmental Right.....	42
2.4	Marine Environmental Legislation	44
2.4.1	National Environmental Management Act	44
2.4.2	Mineral and Petroleum Resources Development Act	46
2.4.3	Integrated Environmental Management	47
2.4.4	Mineral Rights and Environmental Authorisation:.....	53
2.5	Conclusion:.....	55
3	CHAPTER 3: MARINE BIODIVERSITY INFORMATION IN SOUTH AFRICA AND ITS USE IN IMPACT ASSESSMENT	56
3.1	Biodiversity Assessments	56
3.1.1	What are biodiversity assessments?.....	56
3.1.2	The National Spatial Biodiversity Assessment 2004.....	58
3.1.3	The NSBA 2004 Marine Technical Report	58
3.1.4	The National Biodiversity Assessment 2011	60
3.1.5	The NBA 2011 Marine Technical Component	60
3.2	What is systematic planning?.....	69
3.2.1	Offshore Marine Protected Area Project.....	69
3.3	Data Availability and On-line Planning platform.....	71
3.4	Case Study: Green Flash Trading Sea Bed Mining Application.....	71
3.4.1	Use of OMPA and NBA 2011	72
3.4.2	Influence of OMPA and NBA 2011	74
3.5	Conclusion	76
4	CHAPTER 4: METHODOLOGY AND METHODS:.....	77
4.1	Methodological framework:	77
4.2	Data Collection:	78
4.2.1	Method of Data Collection.....	78
4.2.2	Text data collection	79
4.2.3	Visual Data Collection:.....	82

4.3	Data Analysis:.....	84
4.4	The Case for the Case Study:.....	84
4.5	Geographical Information Systems (GIS):.....	84
4.5.1	GIS Methods.....	85
4.6	Limitations to the research method, research alternatives:.....	85
5	CHAPTER 5: FINDINGS.....	86
5.1	Exploration Methods:	86
5.2	Biodiversity References (including Maps)	87
5.2.1	Results for the main text of the EMP	87
5.2.2	Results for the Specialist Reports	88
5.2.3	National Spatial Biodiversity Assessment 2004.....	90
5.2.4	Offshore Marine Protected Areas focus areas.....	91
5.2.5	National Biodiversity Assessment 2011:	91
5.3	Results for Relationships between Exploration Methods and Biodiversity Information	93
5.4	Mitigation Recommendations linked to Selected Biodiversity Information	94
5.5	Spatial Analysis for Threatened Ecosystems	94
6	CHAPTER 6: DISCUSSION OF FINDINGS	95
6.1	Addressing the Research Questions:.....	95
6.1.1	Are the selected biodiversity products utilised in EIAs?.....	95
6.1.2	Where utilised, does the EIA give appropriate consideration to threatened habitats/ecosystems and priority biodiversity areas through mitigation recommendations?	95
6.1.3	Do specialist studies, where present, provide sufficient information and/or recommendations on threatened habitats/ecosystems?.....	96
6.1.4	Is the EIA process sufficient in ensuring sustainable development in the marine environment?	97
6.2	General Findings:	97
6.2.1	OMPA 2011	98
6.2.2	NSBA 2004.....	98

6.2.3	NBA 2011	99
6.2.4	Types of Exploration Methods and Impacts	100
6.2.5	Limited Number of EAPs.....	101
7	RECOMMENDATIONS AND CONCLUSION.....	103
7.1	Recommendations:.....	103
7.2	Conclusion:.....	104
	REFERENCES	106
	APPENDICES.....	125
	APPENDIX I: Methods and equipment used in Mining Exploration	125
	<i>Seismic Surveys</i>	125
	<i>Seabed Surface Heat Flow Measurements:</i>	126
	<i>Water Column Sampling:</i>	127
	<i>Seabed Sampling:</i>	127
	<i>Multibeam Echo Sounder:</i>	128
	<i>Sub-bottom Profile:</i>	129
	APPENDIX II: The first hierarchical marine habitat classification (Lombard et al. 2005)	130
	APPENDIX III: Key characteristics of the 16 pelagic “habitats” recognised within the South African EEZ. Note that descriptions of key characteristics are within a South African and not a global context (Sink et al. 2012).....	131
	APPENDIX IV: OMPA Focus Areas Rationale and Management Considerations.....	132
	APPENDIX V: Data captured from EMPs using content analysis.....	134
	APPENDIX VI: Spatial analysis results for EMPs overlap with NBA 2011 Benthic Ecosystem Threat Status Map.....	155

CHAPTER 1: INTRODUCTION

1.1 Background to this Study:

In South Africa, the National Environmental Management: Biodiversity Act (RSA 2004) provides the legal definition of biodiversity; *“the variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part and also includes diversity within species, between species, and of ecosystems”*. Of the different environments mentioned in this definition, those in the terrestrial realm have historically received more scientific attention than aquatic systems (Menge et al. 2009, Stergiou and Browman 2005, Kochin and Levin 2004). This has resulted in marine and freshwater biodiversity information lagging behind that of the terrestrial environment. This has constrained the ability to make informed decisions around the management and conservation of marine biodiversity. This changed dramatically with the promulgation of the National Environmental Management: Biodiversity Act (RSA 2004) and the establishment of the South African National Biodiversity Institute (SANBI) which addresses biodiversity issues across all realms (Driver et al. 2012).

The SANBI is mandated by the National Environmental Management: Biodiversity Act (RSA 2004) to monitor and report on the state of biodiversity. It must also provide scientific, planning and policy advice to government and stakeholders. The Marine Programme within SANBI was created in 2006 and is responsible for achieving the marine and coastal aspects of this mandate. Limited capacity and resource constraints have impacted on the level of engagement that this programme has been able to achieve. As a result, the Marine Programme has consistently tried to be strategic and efficient in its efforts to contribute towards the goals of SANBI. Within this context, monitoring the effectiveness of the efforts of SANBI's Marine Programme in fulfilling this mandate is a necessary step in ensuring that its energy and resources are channelled in the most effective manner and that investment in improving marine biodiversity information and management is achieved.

The success of biodiversity projects and interventions are measured by the impact of mainstreaming efforts (Dalal-Clayton and Bass 2009). Mainstream is defined in the Oxford dictionary as *“[t]he ideas, attitudes, or activities that are shared by most people and regarded as normal or conventional”* (Oxford Online Dictionary 2015). Mainstreaming in the biodiversity sector is defined as the internalisation of the goals of biodiversity conservation and sustainable use of biological resources into the economic and public sectors (Petersen and Huntley 2005). The Convention on Biological Diversity (CBD) set a target of 10% for all marine and coastal ecosystems to be included in a representative

network of formal protected areas accompanied by other forms of area-based conservation management by 2020 (CBD 2012). This means that 90% of the marine environment will never be under formal protection should this target remain unchanged. Therefore mechanisms other than formal protection are required to ensure sound environmental management (Redford 2014). This elevates the importance of mainstreaming as a biodiversity tool, which is discussed in more detail in Chapter 2. Through successful engagement with industry and the general public mainstreaming environmental concerns in planning and decision-making, environmental management organisations and government are able to ensure that areas outside of formerly protected areas are managed with the needs of biodiversity at the forefront of decision-making.

1.2 Study Area: The South African Exclusive Economic Zone

In 1982 the United Nations ratified the Convention on the Law of the Sea (UNCLOS) (UN 1982) which came into effect in 1994. This international treaty stipulates the boundaries of marine territory of nations and gives coastal nations sovereignty over the natural resources (including oil and gas) found within their exclusive economic zone (EEZ) (Glassner 1986). South Africa has a total marine territory of 1,553,000 km², which extends from the 500m high water mark to the 200 nautical miles offshore delimitation of the EEZ (Celliers et al. 2009). This is estimated to encompass an area of over 1 million km² for the mainland and just over 400,000 km² around the Prince Edward Islands situated in the Southern Ocean (SA Navy 2006). South Africa, therefore, has a large diversity of marine systems under its jurisdiction, and under UNCLOS a responsibility to manage these systems appropriately. In 2013, the Prince Edward Islands Marine Protected Area was declared with clearly defined management objectives (RSA 2013). As the Prince Edward Islands are not under pressure from any mining activity, this study will only focus on the marine systems of mainland South Africa.

The South African mainland marine environment is influenced by the warm Agulhas current on the east coast, and the cold but nutrient-rich Benguela current on the west coast, as illustrated in Figure 1 (Branch and Branch 1981). As a result of this high productivity, the West Coast has historically been the hub of industrial fishing, with the majority of demersal hake and pelagic sardine and anchovy catches being caught in this area, whilst the East Coast, with its sub-tropical and tropical water temperatures, has been the heart of line-fishery and recreational fishing (Branch and Clarke 2006). These large current systems create a diversity of ecosystem types, as listed in the NBA 2011 (Sink et al. 2012a). Habitat classification in the marine environment was undertaken for the first time in 2004 (Lombard et al. 2005), and the first marine ecosystem maps published in 2012 (Sink et al. 2012a).

Understanding what marine biodiversity is present and how it responds to disturbance underpins good environmental management.

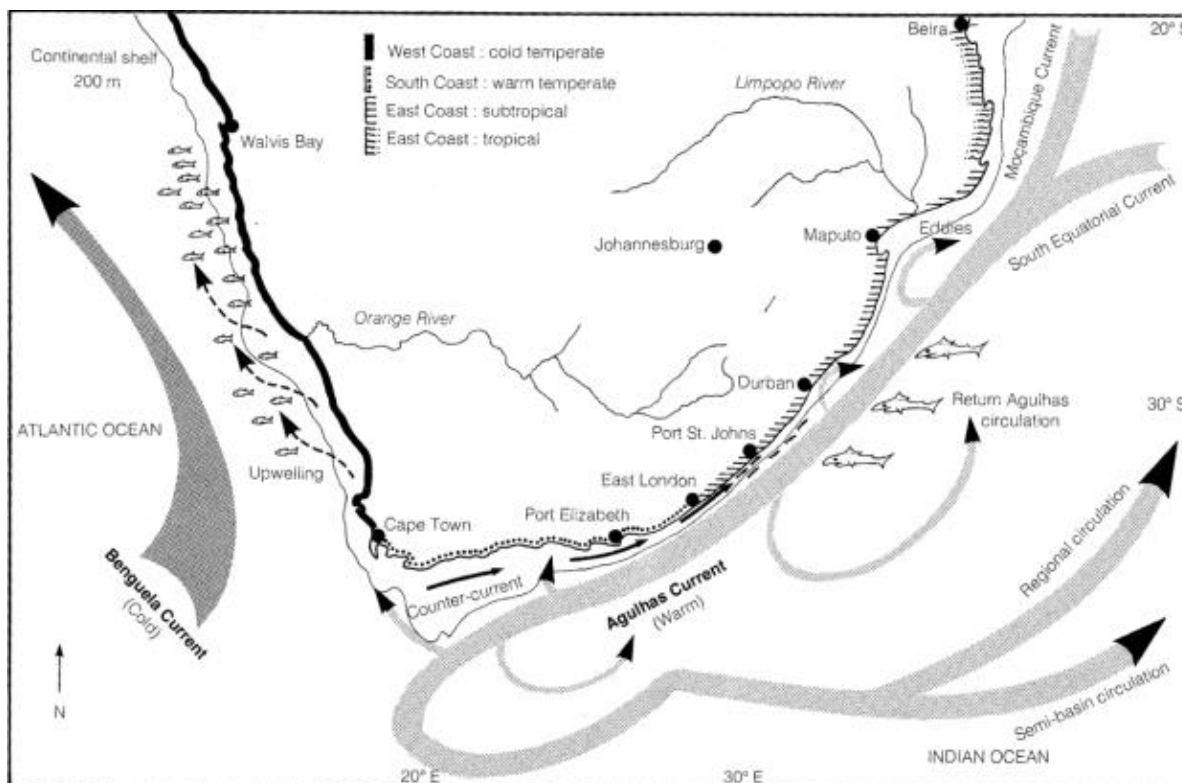


Figure 1: Map of southern Africa showing the major currents (Branch and Branch 1981)

MPAs are the only marine areas where destructive activities such as mining are not allowed, making them especially important in the conservation of species and their habitats and management of marine biodiversity. South Africa has 23 mainland marine protected areas (MPAs) (Figure 2). Protected areas are categorised as special nature reserves, nature reserves including wilderness areas, protected environments, and world heritage sites (RSA 2003). There is a distinct coastal bias in the network of South African MPAs with only 0.17% of the entire EEZ of South Africa having full protection from pressures on marine biodiversity (Sink et al. 2011).

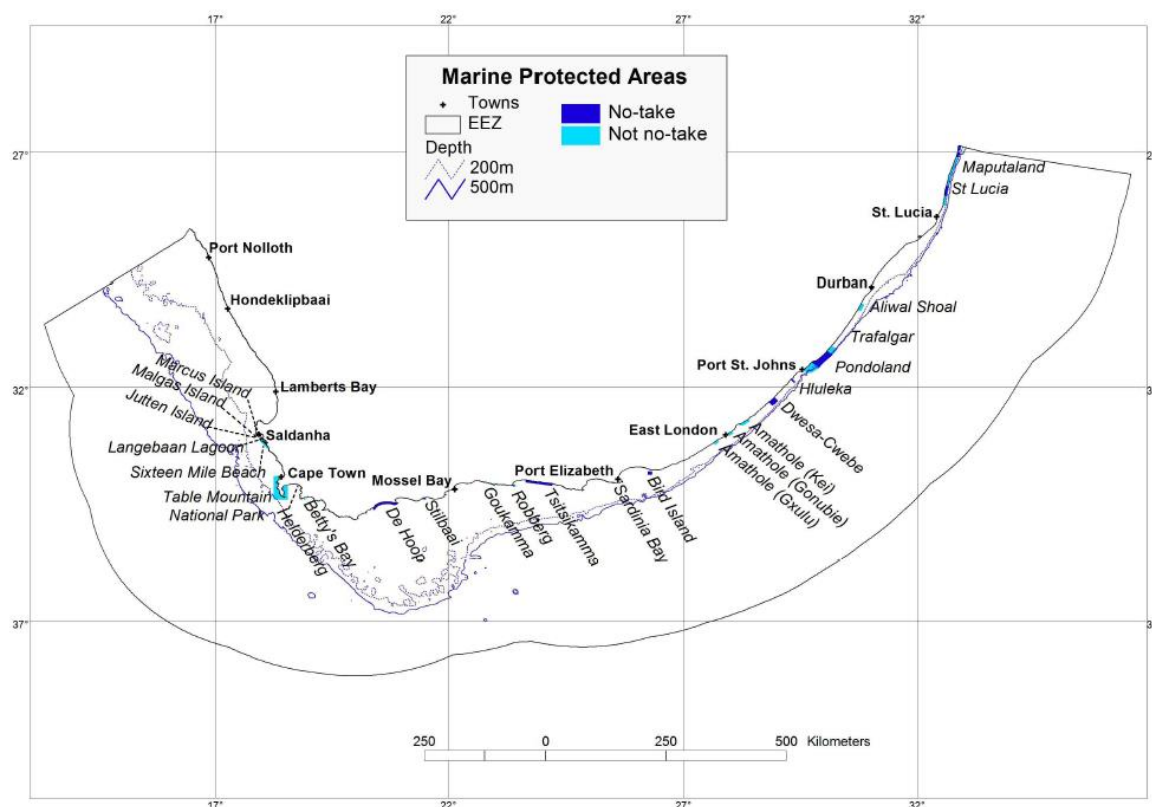


Figure 2: Map of South African Marine Protected Areas (Sink et al. 2012a)

1.3 Problem Statement

The petroleum sector is one of the main stakeholders that SANBI has chosen to engage with on the impacts of activities and infrastructure on the marine environment as part of their mainstreaming campaign. Mining in general is estimated to provide 8.3% directly toward the annual gross domestic product of South Africa (Chamber of Mines 2013). Although this contribution has decreased over the decades from 21% in 1970, mining is still considered to be a valuable contributor to the South African economy in terms of foreign exchange earnings, employment and economic activity (Kantor 2013, Smit 2013). The marine environment has seen an increase in recent years in the number and size of applications for marine mining rights within the petroleum sector. This is clearly illustrated in Figure 3 that shows petroleum activity in 2006, compared to increased activity from 2013 onwards, as shown in Figure 4. Currently ~90% of South Africa's ocean space is either under a mining lease or a lodged mining application. A recent presidential initiative, Operation Phakisa: Unlocking the Oceans Economy, aims to further increase petroleum investment through facilitation of 30 new marine exploration wells by 2024 (Operation Phakisa: Oil and Gas Lab 2014).

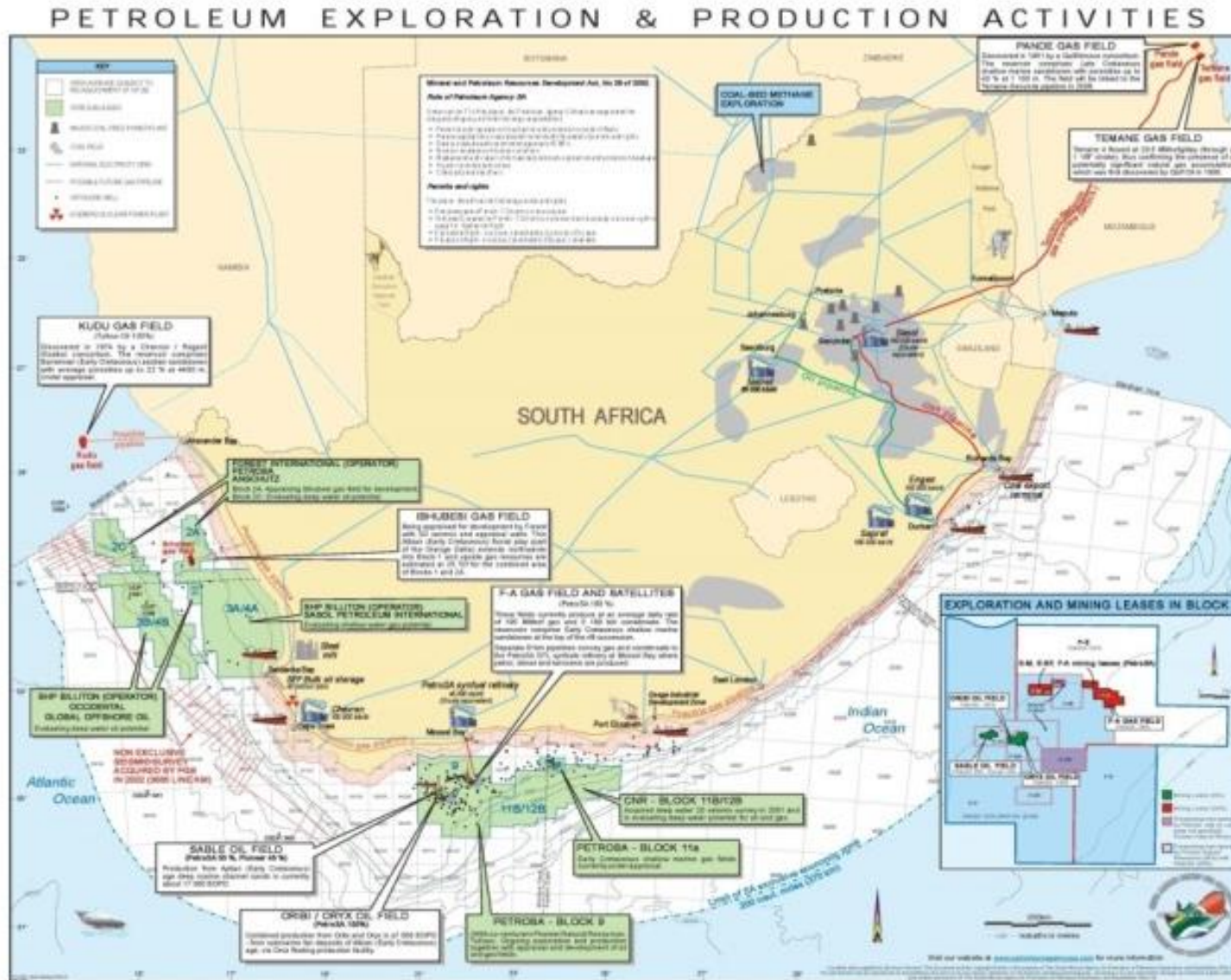


Figure 3: Map of mining activity in 2006 (www.petroleumagencyrsa.com)

PETROLEUM EXPLORATION AND PRODUCTION ACTIVITIES IN SOUTH AFRICA

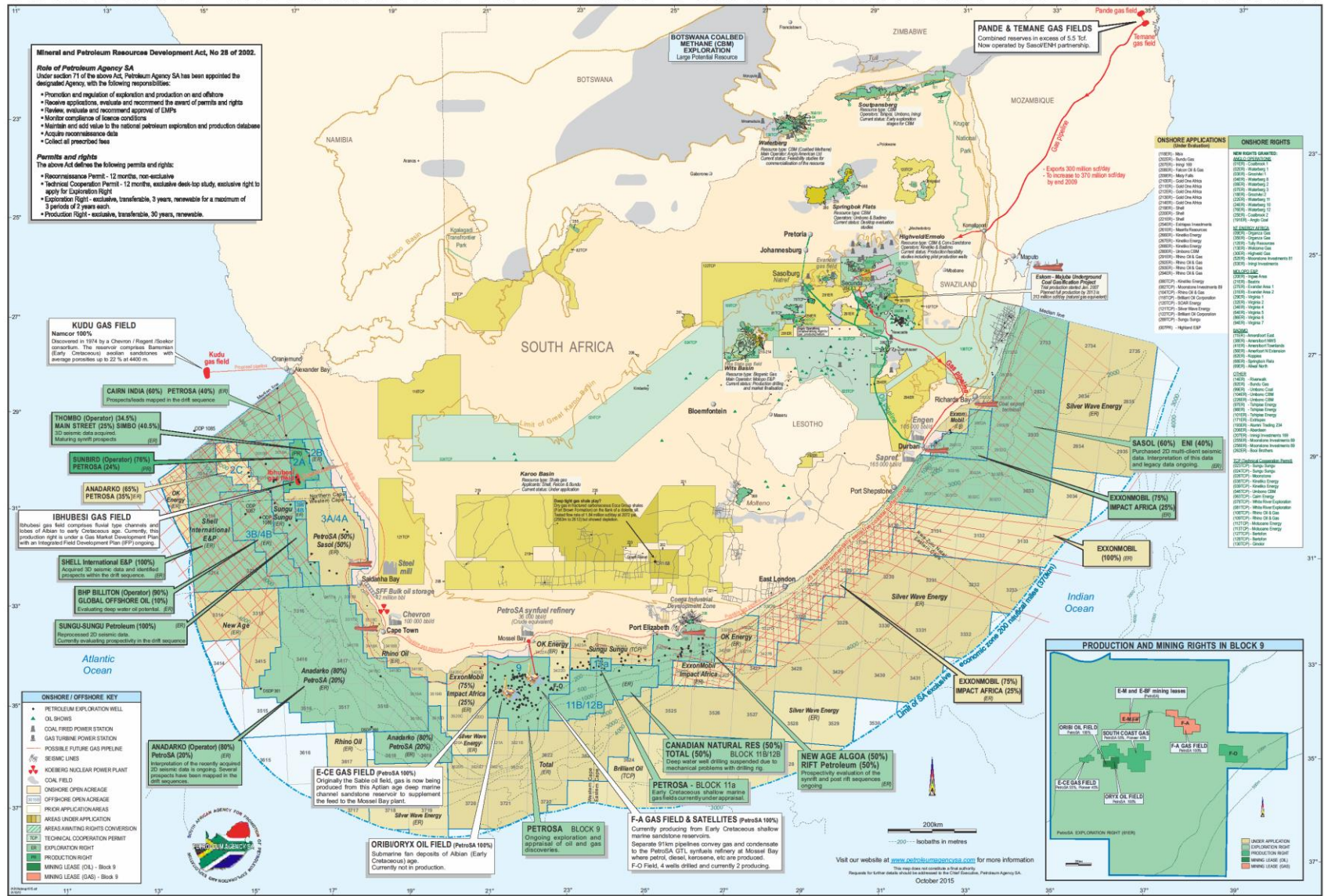


Figure 4: Map of mining activity for 2015 (www.petroleumagencysa.com).

Prior to the 2013 expansion of mining rights, SANBI had carried out the Offshore Marine Protected Area Project (OMPA), the National Spatial Biodiversity Assessment 2004 (Driver et al. 2005) and the more recent National Biodiversity Assessment 2011 (Driver et al. 2012). The OMPA project provided the first spatial biodiversity plan for the offshore marine environment and produced a map of potential areas for offshore protection and/or management (Sink et al. 2011), whilst the National Spatial Biodiversity Assessment 2004 and National Biodiversity Assessment 2011 provided a report on the status of the environment with lists of threatened ecosystem types (these are discussed in greater detail in Chapter 3).

In an ideal scenario, the product of the systematic planning exercise (i.e. the OMPA map), combined with the information on the status and condition of marine and coastal ecosystems produced in the National Biodiversity Assessment: Marine Technical Report 2011 (Sink et al. 2012a), would be utilised to carry out spatial planning for the marine environment in general. National level planning and spatial management would be implemented where areas unsuitable for mining activity would be identified beforehand, and therefore influence policy and legislation to ensure that marine biodiversity is managed in such a way that ecosystem degradation is avoided and ecosystem services are maintained. Marine spatial planning and integrated governance is also being taken forward in Operation Phakisa through the Marine Protection Services and Governance Lab with a proposed network of offshore marine protected areas to improve biodiversity conservation along with the development of policy for marine spatial planning to facilitate integrated governance (Operation Phakisa: Marine Protection Services and Governance Lab 2014). Unfortunately, it is uncertain when these legislative tools will come into effect and the current reality of the marine management environment is that there is no spatial management plan for the marine environment. This is evidenced by ~90% of the mainland marine territory being under mining lease and/or application, with some instances of whole habitat/ecosystem types under threat of mining. In the absence of strategic planning and a comprehensive MPA network, mainstreaming of biodiversity priorities becomes especially important.

Mining is divided into various phases. These are defined as the Exploration Phase, the Prospecting Phase, the Mining Phase, the Closure Phase, and the post-Closure Phase (Newmont 2012). These may be described as follows:

- Exploration Phase: This is referred to in the legislation as “prospecting”. This phase includes the intentional searching for resources through any method that causes disturbance to the natural environment.

- Mining Phase: This is referred to in the legislation as “production”. This phase involves all activities related to the extraction of the resource from the natural environment.
- Closure Phase: In this phase mining has ceased and the focus of the mining operation has shifted to environmental rehabilitation and removal of infrastructure where necessary.
- Post-Closure Phase: In some instances it may be necessary to assess the impact of the mining operation on the natural environment after all mining activities have ceased to assess the rate and level of habitat recovery. The Minister may issue a closure certificate if environmental rehabilitation and all other issues such as pollution have been adequately addressed.

South Africa has only three active production areas (Figure 4) but as discussed previously exploration applications have increased dramatically and so the focus of this study will be the Exploration Phase. There are four methods mainly used in the exploration of marine minerals and resources: seismic surveys, seabed surface heat flow measurements, seabed and water column sampling, multibeam echo-sounder sampling and sub-bottom profiling. Seabed surface heat flow measuring and sub-bottom profiling are considered in this study to be destructive methods as they have direct interaction and impacts on ecosystems, whilst the remaining methods are considered less harmful, as they rely on sonar or sound to collect information. These methods are discussed in further detail in APPENDIX I: Methods and equipment used in Mining Exploration.

Mining applications are subject to the Integrated Environmental Management Framework (DEAT 2004). The only legislated tool available to ensure some degree of environmental consideration is the Environmental Impact Assessment (EIA) process. EIAs are expected to consider available biodiversity information in the application and review process to achieve sustainable development, and it is also expected that the aforementioned national products (i.e. NSBA 2005, OMPA and the NBA 2011) would be the main contributors to marine biodiversity information. The marine mining applications and licence areas shown in Figure 4 overlap with areas identified in these marine biodiversity plans and assessments as key areas for biodiversity and fisheries management with regards to OMPA, and areas that have been identified as threatened by the NBA 2011. The overlap of mining rights areas with areas of high marine biodiversity value / biodiversity priority areas suggests a lack of uptake and integration of these biodiversity plans and assessments in EIAs. This raises concern due to the number of impacts associated with mining exploration activities (Table 1). Thus, there is a need to assess the level of use of these marine biodiversity plans and assessments in informing the EIA process on marine biodiversity issues so as to provide insight into the effectiveness and impact of these products and others like them to improve

the management of marine biodiversity within the marine oil and gas sector. This will also aid in identifying the shortfalls of these products and provide an opportunity to investigate opportunities for improvement.

Table 1: List of known impacts of mining with associated references.

Impact	References
Oil spills	Kerr et al. 2010, Emery et al. 2006, Peterson et al. 2003, Serrano et al. 2003, Crawford et al. 2000, Clarke 1984, Elmgren et al. 1983, Nounou 1980
Environmental pollution from oil production	Grant and Briggs 2002, Holdway 2002, Kingston 2002, Gray et al. 1999, Steinhauer et al. 1994, Gray et al. 1990
Pollution from drill cuttings and fluids	Schaanning et al. 2008, Cranford et al. 1999, Daan et al. 1992, Dow et al. 1990
Impacts of seismic surveys to fisheries	Christian and Bocking 2010, Slotte et al. 2004, Engås and Løkkeborg 2002, Hirst and Rodhouse 2000, Engås et al. 1996, Løkkeborg and Soldal 1993, Løkkeborg 1991
Impacts of seismic surveys to species	Hawkins and Popper 2014, New et al 2014, Weilgart 2013, Niu et al. 2012, Slabbekoorn et al. 2010, Dalen and Mæsted 2008, Southall et al. 2007, Smith et al. 2006, Popper et al. 2005, Hassel et al. 2004, Popper et al. 2004, Smith et al. 2004, O'Brien et al. 2002, Olesiuk et al. 2002, McCauley et al. 2000, Wardle et al. 2001, Santulli et al. 1999, Richardson et al. 1995, Hastings 1990, Dalen and Knutsen 1987
Impacts to Fisheries*	Kloff and Wicks 2004, Gausland 2003, Skalski et al. 1992, Falke and Lawrence 1973
Vector for alien species	Essl et al. 2015, Hopkins and Forrest 2010, Sink et al. 2010, Yeo et al. 2010, Hulme 2009, Wanless et al. 2009, GISP 2008, Coutts et al. 2007, Lewis et al 2006, Page et al. 2006, Godwin 2003, Ponti et al. 2002, Carlton 1987, Foster and Wilan 1979
Impacts to the benthic environment	Kingston 1992, Neff et al. 1989, Savage et al. 2001, Savage 1996
Ecosystem impacts	Currie and Isaacs 2005, Sammarco et al. 2004, Grant and Briggs 2002, Hall 2001, Gray et al. 1999, Montagna and Harper 1996, Daan and Mulder 1996, Olsgard and Gray 1995, Hall 1994, Hyland et al. 1994, Dunaway and Schroeder 1988, Davies et al. 1981

The Mining and Biodiversity Guidelines (Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, and South African National Biodiversity Institute, 2013) aim to facilitate greater consideration for biodiversity within the mining sector. The marine component of this document is based on the National Biodiversity Assessment 2011: Marine Technical Report (Sink et al. 2012a) and the OMPA project results (Sink et al. 2011). This document provides guidelines and guidance on best practice in dealing with biodiversity issues and maps areas (Figure 5) that pose a high risk to mining due to their high biodiversity value and/or threat status. This is an EIA tool aimed at providing environmental assessment practitioners (EAPs) and EIA

reviewers with the necessary biodiversity information to make informed decisions on the impacts of mining on biodiversity and the potential risks to mining activities. The influence of the Mining and Biodiversity Guidelines cannot be measured as yet as they were only released in 2013, although the usefulness of this document for the marine sector has already been reported as limited due to its terrestrial focus (Dr Jessica Courtoreille – PetroSA Environmental Leader, pers. comm.). However, other biodiversity plans are much older and provide an opportunity to measure their impact or influence on marine mining EIAs and Environmental Authorisations.

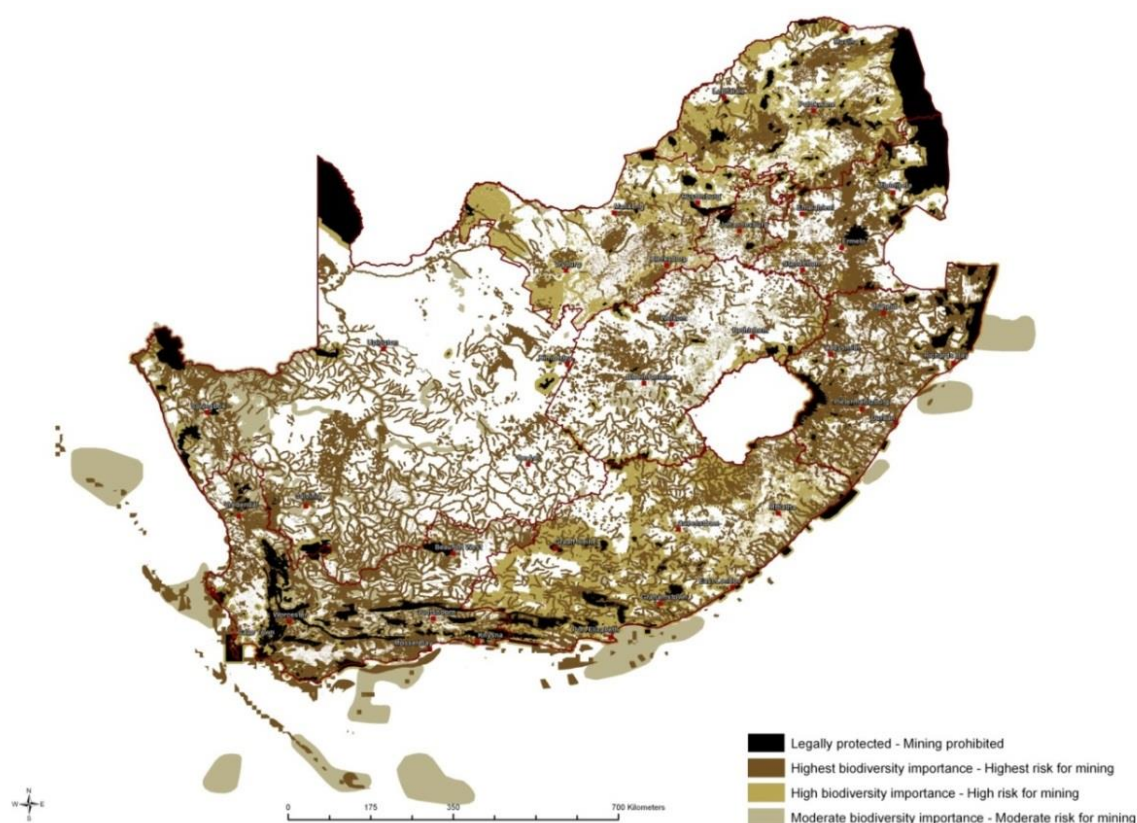


Figure 5: Image of the map of areas of high biodiversity value and the potential impacts to mining (Mining and Biodiversity Guidelines 2013).

1.4 Rationale for this Study:

1.4.1 Monitoring of Biodiversity Management

Monitoring of biodiversity management efforts is an integral part of ensuring that sustainable development principles are adhered to in planning and development. Follow-up on the impacts of decisions that have been taken is an important aspect of ensuring sustainable development and compliance with conditions of project approval (EPA Australia 1995). One of the main challenges in sustainable development monitoring in South Africa is the lack of capacity to undertake this task, as evidenced by the inclusion of occupations such as Environmental Manager, Marine Bioscientist, Biological Scientist and Safety, Health,

Environment and Quality Practitioner on the gazetted list of scarce skills for South Africa (RSA 2014a). In the case of mining, very little monitoring of environmental impacts and health and safety compliance takes place after a project has been approved due to limited financial and human resources (Mr Louis Bezuidenhout – DMR Mining Health and Safety, pers. comm.). This highlights the need for pre-approval monitoring of the quality of information being used at all stages of the process (discussed in section 2.4.3 Integrated Environmental Management) prior to a decision being taken to inform the decision-making process (Arebo 2005).

1.4.2 Effectiveness of EIAs

EIAs are considered to be tools for mainstreaming of environmental considerations into decision-making with many studies undertaken internationally to assess the quality of EIAs to ensure that they are efficient and effective in providing the necessary information for decision-making (Samarakoon and Rowan 2008, Bataineh 2007, Harmer 2005, Söderman 2005). Very few studies have focussed on EIA quality in South Africa (Ralston et al. 2009, de Villiers et al. 2008) but this is changing with the most recent and notable publication of an assessment of the quality of biodiversity information in EIAs for the Cape Floristic Region (Hallat et al. 2015). Unfortunately, the terrestrial bias in monitoring of EIAs has meant that no studies have been undertaken to assess EIAs in the marine context to date. Therefore this study represents an initial inquiry into the effectiveness of EIAs to address environmental management imperatives for the marine environment.

1.4.3 Monitoring the Impact of SANBI's Marine Programme

In the context of this study, pre-approval monitoring of the success of the products of SANBI's Marine Programme to inform sustainable development in the marine mining sector forms part of the broader monitoring framework to assess the quality of information included in decision-making. It would be preferable to monitor the utilisation of biodiversity information at all phases of the EIA process i.e. initial EIA publication, after the stakeholder engagement where comments have been incorporated and responded to, as well as at the approval stage. However, this can only be achieved with appropriate resources and human capacity. The general lack of capacity in the marine biodiversity sector outside of SANBI to undertake monitoring of the EIA process and the seemingly low up-take of biodiversity consideration in the mining sector has created a need for greater intervention on the part of SANBI. Capacity is especially lacking in the offshore environment. The SANBI Marine Programme has only two permanent staff members that are expected to fulfil the entire mandate of SANBI for the marine environment, and therefore rely heavily on strategic, high impact initiatives to meet its

objectives. This study will contribute to setting the strategic agenda in engaging with the mining EIA sector going forward.

1.5 Aims, Research Questions and Research Methods:

1.5.1 Aim

This study aims to evaluate the effectiveness of marine biodiversity information to influence environmental management within the EIA framework of oil and gas exploration. It is expected that the selected biodiversity reports and plans would be utilised to not only assess the level of impact of the proposed mining project on the different ecosystem types, but that they also inform mitigation recommendations.

1.5.2 Research Questions

In achieving these aims, this study will attempt to answer the following research questions:

1. Are the selected biodiversity products (i.e. NSBA 2005, OMPA and the NBA 2011) utilised in EIAs?
2. Where utilised, does the EIA give appropriate consideration to threatened ecosystems and priority biodiversity areas through mitigation recommendations?
3. Do specialist studies, where present, provide sufficient information and/or recommendations on threatened habitats/ecosystems?
4. Does the EIA process ensure sustainable development in the marine environment?

1.5.3 Research Methods

The research questions and characteristics of the data (i.e. contents of EIA documents) to be studied should take priority when determining the methodological approach (Case and Light 2011, Ranjit 2011). Elements of both qualitative and quantitative methodology have been incorporated and this mixed-method approach has itself been well studied (Hyett et al. 2014, Terrell 2012, Case and Light 2011, Ranjit 2011), and is accepted as bringing value to the research question, whilst maintaining research integrity. As EIAs are the only legally gazetted tool incorporated in the environmental management framework, the efficiency of these documents in contributing to meaningful sustainable development in the marine environment needs to be assessed. To assess their efficiency in this regard, this study has relied on the method of content analysis to determine the utilisation of the SANBI's biodiversity information to inform mitigation recommendations within the main text of EIAs along with their associated specialist studies. In this context, the methodology can be viewed as qualitative, while the method used is quantitative in terms of the research design (discussed further in Chapter 4). A case study on a sea-bed mining exploration application has also been included to provide a case of good practice (presented in Chapter 3). This

approach is pertinent to research addressing descriptive questions i.e. “What is happening” in a real-world context (Baxter and Jack 2008). Lastly, Geographical Information Systems (GIS) software is also used to illustrate the usefulness of one of the biodiversity products in planning at the project level.

1.6 Outline of Thesis:

Chapter 1 provides a broad introduction to the study undertaken in this thesis, outlining the need for assessment of use of biodiversity information to achieve sustainable development in the marine environment of South Africa.

Chapter 2 reviews the literature on the history of Sustainable Development within the global context that has influenced policy in South Africa. A more comprehensive introduction to the concept of mainstreaming with an outline of the role mainstreaming plays in ensuring biodiversity management to support sustainable development within and outside of the legislative framework is presented. This chapter also clarifies the legal requirements for the inclusion of biodiversity information in environmental impact assessment and the critical role that biodiversity information plays in guiding development.

Chapter 3 provides more detailed discussion on the Offshore Marine Protected Areas Project (OMPA), the National Spatial Biodiversity Assessment 2004, and the National Biodiversity Assessment 2011. A case study on a seabed mining environmental management plan (EMP) is presented to illustrate appropriate use of these products to formulate mitigation measures when carrying out an EIA.

Chapter 4 discusses the methodology and methods used in this study.

Chapter 5 presents the findings of the study using content analysis of 21 EMPs and their associated specialist studies.

Chapter 6 outlines the implications of the results of this study in evaluating the effectiveness of marine biodiversity information to influence environmental management within the EIA framework of oil and gas exploration. Recommendations and further research is put forward that would improve the mainstreaming success of future spatial plans and biodiversity assessment results.

1.7 Limitations of the Study:

There are limitations to this study that warrant attention for future research. This study did not include information on the resulting outcome (i.e. decision to provide or refuse an

environmental authorisation), as many of the applications linked to the EMPs had either no decision at the time of the study, or had been withdrawn. This would have enabled the evaluation of the mainstreaming success of the selected biodiversity products in the outcome of the decision-making process, and provided a holistic assessment of the impact these products had in ensuring sustainable development in the final result. No examination of the revised EMP or the comments received post its public commenting period was undertaken as the aim of this study was to determine the mainstreaming success of the selected biodiversity products with a focus on inputs from EAPs and specialists. Analysis of EMPs after the commenting period would provide insight into the broader mainstreaming success of the biodiversity products amongst stakeholders and identify stakeholders that are most involved in the marine EIA process.

EAP awareness of the biodiversity products as these were released was assumed (and evidenced by inclusion in some EIA documents analysed) as part of their general competency and no examination of the mainstreaming activities undertaken by SANBI to build awareness was undertaken. This would provide insight into the more effective methods that should be used in mainstreaming of products to EAPs. EAP proficiency in spatial analysis and the use of GIS software as well as their familiarity with the marine environment was also assumed. An analysis of EAP background and area of expertise was therefore not included in this study.

CHAPTER 2: SUSTAINABLE DEVELOPMENT AND THE ROLE OF BIODIVERSITY INFORMATION IN EIA

This chapter provides an overview of the history of Sustainable Development within the global context that forms the backdrop against which South African policy has developed. A more comprehensive introduction to the concept of mainstreaming with an outline of the role mainstreaming plays in ensuring biodiversity management to support sustainable development within and outside of the legislative framework is also presented. This chapter clarifies the legal requirements for the inclusion of biodiversity information in environmental impact assessment in South Africa and the critical role that biodiversity information plays in guiding development.

2.1 Introduction to Sustainable Development:

Concern for the effects of human activity on the natural environment has a history dating back to the late 1800s, with the focus moving from effects on marine species in the late 1800s and early 1900s, to broader consideration of impacts to ecosystems and concern for sensitive ecosystem types such as wetlands in the early 1970s (Elliot 2004). Public awareness of environmental problems and the emerging negative effects of agriculture, industrialisation and nuclear weapons testing began to increase in the 1960s, which led to a general increase in awareness around environmental issues and management (Grove 1992). The need for environmental and social aspects to be considered during the planning process was recognised in the 1970s (Naude 2002) and was brought forward by the introduction of new schools of thought such as Deep Ecology (Naess 1973), and the more radical environmental movements such as GreenPeace (Erwood 2011).

The first international conference where environmental issues were raised / brought into the policy domain was the United Nations (UN) Conference on the Human Environment in 1972, which resulted in the Stockholm Declaration (Sohn 1973). This declaration produced the first set of principles for environmental management, and marked an acknowledgement that governments have a responsibility to ensure the maintenance of environmental condition and sustainability (UN 1972). The outcomes of the convention did not legally bind nation states to implement these principles in local governments, as only two heads of state were present at the convention (Elliot 2004), minimising its potential impact on international environmental management. However, the convention did provide the much needed platform for international debate on environmental issues and was deemed a political, if not an environmental, success (Haas et al. 1992). This convention paved the way for further

scientific inquiry and political debate around environmental management with many conventions and international agreements on species conservation and conventions on pollution being ratified thereafter (Brown Weiss 1992). In 1983 the United Nations General Assembly created a special commission called the World Commission on Environment and Development (WCED) which recognised environmental degradation that was brought on by changing human behaviours and technology as a threat to society and introduced the concept of sustainable development and proposed legal principles for environmental protection (WCED 1987).

In the South African National Framework for Sustainable Development (DEAT 2008) the definition for sustainable development is heavily influenced by that put forward in the WCED Report, also referred to as the Brundtland Commission - "*Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" (WCED 1987). The three underlying pillars that are commonly associated with sustainable development are the environment, the economy and society (Griggs et al. 2013). Under this model (see Figure 6), in principle, each pillar is considered equally as important as the other two.

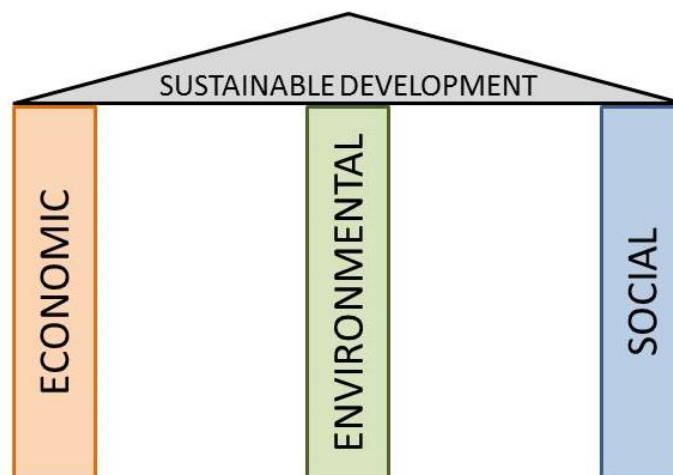


Figure 6: The three pillars of sustainable development (adapted from Adams 2006).

Sustainable development is said to be achieved when economic, environmental and social imperatives are all considered and achieved in decision-making, and is often depicted as seen in Figure 7. The reality, however, is that decision-making takes place in a pragmatic and subjective environment that allows for one aspect to be weighted heavier than another, and therefore depends on the values of the person, corporation and/or government setting the criteria for sustainable development (DBSA 2008, George 1992). The ambiguity or confusion around universal definitions for sustainability and sustainable development (Sutton 2004) has meant that they can be used to complement or justify activities that may

not be in line with environmental goals as these may not be weighted as highly as the economic and/or social development goals. Munslow and Fitzgerald (1994) aptly stated that the popularity of the term sustainable development could be attributed to the fact that “[e]veryone can agree to the idea while pursuing their own interpretation of what it means and how to achieve it.”

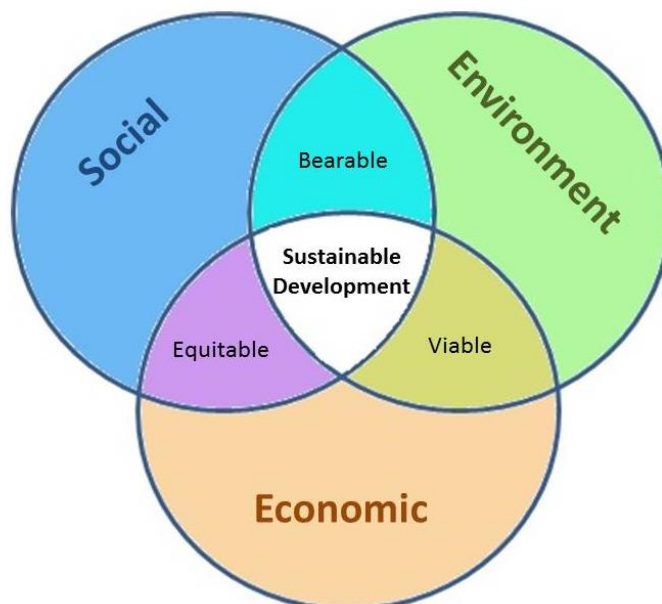


Figure 7: Sustainable Development shown as the overlap of social, economic and environmental imperatives (adapted from Adams 2006).

Sustainable development, or rather the pursuit thereof, therefore does not guard against all forms of environmental degradation as it allows for concessions or trade-offs to be made on environmental integrity in order to enable economic and/or social development at the expense of the environment. This can be considered a weakness in the early thinking around sustainable development (Adams 2006, George 1992) that has impacted on the ability of nations, especially developing nations, to appropriately adhere to the principles put forward in the Brundlandt Commission within the new development paradigm after 1972 (Furter 2003), resulting in the need for further discussion at the international level.

In 1992 the United Nations met at the Conference on Environment and Development (also referred to as the Earth Summit), where member states reaffirmed their commitment to the Stockholm Declaration, and set out to create global partnerships that would endeavour to protect the global environment while respecting the sovereignty of each state and their autonomy to make use of natural resources pursuant to their respective developmental and environmental policies (UNEP 1992a). At this conference, the need for environmental issues to be an integral part of the developmental process was identified as the key to achieving sustainable development. The resulting principles in the Rio Declaration also instructed

member states to institute environmental legislation and implementation of sustainable development tools such as EIA. It also laid the foundation for the concept of co-operative environmental management through the inclusion of inter- and intra-governmental collaboration, consultation with local communities on environmental issues, as well as the importance of creating a global economic environment suitable to sustainable development. This also allowed for increased consideration for environmental issues as well as for related issues such as poverty alleviation and gender equity. One of the major political successes of the Earth Summit was the signing of two legally binding documents – the Convention on Biological Diversity (UNEP 1992b) and the United Nations Framework Convention on Climate Change (UN 1992) – along with the adoption of an action plan for the implementation of sustainable development, i.e. Agenda 21 (UNCED 1992), all of which have been used by many countries (including South Africa) as the basis for ratification of environmental legislation and strategies around climate change, environmental management, carbon reduction and poverty alleviation at the national and local level.

The Earth Summit also led to the formation of an independent Earth Charter Commission after 1992 (Earth Charter International 2012a) which strived to create a statement for the ethical framework that would enable sustainable development to thrive. This commission succeeded in the publication of the first draft of the Earth Charter in 1997– a document outlining the guiding principles for the creation of a *“more, just, sustainable and peaceful world”* (Mackey 2004) which formed the basis for an international ethic around environmental management and conservation. This document shifted the ethics of the global community from anthropocentric – as presented in Principle I of the Rio Declaration where humans are at the centre – to a biocentric ethical framework where humanity is seen as part of the natural environment and all living organisms have value unto themselves (Bosselmann 2004). The shift from an anthropocentric to a biocentric view has bolstered the efforts of organisations such as the International Union for Conservation of Nature (IUCN) to assess, monitor, report and improve the status of species threatened with extinction (referred to as red listing), regardless of their usefulness to society, and has enabled the red listing of many South African species, e.g. The Red List of South African Plants (SANBI 2014). Although not formerly accepted by governments as a binding document, many organisations in South Africa have endorsed it (Earth Charter International 2012a), and according to Earth Charter International (2012b) *“[i]t is used as a basis for peace negotiations, as a reference document in the development of global standards and codes of ethics, as resource for governance and legislative processes, as a community development tool, as an educational framework for sustainable development, and in many other contexts.”*

In 2002 the Earth Charter Commission and various supportive organisations attempted to have the Earth Charter formally recognised by governments when South Africa hosted the World Summit on Sustainable Development (also referred to as the Earth Summit 2002). Although this was unsuccessful, the Earth Summit 2002 saw the adoption of the Johannesburg Declaration as a reaffirmation to sustainable development (WSSD 2002). At this summit, although it was agreed that much progress had been made in the implementation of Agenda 21, it was acknowledged that the progress towards sustainable development to address many of the issues identified in 1982 had not been achieved and further work was required on multiple scales (Doran 2002).

It was recognised that the greatest challenges to achieving sustainable development in African states were the issue of poverty alleviation and the need for increased economic development (Drexhage and Murphy 2010). As a consequence of these challenges, it is interesting to note that some of the actions agreed upon in the Plan of Implementation of the World Summit on Sustainable Development (UN 2002b) promoted sectors and/or activities that are widely recognised as seemingly detrimental to biodiversity, for example under section VIII Sustainable Development for Africa:

g. Enhance the contribution of the industrial sector, in particular mining, minerals and metals, to the sustainable development of Africa by supporting the development of effective and transparent regulatory and management frameworks and value addition, broad-based participation, social and environmental responsibility and increased market access in order to create an attractive and conducive environment for investment;

At the Rio+20 Summit in 2012, the United Nations committed to developing Sustainable Development Goals that would be integrated into the Millennium Development Goals after their 2015 deadline (Griggs et al. 2013). Millennium Development Goals were first introduced at the Millennium Summit, held in New York in 2000. The resulting Millennium Declaration (UN 2000) once again affirmed the commitment of member states to uphold the principles of sustainable development that contributed to a peaceful and just world where the needs of future generations were considered in planning and development. The Millennium Declaration was accompanied by a set of time-bound targets, these being the Millennium Development Goals. The Millennium Development Goals (Millennium Project 2006) are to:

- (1) eradicate extreme poverty and hunger;
- (2) achieve universal primary education;
- (3) promote gender equality and empower women;
- (4) reduce child mortality;
- (5) improve maternal health;

- (6) combat HIV/AIDS, malaria and other diseases;
- (7) ensure environmental sustainability; and
- (8) develop a global partnership for development.

Griggs et al. (2013) put forward that the Millennium Development Goals should be expanded to incorporate environmental imperatives necessary for modern life, thus enabling them to be transformed into Sustainable Development Goals. They also suggested a new definition of sustainable development that places a greater emphasis on the environmental aspect of sustainable development - *“Development that meets the needs of the present while safeguarding Earth’s life-support system, on which the welfare of current and future generations depends.”* (Griggs et al. 2013). This definition places a firmer focus on the environment as the basis of a thriving society. The legal definition of sustainable development as found in the National Environmental Management Act (NEMA) (RSA 1998a) - *“the integration of social, economic and environmental factors into planning, implementation and decision-making so as to ensure that development serves present and future generations”* - places a emphasis on governance as the main driver of sustainability and the means by which to achieve sustainable development (see Figure 8) (Ferris 2010). Unfortunately, this definition maintains the idea that environmental and socio-economic imperatives should be equally weighted. This definition therefore has a weaker focus on the environment than the Griggs et al. (2013) definition and does not align as closely with the framework provided in Figure 8. This could imply that although South Africa is a party to the various international conventions that strive to achieve global sustainable development, and has its own policies around what good sustainable development is, there is still a disconnect between the realisation of the finite capabilities of the environment to absorb increased pressure and the strong demand for services and economic growth by its population (Hunter 2015, Masilela 2015, LRC 2012).

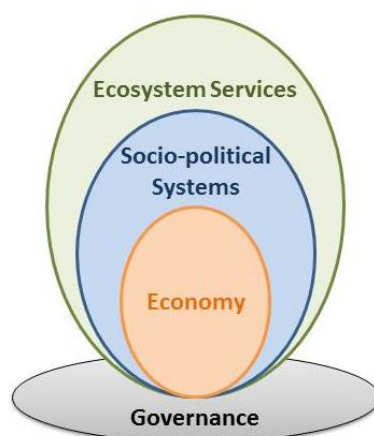


Figure 8: Graphic depiction of the systems approach to sustainability used in South Africa (taken from DEAT 2008).

The conflict between environmental sustainability and economic development is the key challenge to achieving sustainable development in South Africa and other developing countries (Burns et al. 2006). *“[I]t would seem that the logic of capitalism, which is private profit, and the long-term conservation of the environment, which can only be managed collectively, are mutually exclusive”* (Turshen et al. 1988). This challenge is not insurmountable however, as the opportunity still exists for retrospective analysis and assessment of the current planning policy and programme frameworks that are being readied within the government’s Strategic Infrastructure Programme (PICC 2012). A National Infrastructure Plan was adopted by the South African government in 2012 (RSA 2015). This plan focusses heavily on achieving the Millennium Development Goals through increased access to services such as water, healthcare, education and electricity, alleviating poverty through job creation and an improved economy (PICC 2012), whilst striving to ensure appropriate consideration for the environmental impacts of the plan through the utilisation of Strategic Environmental Assessments (SEAs) for four of the Strategic Infrastructure Projects (SIPs), as they are at a national scale¹. The remaining, more geographically focussed SIPs will utilise the EIA process to evaluate environmental impact. This can be seen as the first step towards achieving the goals set out in the National Development Plan produced by the National Planning Commission in 2011 (NPC 2011).

The necessary science-based tools and mechanisms (e.g. spatial plans/planning, ecosystem maps, guidelines on best practice amongst others) exist for this new phase in South Africa’s development to be geared towards a more sustainable future, especially in the marine environment. The ocean environment was notably excluded from the original National Infrastructure Plan and therefore presents a unique opportunity to influence decision-making in this environment as new development initiatives are identified. However, the gap still remains in connecting this rational modern approach to dealing with information and the pragmatic and subjective environment that decision-making takes place in. The way forward in achieving sustainable development is through bridging that gap with collaborative and integrated management and research (Burns et al. 2006) and is a recognised element in the achievement of the National Development Plan. Unfortunately, management of marine activities still takes place in a fragmented manner, as legislation with seemingly opposing mandates force government departments into opposing roles (this is further discussed in section 2.4 Marine Environmental Legislation). One solution to avoiding this unnecessary adversarial intergovernmental environment is to ensure that there is a common understanding of the benefits and importance of the natural and semi-natural environment within all terrains (Wilby and Hector 2008, Costanza et al. 1997, Pimental et al. 1997). This

¹ Further information on the SIPs is available at <http://www.gov.za/issues/national-infrastructure-plan>.

can be achieved through revision of legislation, and mainstreaming. Revising legislation is a lengthy and costly exercise and some could argue that the marine environment is already over-legislated (see Table 2 in section 2.4), whilst mainstreaming can be done relatively quickly as it is an exercise in shifting paradigms and ways of thinking about the environment.

2.2 Mainstreaming and Biodiversity Management:

2.2.1 What is Mainstreaming?

“Mainstream” is defined as *“the prevailing current of thought”* when referring to the noun, or when used as a verb to represent *“the prevalent attitudes, values, and practices of a society or group”* (Oxford Dictionaries 2015). Mainstreaming is therefore the act of integrating a philosophy or creating awareness around an issue into the prevailing current thought so that it can influence the attitudes, values and, ultimately, practices of society. Mainstreaming is a useful tool that has many applications (gender issues, health and safety, increased productivity, technological advances, etc.) that go beyond strict concern for the environment (Mackay and Bilton 2003). Successful mainstreaming is a multi-sectoral exercise that engages with all stakeholders (i.e. the general public, special interest groups, government agencies, non-governmental organisations and the private sector) to understand their position or area of interest around an issue, the role they can play on mainstreaming the new idea or way of thinking put forward, and identifying key areas within policies and ways of working that create win-win situations (Benson et al. 2007).

Mainstreaming as a process is essentially a set of tools that enables entities and organisations that seemingly have contrasting goals and functions to create a common understanding and (hopefully) synergise activities within a thematic area so as to achieve a common goal. *“Mainstreaming an issue into national development planning thus refers to its incorporation into all elements of plans, policies, programmes, strategies and budgets and their implementation”* (Cohen 2010). It is therefore important to establish the common components that should be used in mainstreaming.

2.2.2 Components of Mainstreaming

Cohen (2010) provides a guideline for necessary steps and components to ensure mainstreaming of resource efficiency and sustainable consumption and production into programmes, policies and practice in both civil and private entities within the context of a developing country. This guideline has been adapted here to show its applicability to any ideology that is being introduced into a new or established framework, and the general principles are provided in Figure 9. In this figure, the three main components of mainstreaming are put forward. The framework put forward by Cohen (2010) speaks directly

to the lessons learnt through initiatives to mainstream poverty alleviation into sustainable development strategies as reported by the UNDP-UNEP (2009, 2015) in a handbook for practitioners, thus emphasising the usefulness of the generic principles to any subject.

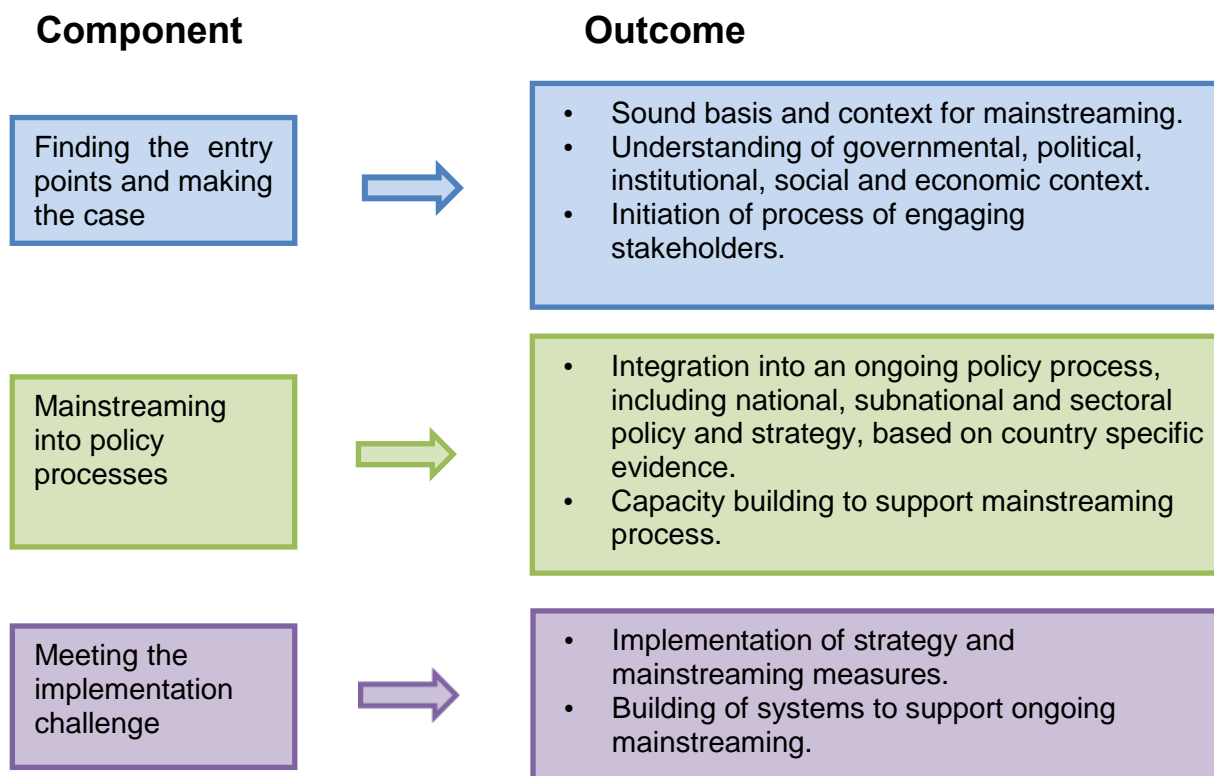


Figure 9: Components and Outcomes of Mainstreaming (adapted from Cohen 2010)

The first component of mainstreaming is “Finding the entry points and making the case”. A sound basis for the need of the new process or activity to be mainstreamed is essential and answers the “so what” question often-times posed by those reluctant to move away from the status quo (de Jager 2001). Entry points are opportunities that exist in the current framework of decision-making where mainstreaming initiatives may be able to influence the way in which decisions are taken and are identified through a thorough understanding of the context, motivations and goals of the sector that the mainstreaming activity or project is aiming to influence (UNDP 2011). This can be achieved through desktop analysis, but is mainly dependent on effective stakeholder engagement.

Stakeholder engagement, a mainstreaming tool in itself, provides in-depth understanding of the values and motives of the role-players involved and help to identify areas of opportunities for mainstreaming initiatives that best complement their existing work processes and interests (Adams et al. 2014, Hughes and Dann 2009). This is the first step towards creating a communication strategy that is targeted and appropriate to the sector that is being

engaged. “Making the case” is therefore the development and implementation of a communication strategy around the issue being mainstreamed, and is focussed on communicating the benefits of the proposed idea or activity to stakeholders and decision-makers. Information should, therefore, be written and presented in a way that is specific to the sector/agency that is being targeted so that it has the most traction (Harrison et al. 2015, Hughes and Dann 2009, UNEP and CBD 2007). This may mean that various types of communication need to be developed that are aimed at different role-players to ensure that messaging is at the appropriate level (APSC 2007). Stakeholder engagement also helps to focus the development of tools that assist with decision-making, e.g. maps, online information systems, and/or publication of guidelines, which are sector specific and easy to use to allow for improved utilisation of the information presented (APSC 2007). This phase also enables the identification of gaps in capacity to implement mainstreaming initiatives in addition to identifying the current capacity within the engaged sectors to absorb or adopt the new “way of doing/thinking” within their specific context (Denny 2001, Downs 2001).

Capacity building to ensure the uptake and implementation of the new mode of thinking/doing is therefore a key component of ensuring “Mainstreaming into policy processes”. This component relies heavily on the information gathered in the first component (i.e. finding the entry points and making the case), as this first phase provides the background information for building the mainstreaming strategy of the initiative to enable appropriate intervention at all levels at which policy is made. It is necessary to have an in-depth understanding of the legislative framework and where opportunities within legislation and policy development exist (UNDP-UNEP 2015) to incorporate the idea being mainstreamed into the existing framework. This requires on-going stakeholder engagement to ensure that mainstreaming initiatives/communications remain current and relevant to the sector being targeted. Therefore, it is necessary to use a flexible approach when mainstreaming to be able to identify and capitalise on new opportunities/entry points as they arise (Folke et al. 2002).

In “Meeting the implementation challenge”, this flexible approach is key to ensuring that the activities being mainstreamed are practical and operational, such that it can be included into a monitoring framework (Conlin and Stirrat 2008). Ensuring the operability of the new activity requires a good understanding of the financial and human resources available, and reiterates the need for capacity development (Folke et al. 2002). Mainstreaming is not a once-off exercise, but requires ongoing engagement and support from mainstreaming entities and should be viewed as a long term strategy (UNDP-UNEP 2009). Monitoring of the impact of a mainstreaming initiative assists in providing a feedback loop, as the

effectiveness of an initiative or process can be evaluated and re-designed if its impact is not sufficient (Ijeoma 2010). This re-emphasises the flexible approach required for effective mainstreaming that allows for learning by doing (UNDP-UNEP 2009)

2.2.3 Determining the effectiveness of environmental mainstreaming

Dalal-Clayton and Bass (2009) define “*Environmental mainstreaming*’ [as] *the informed inclusion of relevant environmental concerns into the decisions of institutions that drive national, local and sectoral development policy, rules, plans, investment and action.*” They also identified that the main challenge to successful environmental mainstreaming was the lack of coordinated governance, as indicated in Figure 8, as the basis for sustainable development in South Africa. Many government departments and private corporations have previously viewed environmental degradation as an externality (i.e. they do not bear the cost of degradation) and therefore biodiversity and environmental integrity were not previously valued. As such, governance frameworks were/are not geared towards viewing biodiversity as a priority (Furter 2003). In developing countries such as South Africa, the focus may be first on economic growth and social upliftment to reverse the legacy of colonialism (in the South African context – apartheid) before consideration of environmental impacts can be tabled (Ferris 2010). An environmental mainstreaming approach should therefore follow the steps outlined in Figure 9 to identify entry points that make the case for biodiversity consideration at all levels, to integrate environmental issues into all levels of policy and decision-making.

The core principles for effective mainstreaming have been identified by Dalal-Clayton and Bass (2009) as:

- a. *Leadership – the mobilisation and creation of political will, engaging with ‘champions’;*
- b. *Integration – where environment and development approaches are integrated;*
- c. *Key sectors – a strong focus on economic sectors;*
- d. *Dialogue – a wide range of means for making voices heard and for cooperation;*
- e. *Ownership – mainstreaming process managed by the country or locality in question;*
- f. *Subsidiarity – decisions taken at the lowest possible level of public authority;*
- g. *Use mainstream processes – existing analytical/planning process where possible;*
- h. *Transparency and accountability – information on issues, decisions made and reasons.*

Measuring the effectiveness of environmental mainstreaming initiatives can be assessed using qualitative and quantitative means as it has aspects of changing attitudes of decision-makers on one hand (e.g. inclusion of sensitive ecosystems in planning) that should be

reflected in specific and measurable outcomes (e.g. the increase in budget allocation for ecosystem rehabilitation efforts) on the other. From the perspective of environmental managers and practitioners, the preferred outcome of decision-making is that no degradation of ecosystems is allowed (Chothia 2010) which would translate to zero net loss of biodiversity over a certain period, but this is clearly not in line with the aims of sustainable development which seeks to maintain ecosystem services and function, not ecosystem pristineness. Therefore other metrics need to be used to assess the effectiveness of environmental mainstreaming.

Environmental mainstreaming requires continuous monitoring and evaluation to ensure its effectiveness. This allows for a knowledge feedback loop that enables adaptive and flexible approaches. Effectiveness can be measured by assessing if all the necessary processes of mainstreaming have been followed (as laid out under section 2.2.2 Components of Mainstreaming) and whether the principles of effective mainstreaming have been adhered to. The next step is identifying the outcomes and determining if they are in line with the objectives and goals of the specific mainstreaming strategy. Criteria and indicators for environmental mainstreaming that assist monitoring and improvement therefore, need to be developed. These should be based on specific processes or outcomes, and not on the completion of products.

Useful indicators for determining the effectiveness of mainstreaming of poverty-environment linkages were put forward by the UNDP-UNEP (2009) and have been adapted for the environmental sector here:

1. *Inclusion of environmental imperatives in national development and resource-use strategies.*
2. *Strengthened capacity within finance/planning ministries as well as environmental agencies to integrate environment into budget decision-making, sector strategies and implementation programmes.*
3. *Inclusion of environmental imperatives in sector planning and implementation strategies.*
4. *Strengthened capacity in key sector ministries to include environmental sustainability into their strategies.*
5. *Widened involvement of stakeholders in making the case for the importance of environment to growth and poverty reduction.*
6. *Improved domestic resource mobilization for investments.*
7. *Increased donor contributions to country-level environmentally sustainable investment.*
8. *Improved livelihoods and access to environmental and natural resources for the poor that are in-line with sustainable resource use.*

Dalal-Clayton and Bass (2009) also presented an adapted example of an indicator tool from the UNDP (2005) to assess the effectiveness of drylands mainstreaming (See Box 1).

Box 1: Example of criteria to be scored in an assessment of effectiveness of mainstreaming (adapted from Dalal-Clayton and Bass 2009).

Criteria	Evaluation Questions
1. Political leadership	How supportive is political leadership on environmental issues? Do key individuals in government hold environmental responsibilities?
2. Institutional commitment	Are there institutions specifically mandated for environmental management? Are they committed to environmental mainstreaming? Are the institutions responsible for planning and finance equally committed to environmental mainstreaming? Are institutions orienting their staff to adopt a mainstreaming culture? Does government increasingly finance mainstreaming processes?
3. Coordination	Is there an institution that coordinates environmental mainstreaming? Is it well staffed, with technical backstopping? Are there sub-committees, sector working groups or task forces on environmental mainstreaming? Have they been successful in advocating for environmental issues?
4. Participation	Is planning done in a participatory manner? Do the direct beneficiaries participate? Is there a plan to cost-effectively manage the participatory/consultative processes?
5. Communication reporting	Are there good and regular communication links among the institutions and groups involved in mainstreaming? Is there sharing of information on mainstreaming practices? Is the media used to disseminate emerging good practices?
6. Guidance training	Are staff trained before they undertake mainstreaming? Are they guided by experts knowledgeable in mainstreaming? Are guidelines available to the staff?
7. Awareness raising	Are all staff in the organisation(s) that lead mainstreaming initiative(s) made aware of its importance and steps? What about the general public? Are awareness campaigns conducted for the political leadership?
8. Approval/ Assessment	Is the assessment of likely impacts made? Is the assessment of potential developmental opportunities from natural resources also made? Are the environmental, economic and social challenges of exploiting particular resources or development in areas articulated?
9. Mainstreaming tools	Are tools for mainstreaming available? Are they being followed? Is training made available for the users?
10. National/local sustainability	Are there national and local (e.g. district) sustainability strategies or environment plans?
11. Target objectives	Have baselines indicators/benchmarks to mainstreaming been created? Have objectives been set very clearly? Are target indicators reflected in the respective planning frameworks?
12. Allocation of spending and actual funding	Are the plans made linked to the budgeting framework or other funding mechanisms? Are approved budgets actually spent? Are public expenditure tracking surveys regularly conducted?
13. Monitoring	Does the monitoring framework include monitoring of mainstreamed issues? Are the mainstreamed issues sufficiently reported upon? Is there a culture to share the TOR for hiring consultants to review mainstreaming well in advance?

2.2.4 Focus of the Current Study

The focus of this study is to assess aspect 8 and 9 of the criteria tool (Box 1) which focuses on the assessment process and availability and use of mainstreaming tools respectively. The tools are discussed in section 2.4.3 Integrated Environmental Management. This study presents an opportunity to assess the uptake of new information as a means of monitoring the assimilation of information by EAPs and specialist study consultants. Monitoring of upskilling or capacity development of EAPs and specialists in conjunction with decision-makers is a key step in the monitoring and evaluation aspect of mainstreaming as many high level officials were trained at a time where issues such as environmental imperatives were given little attention (Dalal-Clayton and Bass 2009), and this is especially true in the marine environment. The results of this study will also assist in identifying how well some of the aspects and principles of effective mainstreaming have been implemented and provide some insight into revising the current mainstreaming strategy to mainstream marine biodiversity information if need be.

The long history of sustainable development has had a marked impact on the current development goals of South Africa. Unfortunately the need for economic growth and social upliftment within the South African context has resulted in actions that are not always in-line with the objectives of sustainable development. This could be attributed to the lack of understanding of officials and decision-makers on environmental issues, as most of these officials may have been trained in their respective fields when these issues were not a matter of concern. There is, therefore, a need for effective environmental mainstreaming into sectors that have an impact on biodiversity, but not necessarily a responsibility to ensure good biodiversity management. The South African government recognised that good governance is the key to implementing planning and development that meets the objectives of sustainable development (DEAT 2008). South Africa has very good environmental legislation that was formulated after the disbandment of the apartheid regime (DEAT 2007). However, much of the legislation governing the marine environment is very new and an overview of this legislation is needed to understand the constraints to a collaborative and integrated sustainable development strategy for the marine environment.

2.3 South Africa's Environmental Right

In 1994, South Africa embarked on a new dispensation that saw the repealing of several laws that were instituted during the apartheid regime which began with the publication of the Constitution of the Republic of South Africa (RSA 1996). Under the Bill of Rights (Chapter 2 of the Constitution) section 24 states:

24 Everyone has the right

- a. *to an environment that is not harmful to their health or well-being; and*
- b. *to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that*
 - i. *prevent pollution and ecological degradation;*
 - ii. *promote conservation; and*
 - iii. *secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.*

The inclusion of an environmental right into the Bill of Rights saw the promulgation of several new acts as well as amendments to existing acts to give action to this right. Those directly relevant to the marine environment are listed in Table 2. It should be noted, however, that this is by no means exhaustive as many laws focussed on land-based activities have implications for marine biodiversity management in the coastal and offshore environments.

Table 2: Environmental laws for the marine environment.

Name of Act	Name of Act
National Environmental Management Act 1998	National Environmental Management: Biodiversity 2004
National Environmental Management: Integrated Coastal Management Act 2008	Marine Living Resources Act 1998
Spatial Planning and Land Use Management Act, 2013	Admiralty Jurisdiction Regulation Act 1983
Carriage Of Goods By Sea Act 1986	Dumping At Sea Control Act
Marine Pollution (Control And Civil Liability) Act, 1981	Marine Pollution (Intervention) Act 1987
Marine Pollution (Prevention Of Pollution From Ships) Act 1986	Marine Traffic Act 1981
Maritime Zones Act, 1994.	Merchant Shipping (International Oil Pollution Compensation Fund) Act 2013
Merchant Shipping (Civil Liability Convention) Act 2013	Merchant Shipping (Safe Container Conv) Act 2011
South African Maritime Safety Authority Act 1998	Prevention and Combating of Pollution of the Sea by Oil Amendment Act 1990.
Seals and Seabirds Act 1973	Wreck And Salvage, 1996
Disaster Management Act 2002	Environment Conservation Act 1989
South African Maritime And Aeronautical Search And Rescue Act 2002	

A clear aim of the new dispensation post- 1994 was to reverse environmental racism, which included the forced removal of indigenous people to make way for white only settlements, as well as to establish environmental conservation areas (Khan 2002). This has led to the perception of non-white South Africans that conservation is a concern of the privileged, and

therefore at odds with redressing the past inequities of the apartheid regime (Glazewski 1993). This may be one reason behind the inclusion of the idea that sustainable development should promote “*justifiable economic and social development*” under Section 24 (b)(iii) of the Constitution. No legal definition for “justifiable” is presented in the Constitution or any of the laws related to biodiversity or environmental management, reiterating the dependence of sustainable development implementation on the prevailing mainstream opinion of what constitutes justified environmental degradation in order to achieve economic and social development. It could be argued that this clause is in direct conflict with 24(b)(i) which calls for the prevention of ecological degradation. However, “ecological degradation” is also not defined in any of the legislation, and therefore can also be viewed as a pragmatic assumption based on the prevailing thought around acceptable and unacceptable forms of environmental modification, resource use and/or biodiversity loss.

Although many other pieces of legislation also form part of this legislative environment, the focus of this study will be restricted to the NEMA and Mineral and Petroleum Resources Development Act (MPRDA) (RSA 2002) as they form the primary regulatory regime related to marine biodiversity, mining and impact assessment.

2.4 Marine Environmental Legislation

Sustainable development and environmental management go hand-in-hand. It is, therefore, important to consider how these interrelated ideals have been incorporated into the legislative framework for the marine and coastal environment and how they contribute, or not, to good environmental management practice within the marine petroleum sector.

2.4.1 National Environmental Management Act

NEMA was promulgated in 1998 and came into effect in November of that year. This act gives effect to the environmental right across all environments and is the central piece of legislation related to mainstreaming of the environment into planning and management across all sectors, and provides the legal definition for sustainable development. Under Chapter 1: National Environmental Management Principles of the act, section 2 (RSA 1998) states “*Environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably.*” However, in the very next section it states “*3. Development must be socially, environmentally and economically sustainable.*” These two clauses at face value do not seem contradictory, but it must be acknowledged that a framework that has such a strong anthropocentric emphasis would lend itself to a development agenda that is focussed on the short-term needs of the current generation, and therefore equal weighting of the

environmental imperatives versus social and economic ones is unlikely (Scholtz 2005). This is evidenced by the Act's definition of **best practicable environmental option** - "*the option that provides the most benefit or causes the least damage to the environment as a whole, at a cost acceptable to society, in the long term as well as in the short term*" (RSA 1998). In light of the perceived economic and social benefits of mining (Mbatha and Wynberg 2014) it is crucial that the cost of environmental degradation is well understood when determining what can be considered acceptable and unacceptable impacts of activities on biodiversity in relation to the well-being of future generations if sustainable development is to be ensured (Weiss 1992, Anstee-Wedderburn 2014).

NEMA does attempt to balance the need for benefits to the current generation with potential and/or future benefits to coming generations by outlining the principles for how decision-making for sustainable development should be carried out. Section 4 of Chapter 2 of the Act outlines considerations that should be included in the following subsections:

(4) (a) Sustainable development requires the consideration of all relevant factors including the following:

- (i) That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied;*
- (ii) that pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied; [...]*
- (v) that the use and exploitation of non-renewable natural resources is responsible and equitable, and takes into account the consequences of the depletion of the resource; [...]*
- (vii) that a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions;*

From the wording of this section, it appears that the preferred course of action should be to avoid environmental damage, but where this is unavoidable, mitigation is a legal requirement. This section also introduces the concept of the precautionary principle (Section 4(a)(vii)) as a means of mitigation before damage to the environment is allowed (Sheng et al. 2015, COMEST 2005, Hey 1993). Carter (2001) aptly stated that "*[t]he problem of uncertainty is exacerbated by the irreversibility of many environmental problems*".

Knowledge of the environment that is being impacted upon is therefore required to enable proper assessment of potential environmental damage and appropriate mitigation. The Act instructs the Minister of Environmental Affairs to produce an Environment Outlook Report (Section 16) that provides information on the condition of the environment and its natural resources to allow for informed decision-making (DEAT 2008). The most recent report is

called Life: The State of South Africa's Biodiversity 2012 (SANBI 2013), and is based on the results of the National Biodiversity Assessment 2011 (Driver et al. 2012) which was developed by the SANBI (see Chapter 4 for further discussion). The National Environmental Management: Biodiversity Act (RSA 2004) forms part of the NEMA series and provides the mandate for the SANBI to conduct research and develop knowledge on the South African environment, as well as to report and monitor the state of the ecological estate to facilitate informed decision-making in support of sustainable development.

Environmental information is an integral part of informed decision-making as the basis for ensuring appropriate management of biodiversity and resources. As mentioned in Chapter 3, existing biodiversity information for the marine environment, albeit limited in detail for some deep-sea offshore ecosystems, provides a robust backdrop for decision-making. The way in which this information should be used is presented in NEMA under Chapter 5: Integrated Environmental Management and is discussed in further detail in section 2.4.3 below. Section 24 of the NEMA refers to the legal instrument (Environmental Authorisation) that must be obtained for permission to initiate any action, such as those associated with mining, that is listed in the government gazette as having an impact on the environment (RSA 1998). Mining is managed under the MPRDA and there is a reciprocal referencing relationship between that and NEMA. The role of the MPRDA in contributing to sustainable development and its contribution to environmental management is outlined in the following sub-section.

2.4.2 Mineral and Petroleum Resources Development Act

The MPRDA gives effect to the Right of Equality as set out in Section 9 of the Constitution. The main aim of the MPRDA is to ensure that benefits of mineral and petroleum resources support sustainable development through economic growth and social development that allows for redress of injustices of the apartheid regime by enabling previously disadvantaged groups to access the sector (Cawood 2004, April 2012). Section 100(2)(a) specifically calls for the development of a mining charter that will set timelines and targets to ensure transformation at all levels of the sector to provide access for previously disadvantaged groups. The resulting South African Mining Charter (RSA 2010a) does however make specific reference to the obligation of mining companies to *“implement environmental management systems that focus on continuous improvement to review, prevent, mitigate adverse environmental impact”* and to carry out continuous rehabilitation in areas that have ongoing mining activities taking place.

The MPRDA was promulgated after the NEMA, and as such the Act has incorporated aspects of the NEMA definition for sustainable development into the one put forward in the Act – *“the integration of social, economic and environmental factors into planning,*

implementation and decision making so as to ensure that mineral and petroleum resources development serves present and future generations.” The Act also gives effect to the Environmental Right (Section 24 of the Constitution) in Section 2(h) which states that government should ensure that *“resources are developed in an orderly and ecologically sustainable manner while promoting justifiable social and economic development”*. This sentiment is repeated in Section 3(3): *“The Minister must ensure the sustainable development of South Africa's mineral and petroleum resources within a framework of national environmental policy, norms and standards while promoting economic and social development.”* In light of the strong economic and social objectives of the MPRDA (Cawood 2004), the term “justifiable” in relation to environmental impacts once again lends itself to the subjective nature of the decision-making process and the importance of sound biodiversity information to support said process.

Section 16 of the MPRDA states that anyone applying for a prospecting licence must submit an application for an environmental authorisation and follow the procedure laid out in Chapter 5 (Integrated Environmental Management) of the NEMA. Mining is therefore subject to the Integrated Environmental Management framework laid out in the following section.

2.4.3 Integrated Environmental Management

Chapter 5 of NEMA sets out to promote the use of appropriate tools to ensure that the principles of sustainable development are incorporated in planning and development. The general objectives of Integrated Environmental Management under NEMA section 23(2) include:

- (b) identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage, the risks and consequences and alternatives and options for mitigation of activities, with a view to minimising negative impacts, maximising benefits, and promoting compliance with the principles of environmental management set out in section 2;*
- (c) ensure that the effects of activities on the environment receive adequate consideration before actions are taken in connection with them; [...]*
- (e) ensure the consideration of environmental attributes in management and decision-making which may have a significant effect on the environment:...*

Integrated Environmental Management is therefore a toolbox that provides the framework for the process and procedures around ensuring sustainable development (Figure 10), with impact assessments as the main tools put forward. Impact assessments are used to measure the positive and negative effects of an action or inaction. Many forms of impact assessments exist that are able to contribute to achieving sustainable development as laid

out by Griggs et al. (2013). These include Social Impact Assessments that assess the impact an activity or project will have on the affected communities (Moon 2007), Life-Cycle Assessments that assess all aspects (i.e. inputs and outputs) of an activity throughout its life-cycle (DEAT 2004a), Cumulative Effects Assessments that use a systematic approach to determine all possible effects of an activity in a holistic manner, as well as EIAs. A powerful assessment tool, Strategic Environmental Assessments (SEA), can be used to assess the impacts of a policy, programme or project and can be used prior, during or after a decision has been taken (DEAT 2004b). The strength of SEA is that although the area of interest may be geographically defined, inputs for and implications of decision-making may extend outside of the area and address all aspects such as social, environmental and economic. In South Africa only regulations for EIAs have been gazetted, making it the only legal tool available to assess environmental impacts of a site-specific project (DEAT 2004b).

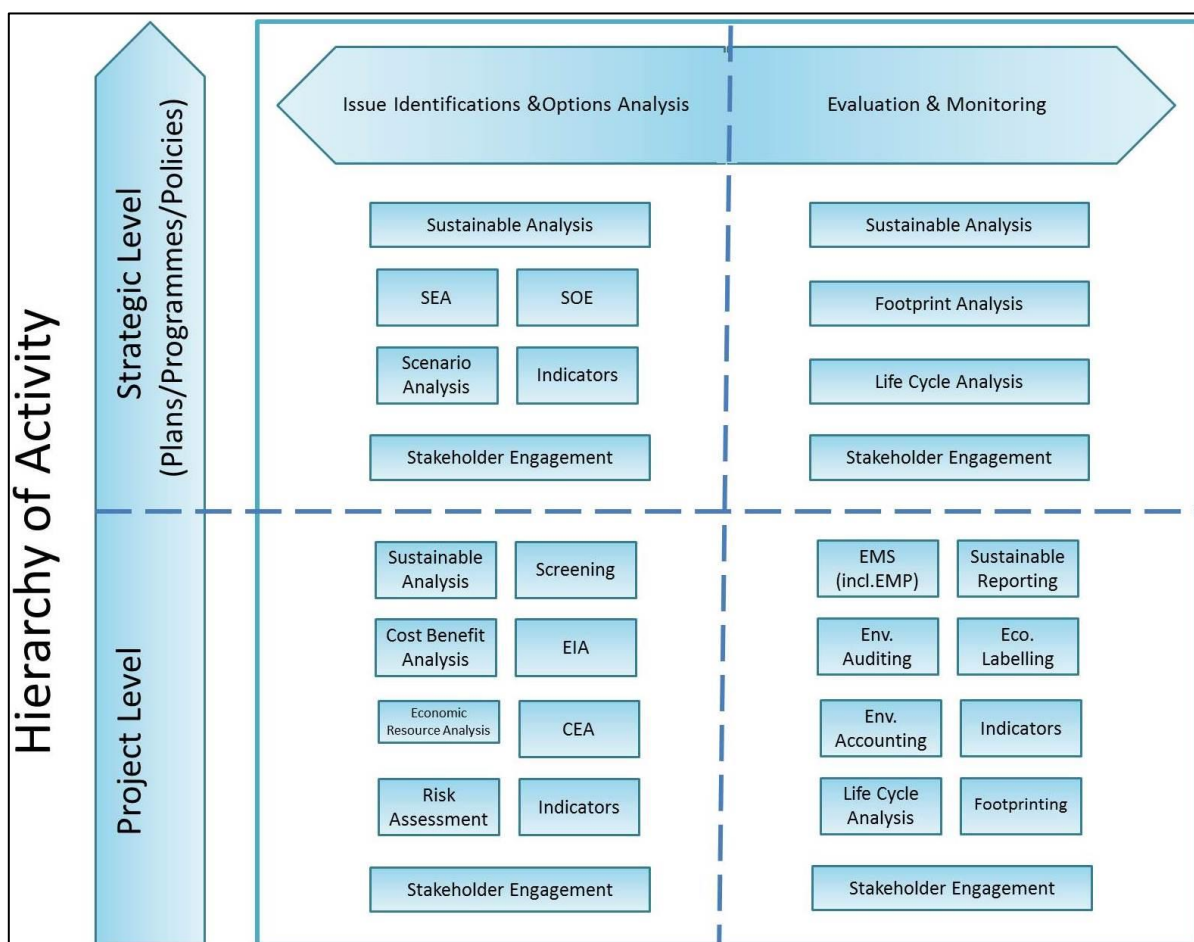


Figure 10: Commonly used tools in the Integrated Environmental Management toolbox (adapted from DEAT 2004)

The EIA is a systematic process to identify potential positive and negative impacts on the environment including the biophysical, socio-economic, and/or cultural impacts associated with a proposed activity, as well as to suggest alternatives to the project being proposed or

identify alternative areas where the project would be more suitable. It provides an opportunity for informed decision-making for authorities, planners and developers, as well as allowing local communities and stakeholders the opportunity to raise their concerns regarding the proposed activity. The use of EIA in the marine environment has followed the standards and protocols applied in the terrestrial realm (Figure 11).

As shown in Figure 11, public participation is an integral part of the EIA framework. The Department of Agriculture, Forestry and Fisheries is one of the most powerful stakeholders outside of the mining sector that has the ability to influence whether or not a mining activity takes place. Mining activities that pose a threat to economically important fished species are faced with heavy opposition both from the private and governmental wings of the fisheries sector, and therefore the fisheries sector is a key interested and affected party to be consulted (Atkinson and Sink 2008). The principles of the Marine Living Resources Act (MLRA) (RSA 1998b) that guide fisheries management in South Africa are complementary to sustainable development within the Brundtland definition, as the Act sets out to protect marine resources from overexploitation through sustainable use and development within the fishing sector (RSA 1998b). This is complemented by the Small Scale Fisheries Policy (DAFF 2012) which sets out to improve access of previously disadvantaged groups to marine living resources. These mirror the goals of the MPRDA as laid out in section 2.4.2.

Most importantly, it should be noted that all of South Africa's existing MPAs were declared under the MLRA. This has made it the key piece of legislation in marine biodiversity protection in the past, albeit with a fisheries management focus, before MPAs were moved to the National Environmental Management: Protected Areas Act (RSA 2014b). At present, the fisheries sector exerts the greatest pressure on the marine environment of South Africa (Sink et al. 2012a), with trawling having the most impact on the physical environment. This sector, however, is not subject to the EIA framework, and unlike mining is not strictly prohibited in marine protected areas (RSA 2003). Under the new development goals of South Africa, there is a growing concern within the fishing sector that the long term sustainability of industrialised fisheries could be jeopardised by inappropriate mining activity in the offshore environment (Dr Johann Augustyn - Secretary at the SA Deepsea Trawling Industry Association, pers. comm.). The assessment of impacts on the fishing sector is an important focus in marine mining EIAs.

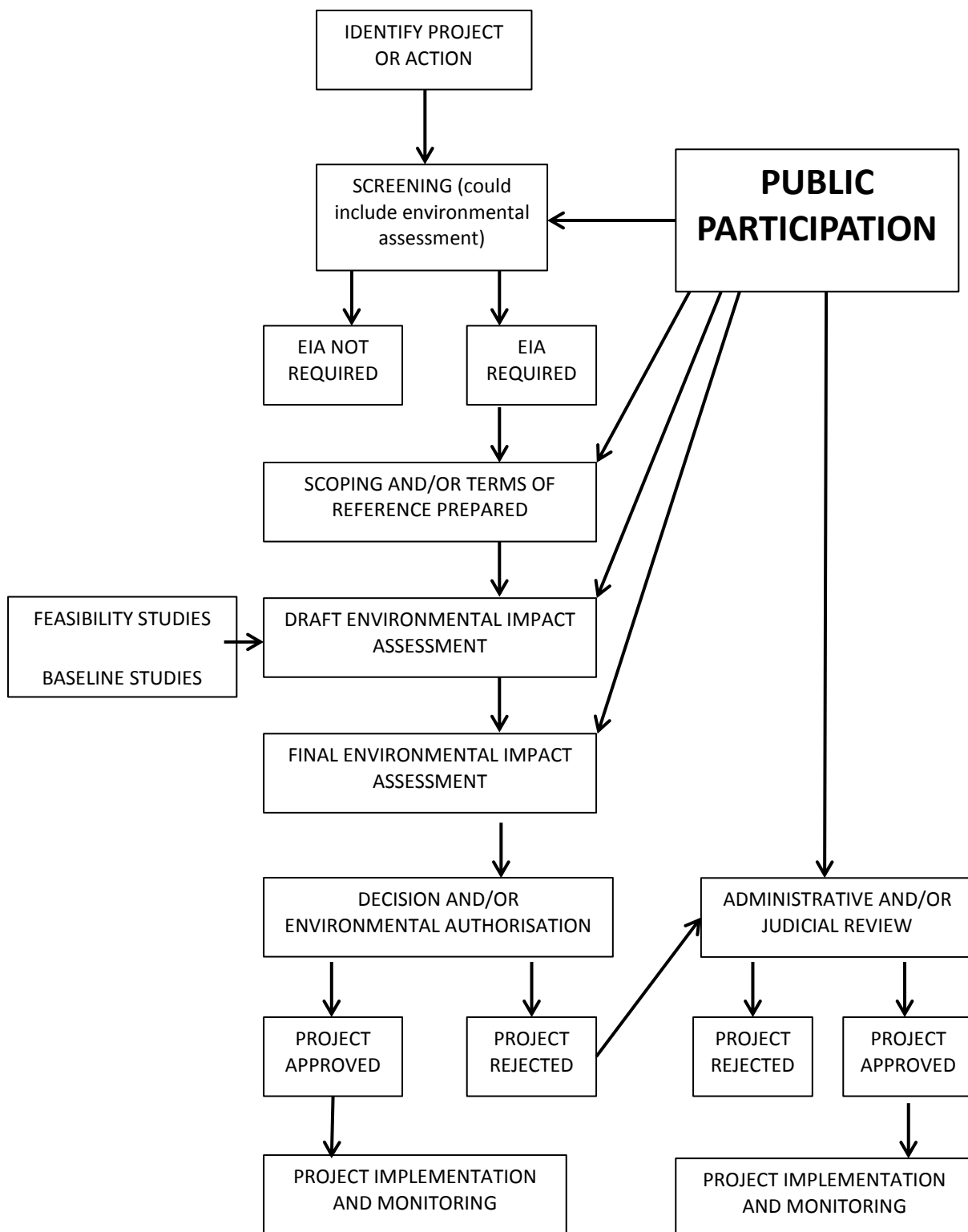


Figure 11: Flowchart depicting the basic elements in good EIA practice (ELAW 2010)

Unfortunately, the trend in developing countries such as South Africa is that of an over-reliance on EIAs to ensure environmental consideration and sustainable development (Rossouw et al. 2003). This has not been successful as inappropriate developments and activities have continued to cause environmental degradation, with mining identified as one

of the key drivers of habitat alteration and degradation in South Africa for the terrestrial, freshwater and estuarine environments (Driver et al. 2012). For EIAs to effectively contribute to achieving sustainable development goals, they need to demonstrate efficiency in identifying areas and actions that can contribute to poverty alleviation, employment creation, improved economic development as well as biodiversity management. These are lofty ideals that are not easy to achieve, and reiterate the potential for beliefs and politics to influence decision-making. A paradigm shift, both in biodiversity assessment and in decision-making, is essential for EIA to address and integrate the main pillars of sustainable development i.e. economic, political, social, ecological and physical sustainability (Weaver, 2003). It is also necessary for EIAs to be used more strategically to avoid the pitfalls of environmental “death by a thousand cuts”, as the focus is currently on single decisions with little attention paid to their cumulative impacts (Glazewski and Haward 2005).

One of the major challenges of Integrated Environmental Management implementation and consideration of environmental management (specifically in relation to alternatives) within mining is that mining can only take place where the resources are found (Strydom and King 2005). This suggests that practical implementation of sustainable development as it relates to section 24 (b)(i) in the Constitution (i.e. the avoidance of ecological degradation) within mining is only achievable when there are demarcated, legislated areas that are not open or available to be put under prospecting and exploration lease applications. Currently only marine protected areas are legally exempt from mining activities (RSA 2003) with the implication that all other areas, irrespective of biodiversity value, are vulnerable to mining impacts should a resource be found. Although section 49 in the MPRDA allows the Minister of Mineral Resources to declare “no go” areas for all mining activities based on their strategic importance to the country, this clause has never been used with little evidence that it will be utilised in the near future, as evidenced by the expansion of prospecting licences shown in Figure 4.

As a result, under NEMA 24N(1a) where an EIA has been identified as the tool for informing decision-making, the applicant is required to submit an Environmental Management Programme (EMP) to the competent authority before a decision to grant an environmental authorisation can be taken. NEMA 24N states that an EMP must include *“information on any proposed management, mitigation, protection or remedial measures that will be undertaken to address the environmental impacts that have been identified in a report contemplated in subsection 24N(1A)”*. EMPs therefore are focussed on mitigation of impacts on the affected area but are not barred from including mitigation recommendations to avoid certain areas/ecosystems within the lease area that are particularly sensitive, have a high

biodiversity value or are considered threatened where identified. The regulations for EIAs (RSA 2010b) give clear guidance under regulation 33 that the contents of an EMP must comply with NEMA 24N and must include “(d) a description of the environment that may be affected by the activity and the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity”. This reiterates the importance of current and site-specific biodiversity information in the decision-making process.

Sustainability and sustainable development in the marine environment is hampered by the inaccessibility of some deep sea ecosystems which limits the ability to carry out independent biodiversity research and monitoring, resulting in many past and present projects having to piggy-back on other initiatives of other industries (Atkinson 2013, Sink et al. 2010). The effects of activities are not easily studied and are very expensive to measure, as many of the large commercial activities take place offshore at depths greater than 500m (Sink et al. 2012b). A consideration that is unique to the offshore systems is that because of the 3-dimensional nature of the marine environment, multiple users engaged in very different activities can occupy the same space thus resulting in additive impacts. Planning in the marine and coastal environment is also fragmented, with very little appropriate governance frameworks in place to ensure collaboration and information sharing, although legislation is under development as indicated by South Africa’s emerging Oceans Policy (RSA 2014c) to rectify this but is in the early phases of the lengthy implementation process. In the interim, it would seem that South Africa suffers from the same challenges as Asian countries, as discussed by Alshuwaikhat (2005), with insufficient capacity, experience and resources to implement EIAs properly within the marine environment.

The ability of scientific knowledge to impact on decision-making is based on its use and application to specific projects or assessments. One of the main documents that are used in the EIA process to ensure good environmental practice is the EMP. The purpose of this document is to provide the Environmental Impact Reviewer with all the necessary information on the affected environment where the proposed activity will take place, the project and its proposed timelines, other sectors that may be affected by the activities and how the applicant plans to mitigate negative impacts that may arise. This information is used by the reviewer to make recommendations to the Minister on whether a right should be granted or denied and therefore plays a critical role in decision-making and environmental management.

Southalan (2012) describes the problem with EIAs very succinctly: “*At the exploration stage, when it is uncertain whether mining will occur, a company will not want to devote the time*

and resources needed to meet all the environmental requirements for a mining operation (because it is unlikely a feasible deposit will be found). However, there is a dilemma. Industry will not want exploration rights which do not guarantee mining rights when a deposit is found, but a government will not want to grant mineral rights over an area without assurance that any activity under these rights will meet minimum environmental standards.” If Southalan is correct, it implies that EIAs will be insufficient in providing the necessary information for informed decision-making as applicants will appoint the consultant that requests the lowest fees – this in turn implies that the appointed consultant, having a limited budget to work with, will not invest as much of his/her time to the project and provide only that which is required under the regulations and thus would potentially be underreporting. If this theory were true then the logical assumption is that EIAs would not serve the objectives of sustainable development as they would contain insufficient information. This theory is extremely alarming when viewed in conjunction with the lack of alternatives that is inherently part of the mining sector, and emphasises the role that biodiversity products and tools have to play in ensuring appropriate environmental consideration.

A recent addition to NEMA under Chapter 5 is the inclusion of mainstreaming under section 23A. This section provides that the Minister of Environmental Affairs may engage any sector to promote the voluntary use of sector-based instruments (e.g. guidelines) that facilitate integration of environmental consideration into decision-making to support sustainable development. This amendment came into effect on the 18 December 2014 and may provide for an opportunity going forward for organisations such as SANBI to liaise with the Environmental Affairs and Mineral Resource Ministries to facilitate the mainstreaming of its products into the petroleum sector so as to improve the information available to assist with decision-making which would in turn strengthen the conditions included in environmental authorisations. Some provincial governments have already taken steps to improve EIAs through guidelines for the selection and inclusion of specialists, e.g. Guideline for involving biodiversity specialists in EIA processes (Brownlie 2005).

2.4.4 Mineral Rights and Environmental Authorisation:

Mining exploration and lease area licences are administrated by the Department of Mineral Resources (DMR). Prior to the 2008 and 2009 amendments to both the NEMA and the MPRDA, an environmental authorisation was also required from the Department of Environmental Affairs (DEA) to commence any listed mining-related activity. This meant that a dual application process had to be followed. This resulted in a contentious relationship between the DMR and DEA as to the management of the environment within the mining sector which has been fuelled by the historical perception that the DEA is subservient to

other, more economically-focussed departments. This can be attributed to the legislation that was in place prior to the promulgation of NEMA, as section 2(a) of the Environmental Conservation Act of 1989 stated that the Minister of Environmental Affairs could only act with the permission of other government departments whose interests may be affected (Lumby 2010).

Currently reviews of EMPs are undertaken through the Petroleum Agency SA and the issuing of environmental authorisation undertaken within the DMR for the petroleum sector. The practical implementation of the MPRDA and NEMA regarding the management of the environment has been hampered by the tussle between the respective departments regarding the legal mandate to ensure environmental management within the mining sector (Naidoo 2014). This has resulted in amendments to NEMA and MPRDA in 2008 and 2009 (Humby 2009). The amendments that came into effect on the 7 June 2013 brought about the following changes (Wentzel 2013):

- Regional managers were no longer allowed to accept prospecting or production applications if an application (regardless of whether a decision had been taken) by another applicant had already been lodged for the same or overlapping area within a specific mining sector, thus minimising the number of applications per area for the same minerals and therefore potential cumulative impacts;
- BEE compliance was made compulsory and no longer a discretionary aspect of the application, and was retrospectively imposed on existing or old rights to improve and fast-track the transformation of the sector;
- Eighteen (18) months after the date of promulgation of the Amendment Act applicants would be required to submit applications for any aspect of mining activity along with applications for an environmental authorisation simultaneously, with the Minister of DMR as the competent authority for issuing environmental authorisations and the Minister of Water and Environmental Affairs the competent authority in dealing with appeals. This was to reduce the administrative burden on applicants as well as to facilitate co-operative governance between the two departments.

The One Environmental System was implemented on 8 December 2014 with the gazetting of new regulations for EIAs under NEMA (RSA 2014d). Under the new regulations, the Minister of DMR remains the competent authority for issuing of environmental authorisations for mining whilst also having the authority to issue waste management licences. The DEA remains the appeals authority. The DMR may only issue an environmental authorisation for mining activities, including exploration, if the applicant is in compliance with NEMA section 24P(1) which refers to prescribed financial provisions for remediation of negative impacts.

Government has made every effort to ensure that applicants and consultants are aware of the legislative and administrative requirements to ensure that mining is properly funded and environmental rehabilitation is incorporated in the management plan through the publication of the Guidelines for Mining Work Programme (DMR 2011) and refers to the requirements laid out in the EIA regulations (RSA 2014d). However, these regulations do not provide appropriate guidelines for the inclusion of biodiversity information and are not suitable for consideration in the marine environment due to their terrestrial bias (e.g. Appendix 3 of the EIA regulations that lays out the contents of an EIA report refers to “properties” and “farm land”) resulting in a gap in appropriate management of offshore environments. In light of the revised authorisation scheme discussed above and the lack of suitable guidelines for the marine environment, the role of environmental information early in the mining application process is highlighted.

2.5 Conclusion:

South Africa has strong sustainable development policy which is evidenced by its incorporation into legislation across various sectors. Unfortunately the over-reliance on EIA as the only legislated tool for ensuring environmental management in the mining sector has resulted in a gap in strategic national development planning and environmental management. This is exacerbated by the coastal bias of the South Africa’s MPA network and the lack of implementation of “no go” areas in the mining sector. The role of environmental information early in the project planning phase is therefore critical in ensuring that environmental considerations for areas of high biodiversity concern are incorporated into planning. Information on marine biodiversity has been developed by the SANBI to address this need in development planning and EIA and is discussed in the following chapter.

CHAPTER 3: MARINE BIODIVERSITY INFORMATION IN SOUTH AFRICA AND ITS USE IN IMPACT ASSESSMENT

This chapter provides information on the nature of biodiversity plans and assessments as sources of information designed to feed into the decision-making process to enable sustainable development and good biodiversity management. Specific attention is paid to the Offshore Marine Protected Areas Project (OMPA) as the first national marine conservation plan for South Africa, the National Spatial Biodiversity Assessment 2004, and the National Biodiversity Assessment 2011. This chapter also provides a case study on a seabed mining EMP to illustrate the appropriate use of these products in formulating mitigation measures during an EIA, where the area of interest coincides with sensitive or threatened biodiversity features.

3.1 Biodiversity Assessments

3.1.1 *What are biodiversity assessments?*

Agenda 21 (introduced in the previous chapter under Introduction to Sustainable Development:) outlines the action plan for implementation of sustainable development. The most relevant chapters concerning the marine and coastal environment are Chapter 15 “Conservation of Biological Diversity” and Chapter 17 “Protection of the oceans, all kinds of seas, including enclosed and semi-enclosed seas, and coastal areas and the protection, rational use and development of their living resources”. In these chapters, objectives are laid out for the appropriate management of resources and environmental condition, as well as increased protection for this environment and associated species by the identification of pressures on the environment and their impacts through national biodiversity assessments. Biodiversity Assessments are therefore tools used to inventory and evaluate the state of biodiversity (Slootweg 2005). These can be carried out on all environments, at various scales and geographic limits, and can include assessments on species, habitats and/or ecosystems and their services to humanity (Lebel et al. 2015, EHP 2014, Scholes et al 2013). Many assessments have been carried out internationally at differing scales (DEFRA 2014, Edwards et al. 2014, Frélichová 2014, Karnauskas 2013, NOAA 2012, Canada 2010).

In South Africa, the NEMA: Biodiversity Act (RSA 2004) mandates that the SANBI carry out a national biodiversity assessment to provide the spatial input for the National Biodiversity Strategic Action Plan (NBSAP) which is a requisite of the CBD Convention (Driver 2005). The NBSAP should provide the overall framework for national implementation of the three objectives of the CBD Convention, through action for the conservation and sustainable use

of biodiversity and the equitable sharing of benefits arising from the utilisation resources and is expected to underpin the national sustainable development strategy (Prip et al. 2010). The mechanism by which this is accomplished is illustrated in Figure 12.

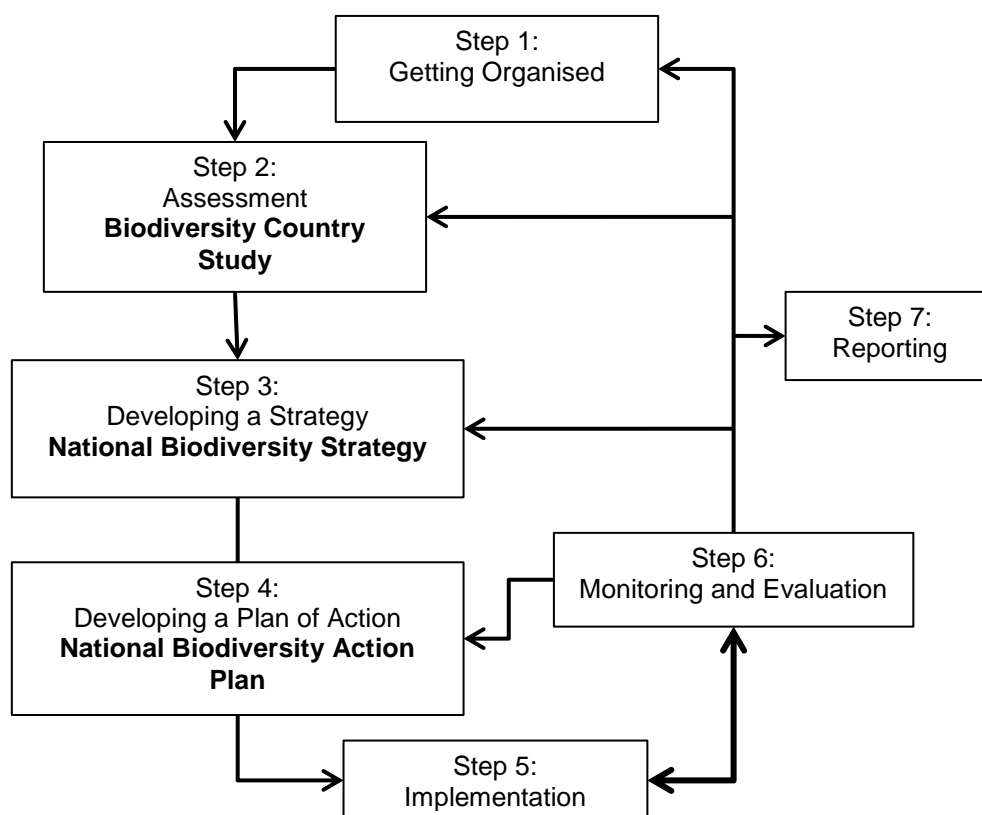


Figure 12: Basic steps of biodiversity planning and its relationship to the planning tools: a cyclical and adaptive process (IUCN, UNEP and WRI, 1995)

The South African biodiversity assessment provides information on ecosystem protection level and threat status for terrestrial, freshwater, estuarine and marine environments. Protection level provides information on the proportion of an ecosystem or habitat type that is formerly protected within a protected area recognised in the National Environmental Management: Protected Areas Act (Driver et al. 2012). Ecosystem types are categorised as not protected, poorly protected, moderately protected or well protected, based on the proportion of each ecosystem type that occurs within a protected area. Threat status level provides information on the proportion of an ecosystem or habitat type that has lost most of its extent or lost aspects of its structure or function relative to a series of thresholds, which in turn may affect its ability to provide ecosystem services (Driver et al 2012). Ecosystem types are categorised as critically endangered (CR), endangered (EN), vulnerable (VU) or least threatened (LT), based on the proportion of each ecosystem type that remains in good ecological condition relative to a series of thresholds. These documents therefore provide crucial information to decision-makers and biodiversity managers for biodiversity

management. South Africa is one of very few countries to have carried out national ecosystem threat status analyses using target thresholds.

3.1.2 The National Spatial Biodiversity Assessment 2004

The first national assessment for South Africa's biodiversity was completed in 2005 and reported the status of biodiversity using data from 2004 (Driver et al. 2005). The assessment was comprised of multiple documents: a Summary Report (Driver et al. 2005) and four technical reports, one for each of the different environmental realms – Terrestrial (Rouget et al. 2004), Freshwater (Nel et al. 2004), Estuarine (Turpie 2004) and Marine (Lombard et al. 2005). Prior to the work undertaken for this thesis, the success of mainstreaming was only examined for the terrestrial component. This was done using anecdotal evidence and suggested good uptake of the terrestrial ecosystem threat status map in the EIA sector (Reyers et al. 2007).

3.1.3 The NSBA 2004 Marine Technical Report

The NSBA 2004 Marine Technical Report (Lombard et al. 2005), hereafter referred to as the NSBA 2004, was an assessment of the mainland EEZ of South Africa and presented a first habitat classification for the country (Appendix II). The EEZ was divided into five inshore Bioregions (Namaqua, South-western Cape, Agulhas, Natal and Delagoa) and four offshore Bioregions (Atlantic, West Indian, South-west Indian and Indo-Pacific) (Sink et al. 2005) as shown in Figure 13.

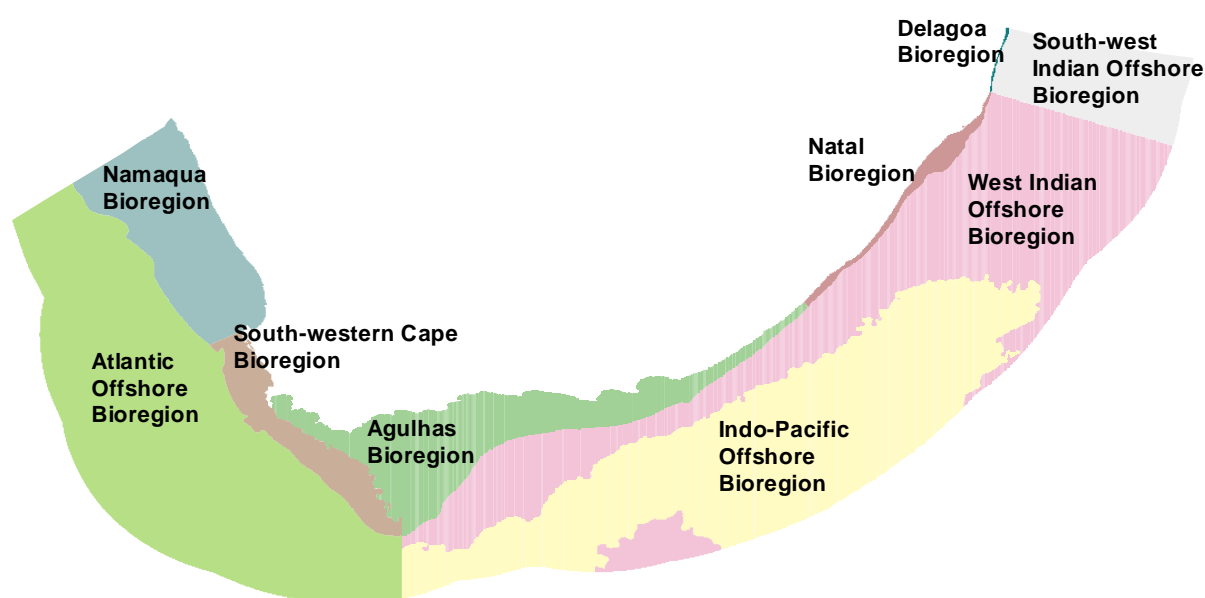


Figure 13: The map of bioregions as defined in the NSBA 2004 (Lombard et al. 2005).

Using the hierarchical habitat classification developed in the NSBA 2004, depth strata were used to subdivide the bioregions into biozones, and the first biozone map was developed (Figure 14).

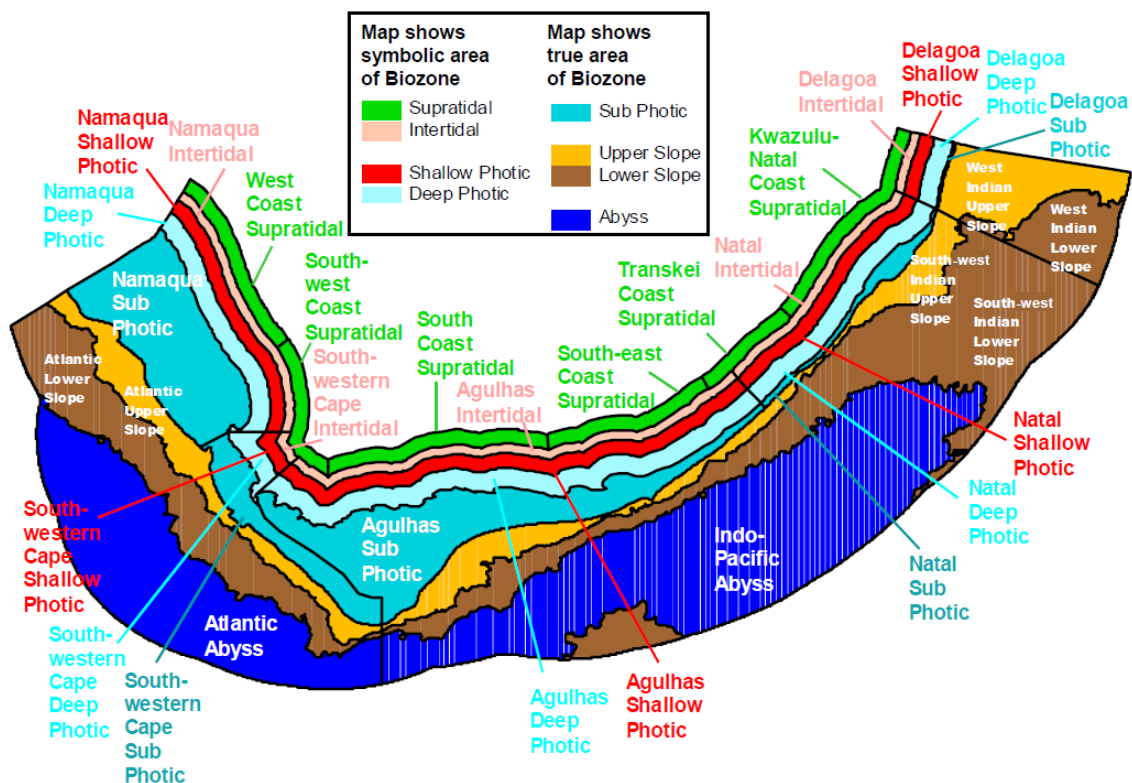


Figure 14: The 34 marine biozones used in this study. Biozones are created by subdividing the depth strata with the bioregions (Lombard et al. 2005).

Due to the coarse nature of the spatial information, the NSBA 2004 acknowledged the limitations of its use in providing advice for fine-scale planning and fisheries sustainability (Lombard et al. 2005). The NSBA 2004 was, however, extremely successful in providing a national context for biodiversity management by identifying the main drivers of change in the marine environment, with mining being the most concerning at the time. It also was able to carry out protection level and threat status (Figure 4) analyses for the defined biozones.

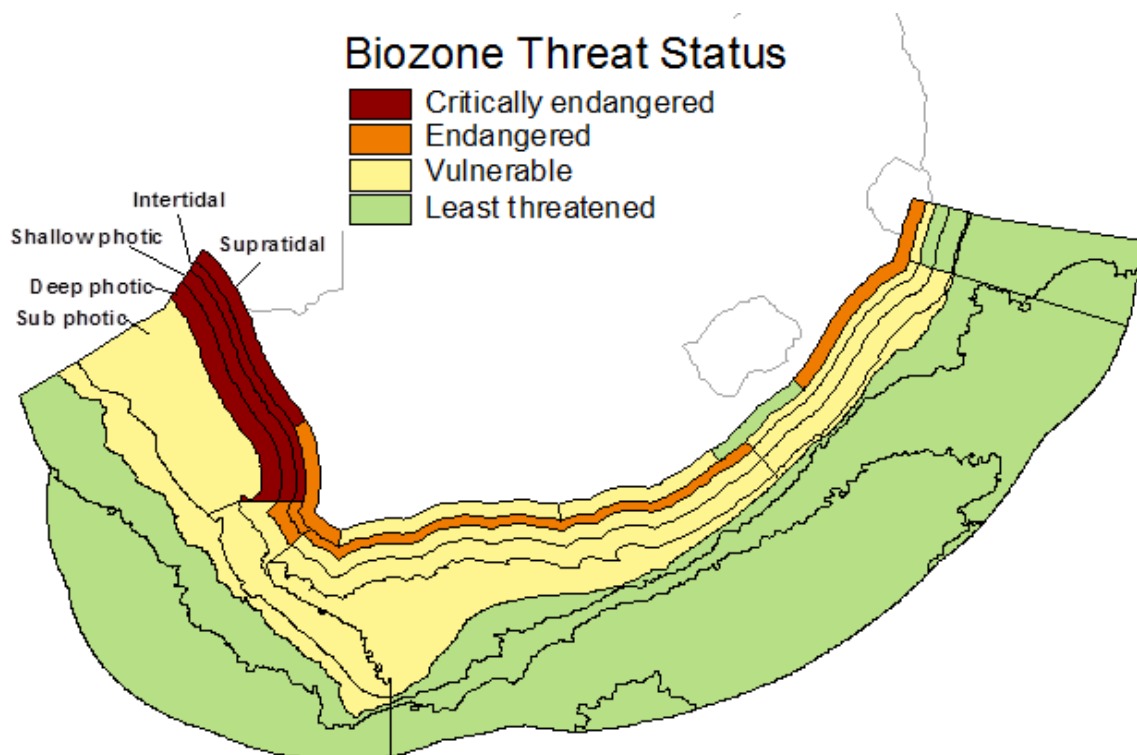


Figure 15: The threat status map used in the NSBA 2004 marine component (Lombard et al. 2005).

3.1.4 The National Biodiversity Assessment 2011

The first national assessment had a focus on spatial information, whereas the more recent biodiversity assessment, referred to as the National Biodiversity Assessment 2011 (Driver et al. 2012), included thematic sections on indigenous species, alien and invasive species and climate change. The 2011 assessment followed the same process for biodiversity assessment (Figure 12) as in 2005, and served the same function of informing the NBSAP. The notable improvements that have been made in the recent assessment have resulted in its capacity to “streamline environmental decision-making, strengthen land-use planning, strengthen strategic planning about optimal development futures for South Africa, and identify priorities for management and restoration of ecosystems with related opportunities for ecosystem-based job creation” (Driver et al. 2012) for all environments. Once again, the assessment included a Synthesis Report (Driver et al. 2012) and technical reports for each of the environmental realms (Terrestrial – Jonas et al. 2012, Freshwater - Nel and Driver 2012, Estuarine – Van Niekerk and Turpie 2012, Marine – Sink et al. 2012a).

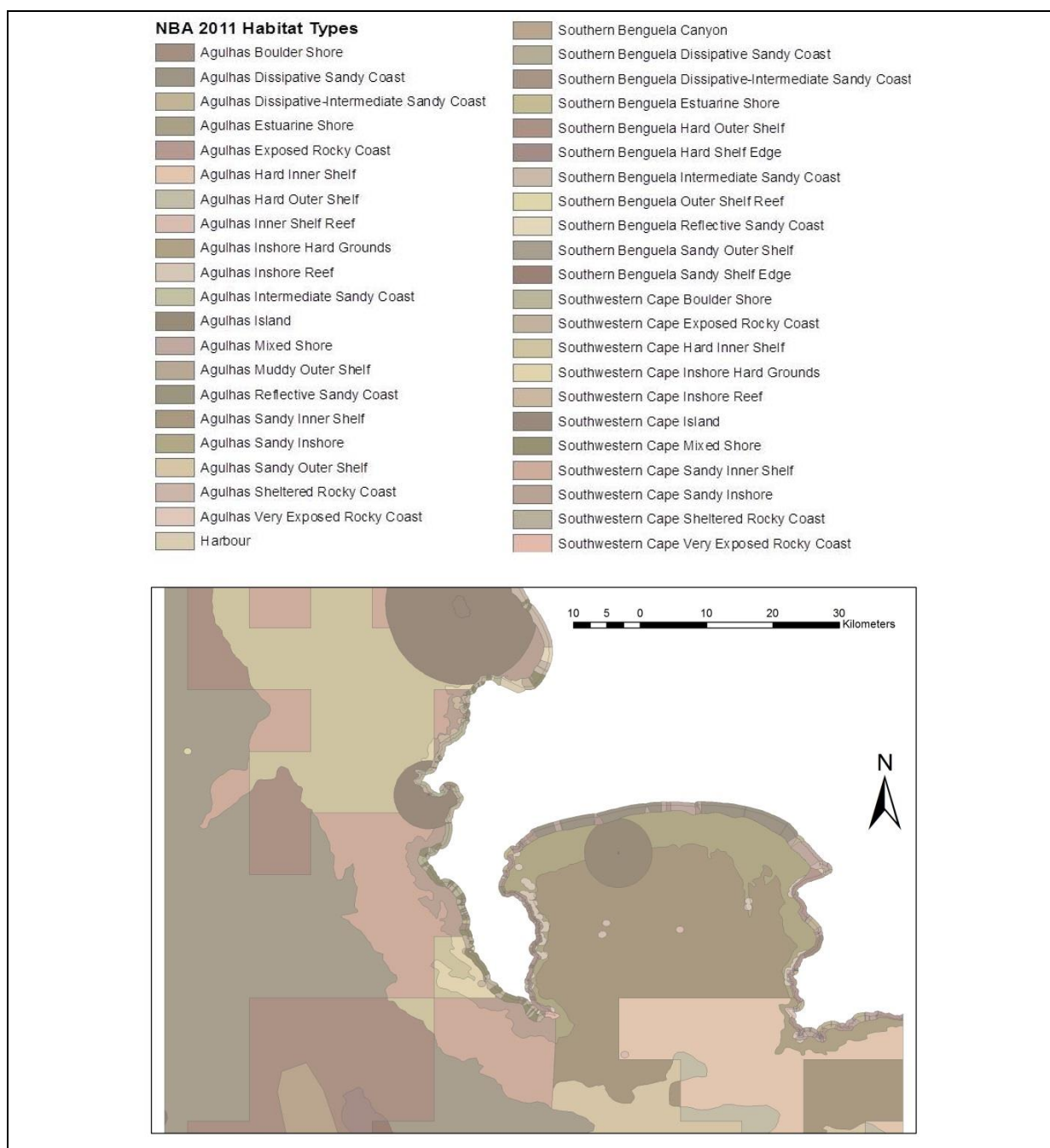
3.1.5 The NBA 2011 Marine Technical Component

The NBA 2011 Marine Technical Component - hereafter referred to as the NBA 2011 (Sink et al. 2012a) - made dramatic improvements on the previous report, not only by refining the Ecoregions map (Figure 16), but also producing the first seamless benthic and coastal

ecosystem map (Figure 17) and the introduction of the first pelagic ecosystem map for South Africa (Figure 18).

The high resolution information incorporated in the benthic ecosystem map (see **Box 2** for an example using the Cape Town region) meant that maps for results of protection level (Figure 19) and threat status (Figure 20 for benthic and Figure 21 for pelagic) could be produced for utilisation at a finer scale.

Box 2: Zoomed in Map of Ecosystems for the Cape Town Region



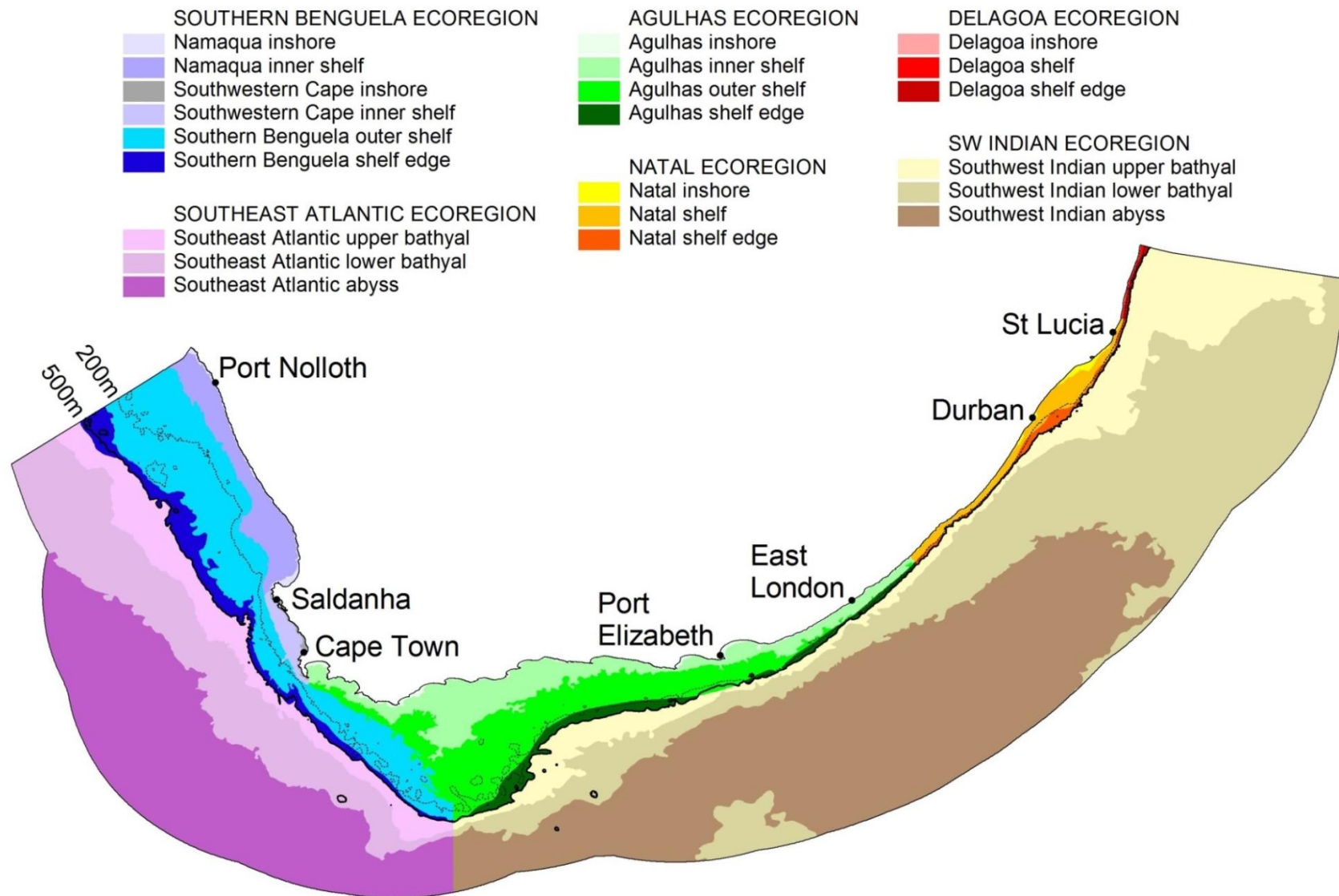


Figure 16: The map of ecoregions used in the NBA 2011 (Sink et al. 2012a).

Benthic Ecosystems - Legend



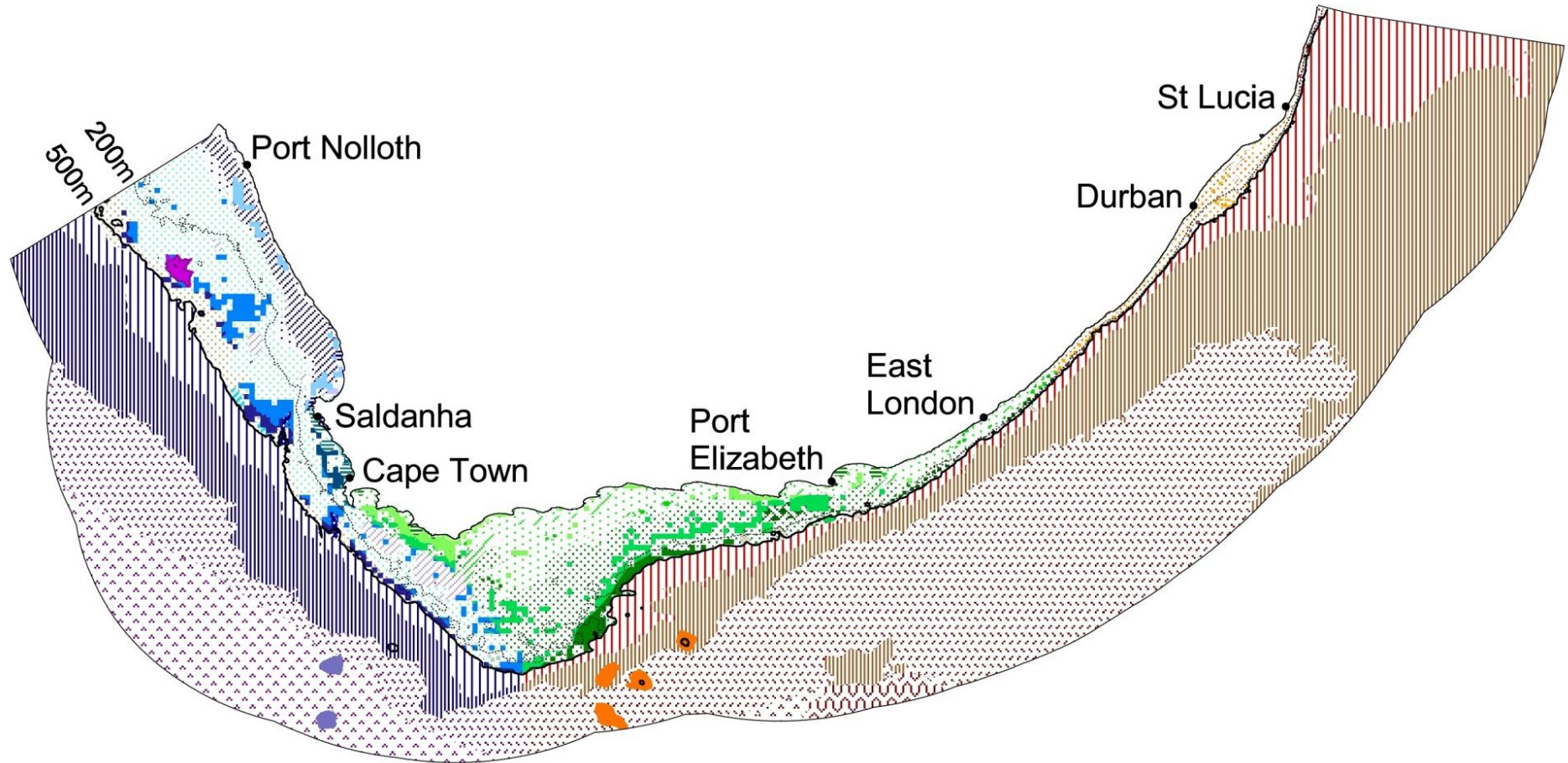


Figure 17: NBA 2011 Marine and Coastal Benthic Ecosystem Map (Sink et al. 2012a)

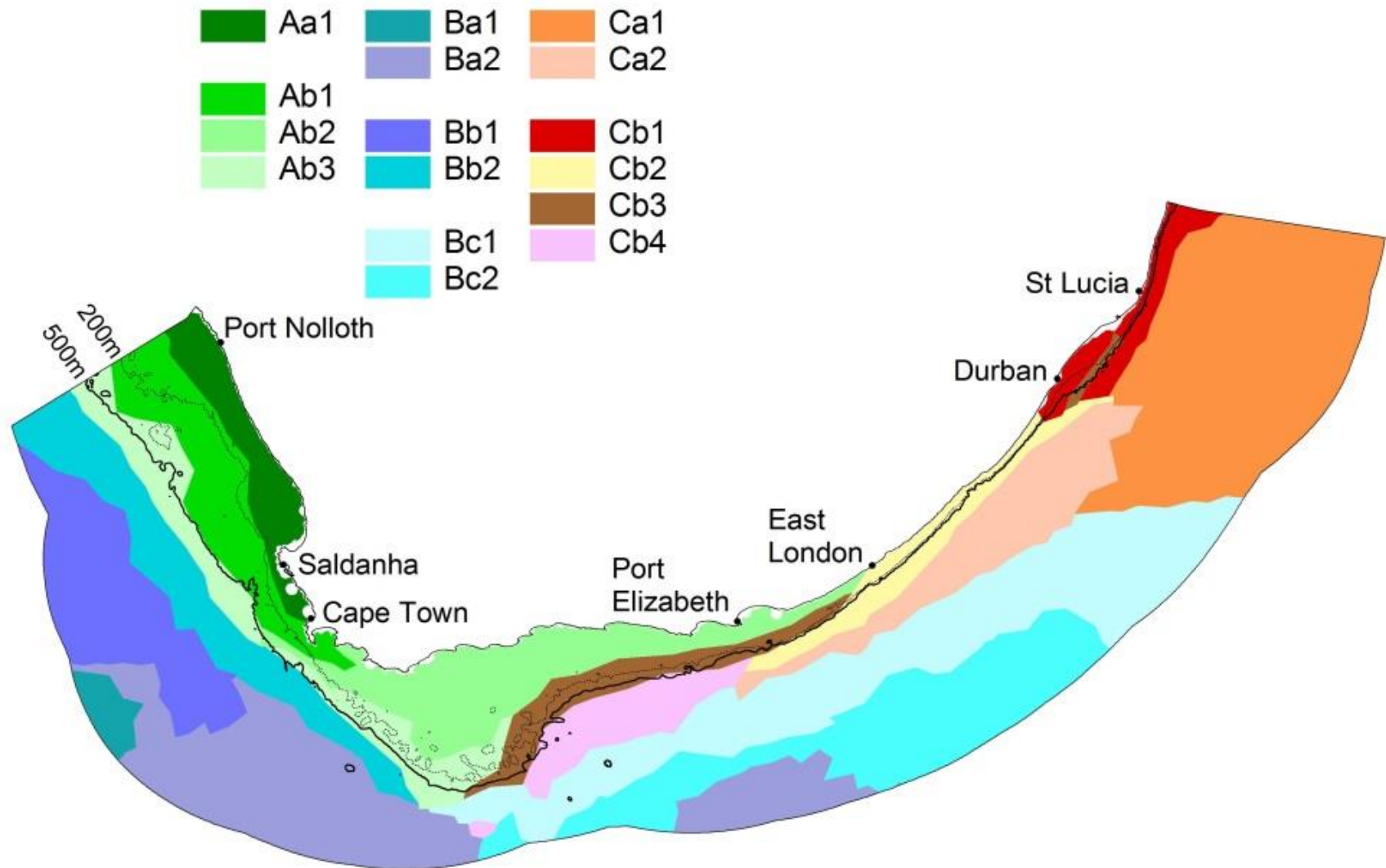


Figure 18: Pelagic ecosystem types nested within pelagic bioregions and biozones (taken from Sink et al. 2014). A description for each of the pelagic ecosystem types is provided in Appendix III.

In the NBA 2011, protection level categories were modified to capture the impact that some fishing sectors have within MPAs due to the zonation of some sections of MPAs as “take” and “no-take” (Sink et al. 2012a). If an ecosystem/habitat type is found within a portion of an MPA that allows for fishing or other extractive use, that ecosystem will not benefit from complete respite of activities. This illustrates the independence of the assessment of protection level from threat status. Owing to the differing management objectives of an MPA, extractive activities such as subsistence or commercial fishing may still be allowed in certain zones. As a result, ecosystems that are protected could still be categorised as threatened due to continued impacts still taking place within the MPA.

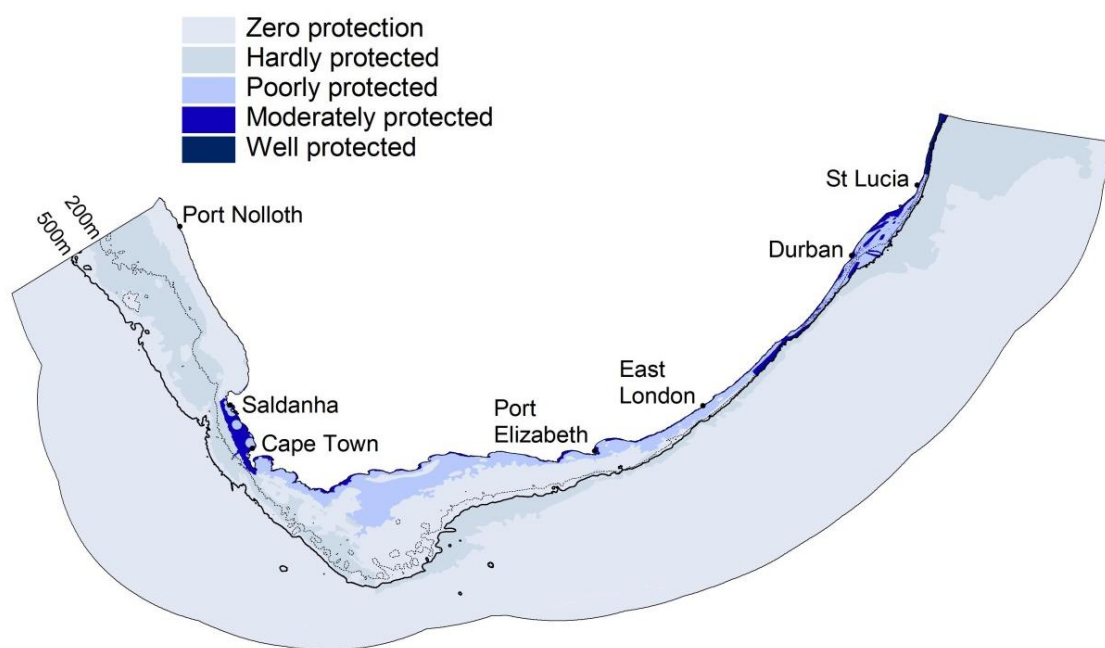


Figure 19: NBA 2011 map of marine and coastal benthic ecosystem protection level (Sink et al. 2012a)

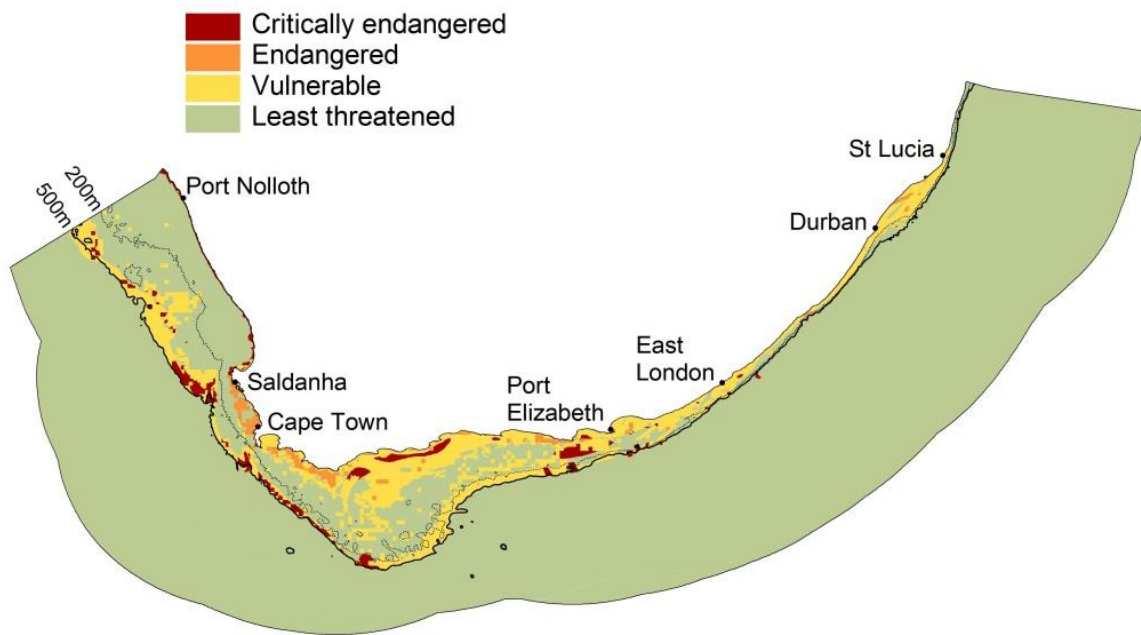


Figure 20: NBA 2011 Marine and Coastal Benthic Ecosystem Threat Status Map (Sink et al. 2012a).

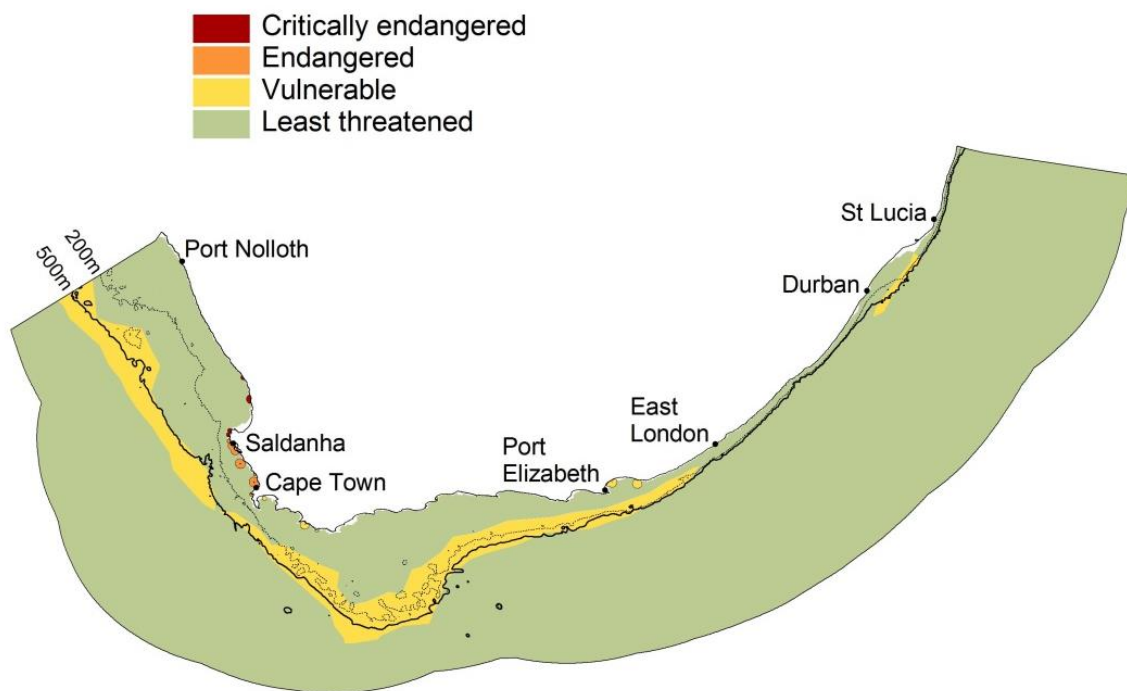


Figure 21: NBA 2011 Marine and Coastal Pelagic Ecosystem Threat Status Map (Sink et al. 2012a).

Another improvement to the previous assessments was the methodology used to assess ecosystem condition (Figure 22). This was done using an innovative method developed by Halpern et al. (2008, 2009). Unlike terrestrial or freshwater environments which are more

accessible, ecosystem degradation cannot be visually assessed in many of the deep-sea environments. Even ecosystems that are close to shore and at shallow depths still require expensive and specialist equipment to access for research and monitoring.

Thus the NBA 2011 used a novel approach for South Africa to assess ecosystem condition utilising an ecosystem-pressure matrix. Each ecosystem type was assessed for sensitivity to each type of pressure or activity using an expert panel informed by more than 350 publications. An impact score was derived for each ecosystem exposed to a specific activity. Cumulative impact scores were then calculated to estimate the condition of the ecosystem and the resulting map illustrates how much of an ecosystem type is in a Good, Fair, or Poor condition using thresholds. This enabled the NBA 2011 team to run threat status analyses and determine which portions or areas of the marine and coastal environment require management intervention.

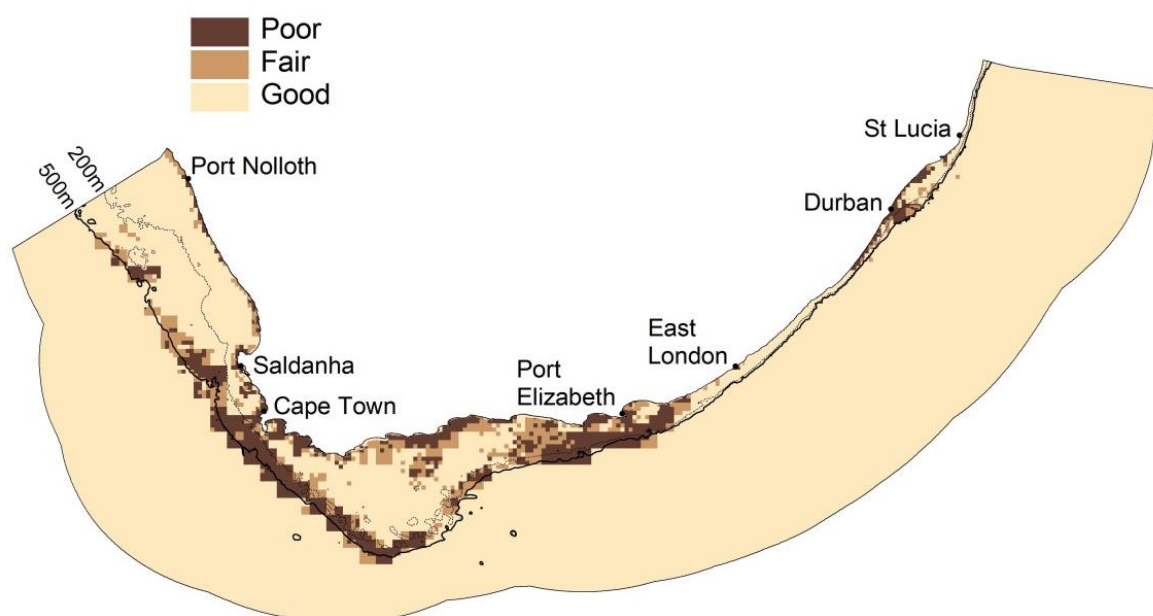


Figure 22: NBA 2011 map of marine and coastal benthic ecosystem type condition (Sink et al. 2012a)

The NBA 2011 analysis provides insight into the success of South Africa in meeting its Aichi targets to curb biodiversity loss and improve its protection as agreed upon in the CBD Convention (CBD 2012) for the marine environment. The deep ocean covers more than 70% of the planet (Prieur 1997), and makes up over a third of South Africa's territory. Despite the seemingly unfavourable conditions of the deep sea floor (i.e. low light, cold temperatures and low energetic supply) the deep sea supports a high level of biodiversity (Allsopp et al. 2009). Some pelagic (open-ocean) zones where features such as upwelling and eddies occur have also been found to enhance biodiversity (Allsopp et al. 2009). The marine

offshore environment (this includes benthic and pelagic ecosystem types) is the least protected of all the environmental terrains (Driver et al. 2012), and currently no offshore marine protected areas exist within the mainland marine territory. Sustainability of marine biodiversity is potentially under threat due to the immense size and number of mining applications that are currently in existence (see Figure 4 in the Introduction), with potential for increased environmental change and impact as technology in deep-sea mining improves.

The NBA 2011 could not have been as successful in meeting its mandate without the preparatory efforts of SANBI to collate all available data and procure new data sets. This was achieved through the first national systematic plan for the marine environment and is discussed in the following section.

3.2 What is systematic planning?

Ecosystem classification and mapping are the first steps and a critical component of systematic planning and biodiversity assessment processes. Neither process is achievable if there is no spatial information available. Ecosystem maps are also crucial in development planning as they provide the information on the environment within in which any new activity will take place and thus should be a key guiding piece of information within any proposed project plan to identify potentially negative impacts to the environment. Ecosystem maps are used in systematic planning to determine which model would best serve the objectives of the plan, thus linking biodiversity science to policy and enabling informed decision-making (McKenzie et al. 2014, Chaudhury et al. 2013).

Systematic biodiversity planning (also known as systematic conservation planning) identifies areas that meet a set of biodiversity objectives with a minimum economic cost to industry and/or subsistence users (Watts *et al.* 2009, Ball and Possingham 2000, Possingham et al. 2000, Pressey 1999). It allows for an integrated approach that facilitates the consideration of multiple data sets and users in a transparent and scientifically defensible process to identify priority areas for spatial biodiversity management (Margules and Pressey 2000).

3.2.1 Offshore Marine Protected Area Project

One such systematic plan that was completed for South Africa is the Offshore Marine Protected Area (OMPA) project. This project was launched in 2006 by SANBI with funding from the World Wide Fund For Nature – South Africa. The aim of the project was to develop a scientifically defensible spatial management plan that not only incorporated targets for biodiversity protection, but also included fisheries management and sustainability considerations. This project aimed to address the lack of offshore biodiversity protection and

coastal bias of the current network (see Figure 2 in the Introduction) to support ecosystem based management and spatial planning in the offshore environment and identify a potential network of offshore MPAs accompanied by other types of effective spatial management (Sink et al. 2011, Sink and Attwood 2008). A systematic planning approach was used in accordance with South Africa's approach to protected area planning (Government of South Africa 2010). The final results were presented in the OMPA report (Sink et al. 2011), and ten focus areas were identified for spatial management (Figure 23). Appendix IV provides detailed insight into the strategic goals of conservation planning for the marine environment.

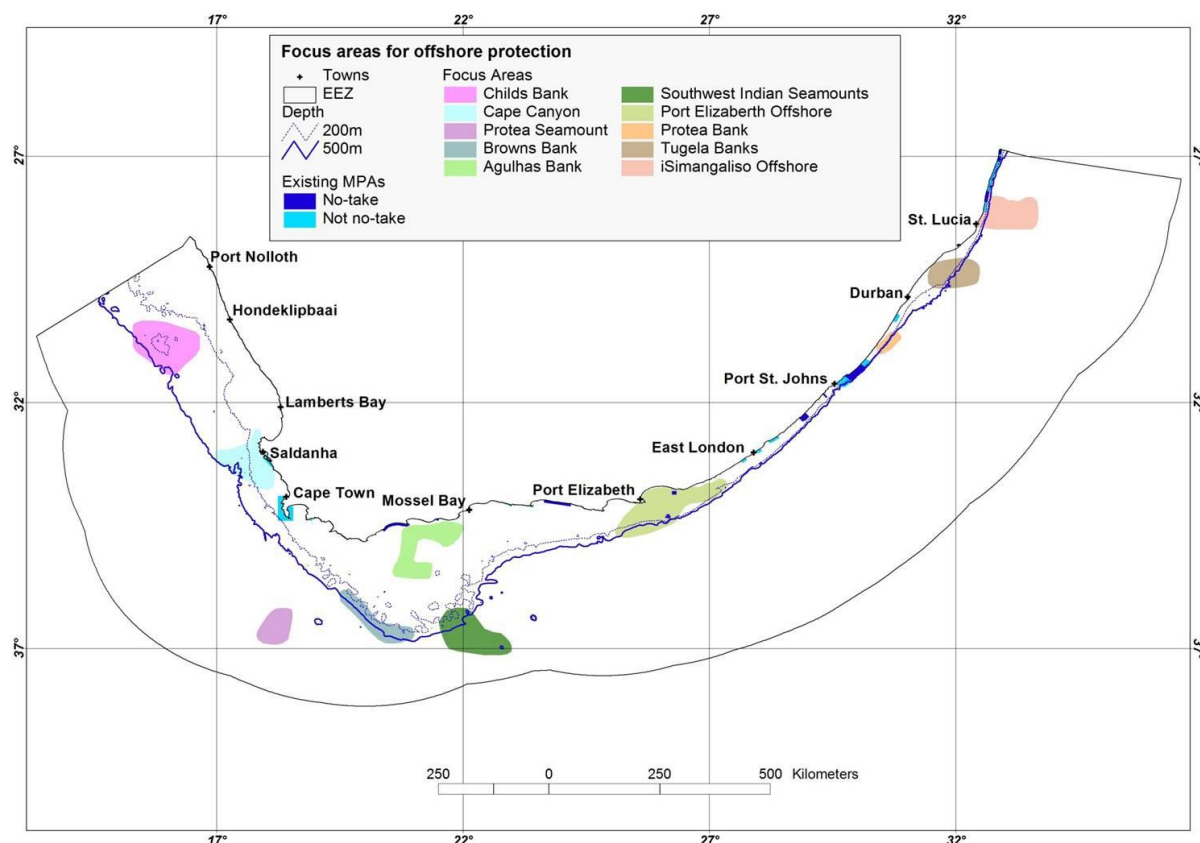


Figure 23: The 10 focus areas identified in the OMPA project for marine protection and/or other spatial management areas (Sink et al. 2011).

The OMPA project followed a stakeholder-focussed approach with several one-on-one and multi-stakeholder meetings held during its five year implementation. At the time, the Marine Programme at SANBI had only three dedicated staff members, which was reduced to two members in the final year of the project. This capacity constraint translated into a lot of investment into building relationships with stakeholders from other government departments and industry to submit data that would not have been accessible otherwise. This approach enabled the project team to develop long-term, often-times mutually beneficial relationships with key stakeholders in the marine mining sector. These new relationships facilitated data-sharing between SANBI and the mining sector, as well as the development of a joint

research project with PetroSA (Sink et al. 2010). The large amount of data collected and analysed in the OMPA project therefore provided the groundwork for the NBA 2011.

As previously discussed, information can only inform decision making and produce an impact on society if it is made available for use. The following section provides a short description on the role that SANBI plays in ensuring that biodiversity data is available and accessible to enable informed decision making and planning.

3.3 Data Availability and On-line Planning platform

Part of the mandate of the SANBI is to ensure that biodiversity information is available to the general public and in a usable format for planning, education and information. In fulfilling this mandate, SANBI launched the Biodiversity GIS website (BGIS) in collaboration with the University of the Western Cape and the International Oceans Institute in 2005 (Willoughby 2006). Prior to that, it had been hosted by the Cape Action for People and the Environment Project. The original project aimed to produce an information management and dissemination system focused on fynbos biodiversity. This was later expanded to have a national focus that included all environments.

BGIS aims to assist in biodiversity planning and decision-making by providing comprehensive and freely accessible spatial biodiversity planning information online (BGIS 2015). Not only does it serve spatial biodiversity data, but also provide tools such as interactive mapping that enable users to upload their spatial data and/or map biodiversity information over their area of interest. Training is provided four times a year, with a dedicated training session on the use of the marine biodiversity data provided once a year (Ms Sediqa Khatieb – BGIS Manager, pers. comm.). In this way, all biodiversity information and training in their capability and use for the marine environment applicable for decision-making has been made available.

3.4 Case Study: Green Flash Trading Sea Bed Mining Application

In 2012, the first prospecting application for bulk sea bed mining was received for South Africa (WWF 2012). The application was for the area off the West Coast and included an area of over 63,000 km² (Figure 24). The focus of the application was for phosphate and other minerals, and excluded diamonds and oil and gas resources. Although the biodiversity information presented in the text of the “Description of the Surrounding Environment” is deemed by this study to be of poor quality (i.e. ecosystem descriptions are at a very broad, national scale and do not reflect the actual biodiversity information for the area, which is available in the NBA 2011), this EMP does represent an example of how biodiversity

information has been able to influence the project plan, as evidence by the mitigation methods put forward in the EMP and illustrated in section 3.4.2.

The proposed prospecting activity would make use of multi-beam echo sounder (non-invasive), but would focus on gathering samples of the sediment using piston coring or grab sampling (invasive). See Appendix I for further details.

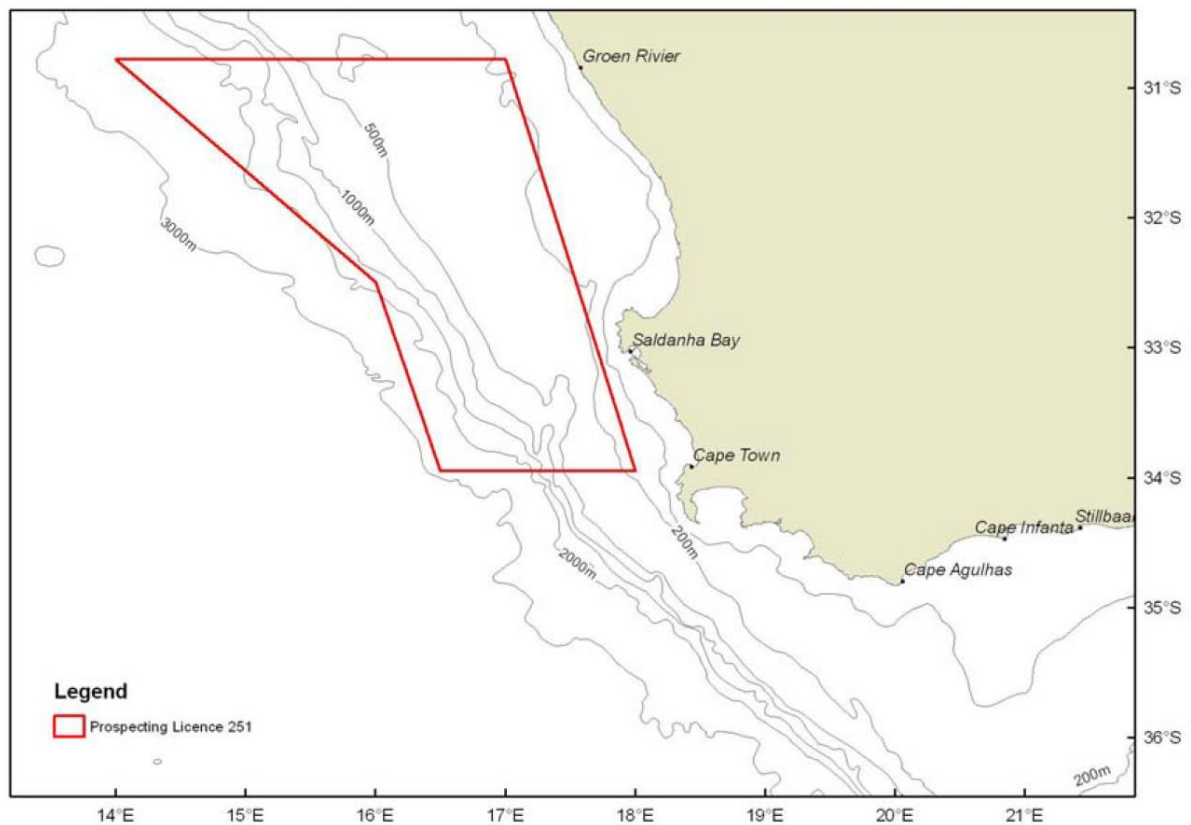


Figure 24: Proposed prospecting area for Green Flash Trading application (Green Flash 2012).

3.4.1 Use of OMPA and NBA 2011

The Green Flash application overlaid the biodiversity spatial information from OMPA onto the prospecting area, and identified overlap of grab sample sites with two OMPA Focus areas (Childs Bank and Cape Canyon), as shown in Figure 25.

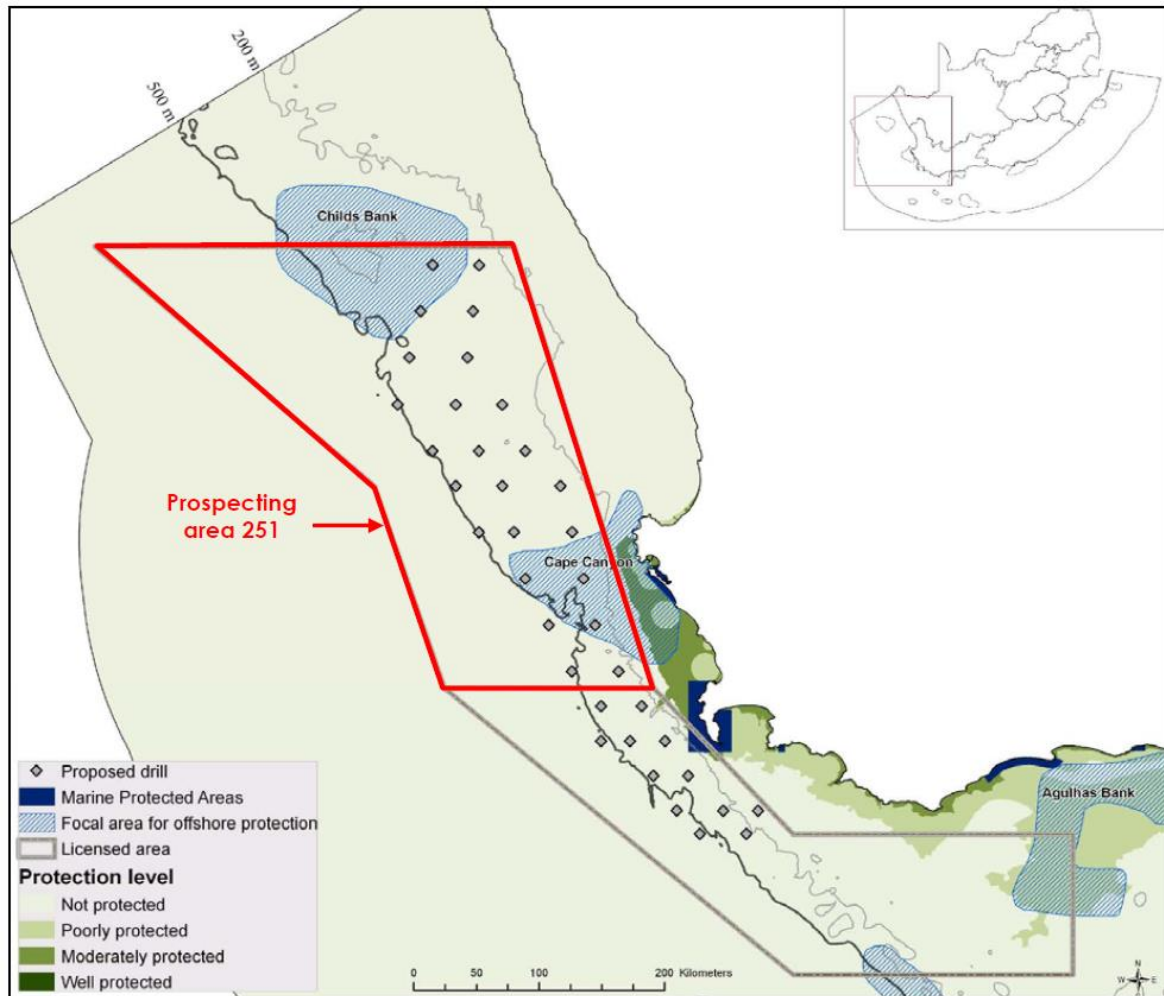


Figure 25: Potential priority areas for sampling in relation to OMPA Focus Areas (Green Flash 2012).

Spatial information on the threat status of the benthic ecosystems from the NBA 2011 was also overlaid onto the prospecting area to assess overlap of grab sample sites with threatened ecosystems (Figure 26).

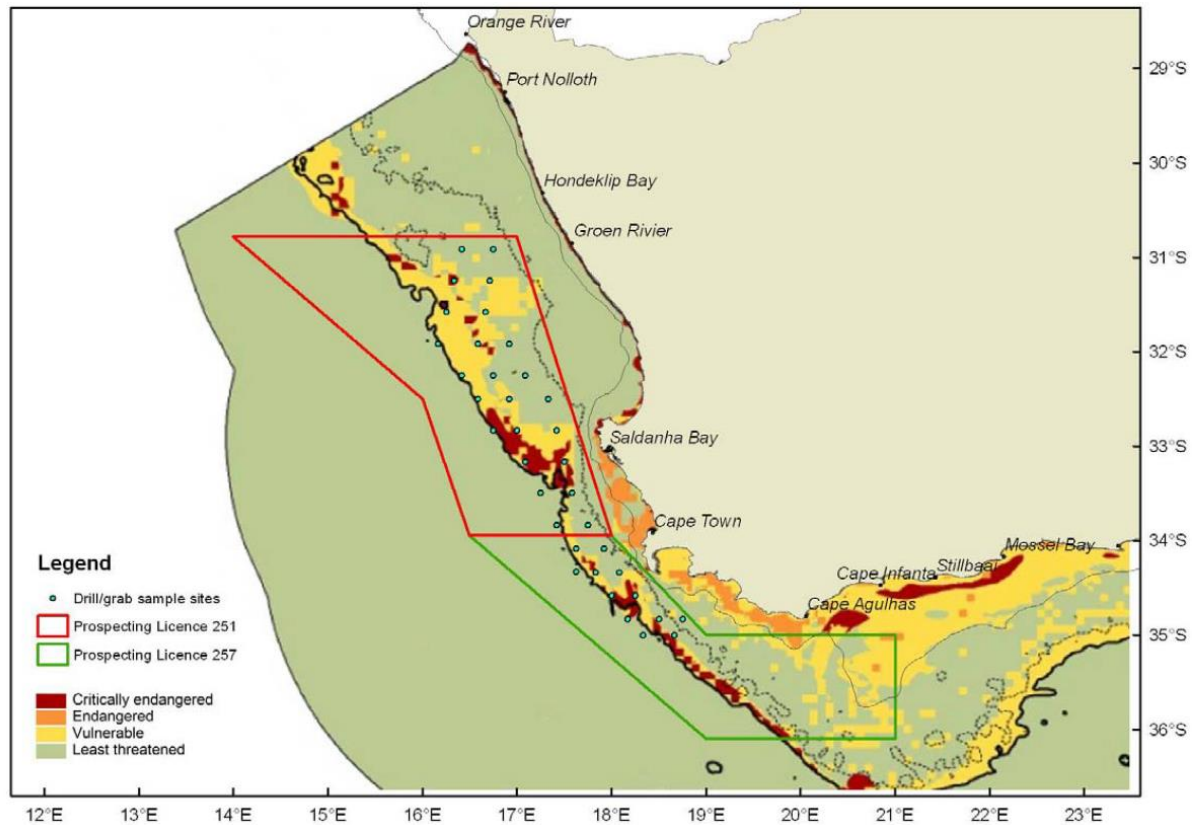


Figure 26: Ecosystem threat status map in relation to potential sampling sites (Green Flash 2012).

3.4.2 Influence of OMPA and NBA 2011

Green Flash used the information presented above to inform mitigation recommendations that would avoid degradation to the OMPA focus areas, and areas identified as Critically Endangered in the NBA 2011 (**Box 3**).

This case study illustrates the capability of the OMPA and NBA 2011 to be utilised in fine-scale project planning, and how good biodiversity management is achievable even in the face of a lack of alternative sites (as discussed in Chapter 2). This EMP is used as the model against which EMPs in the petroleum sector will be assessed.

Box 3: Mitigation recommendations provided in the Green Flash application

Since five of the proposed sample sites coincide with two proposed benthic priority areas (namely Childs Bank and Cape Canyon) (see Figure 3), the impact is considered to be of **medium** significance before mitigation and of **VERY LOW** significance after mitigation.

Mitigation:

No sampling is to be undertaken within SANBI's potential benthic priority areas or Critically Endangered ecosystems. The proposed sampling sites located within these sensitive areas must be relocated (see Figure 6 a & b).

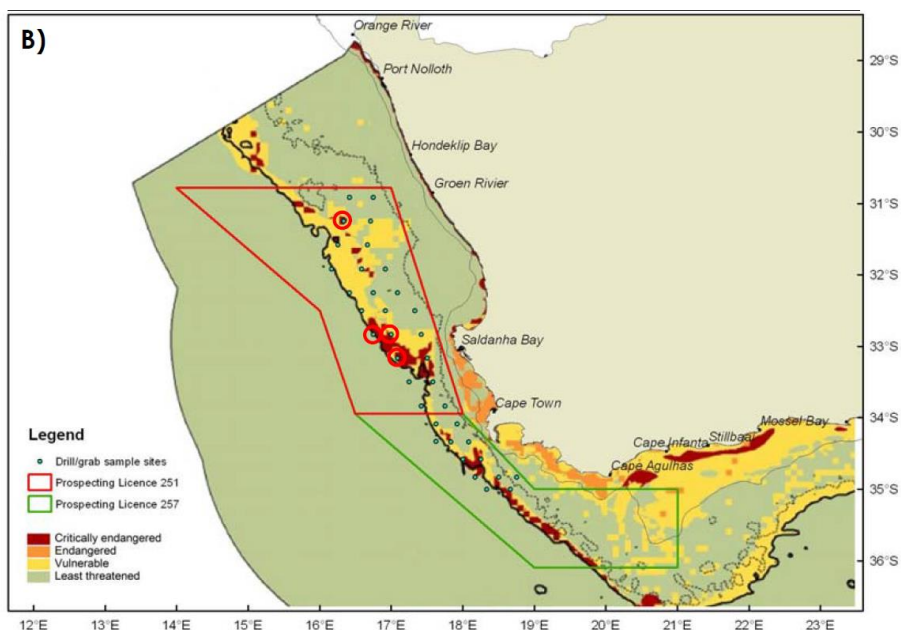
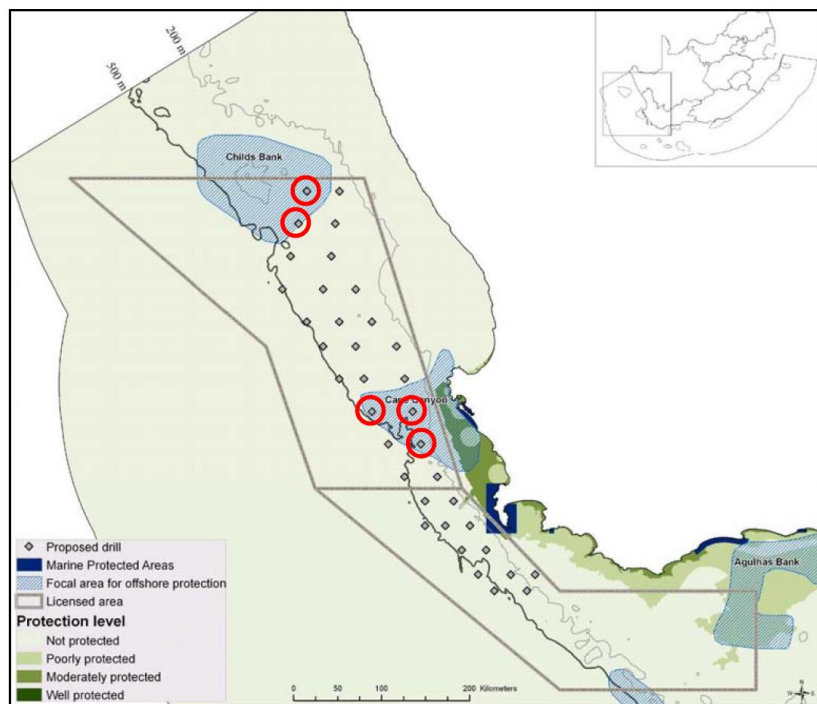


Figure 6: Sample sites to be relocated outside (a) proposed benthic priority and (b) Critically Endangered areas.

3.5 Conclusion

South Africa is recognised as a world leader in biodiversity assessment, and is the only country to have completed a comprehensive threat status analysis of its ecosystems for all environments. The NBA 2011 has advanced marine biodiversity mapping by building on the OMPA project. The potential impact of these two projects on the planning arena for maritime activities have been demonstrated at the fine-scale project level through the Green Flash application, and therefore it is to be expected that EAPs engaged in other mining sectors could utilise this information and capitalise on the resources provided on BGIS. As discussed in Chapter 1, the overlap of prospecting applications and leases seem to suggest a lack of uptake of these products at a national scale in the oil and gas sector. The lack of national strategic planning in the country emphasises the role that projects and associated EIAs play in managing biodiversity and ensuring sustainable development. In light of this gap in strategic planning, it is necessary to assess the level of use and impact of the OMPA and NBA 2011 in guiding biodiversity management in the oil and gas sector at the project level.

CHAPTER 4: METHODOLOGY AND METHODS:

This chapter outlines the methodology used in the completion of this study and clarifies the criteria used in selecting EMPs for inclusion in the study, the method and tool used to capture data and clarifies the types of data that were looked for to answer the research questions. The value of the case study provided in the previous section and its relevance to the data analysis is also clarified. GIS is used to illustrate the planning power of the NBA 2011 at the project level.

4.1 Methodological framework:

The methodology of this study can be classified as inter-disciplinary in nature in terms of the methodology used as the research objective questions not only whether selected biodiversity information has been utilised (quantitative in nature) but also the manner in which scientific information or data has been used within decision-making processes (qualitative in nature).

This study utilised content analysis as the method for data collection using a coding system to allow for quantitative data analysis (as described by Welman et al. 2005). Content analysis is regarded as 'belonging to' the field of qualitative research methodology, which is often regarded as less rigorous compared to quantitative research. Cousin (2009), crudely defines methods as the tools and procedures used for our enquiries, and methodologies as the framework within which they sit. As such, the specific methods employed underlie the methodology called for, which in turn is determined by the research question being asked (Case and Light 2011). Qualitative research methodology concerns itself with phenomenon involving quality and investigates the "why" and "how" of decision-making, whilst quantitative research methodology focusses on the measurement of quantity and uses an iterative process to investigate evidence (usually in the form of graphs and tables) to measure the "what", "where" and "when" of decision-making (Rajasekar et al. 2013). The differences between the two have resulted in a qualitative vs. quantitative chasm in the choice in methodology, often referred to as the "science wars" (Mayring 2014).

The distinction between quantitative and qualitative methodologies arises when asking the question: can methodology used in physical sciences be used to describe social, economic or political actions? Consensus is that it is the application of the values of good research (i.e. control of bias and maintenance of objectivity) to the data collection, analysis and interpretation of findings that is of importance to both methodologies used (Case And Light 2011, Ranjit 2011). While a sizable amount of literature has been published to promote the benefits of each methodology (Mayring 2014, Terrell 2012, Ranjit 2011, Zhang and

Wildemuth 2005, Cresswell and Miller 1997), it is not within the scope of this study to advocate for one over another. This study does however acknowledge the value of the interconnectedness of qualitative and quantitative analysis, owing to the inter-disciplinary nature of methodology used. In recent times, it has been debated whether the two methodologies are as distinct as previously believed, with a growing perception that the relationship between the two can be bound together on a continuum (Brown 2010). The practical applications as well as the merits of such a 'mixed method' approach have been investigated and documented notably in the field of the social sciences, including health science, psychology and education research (Hyett et al. 2014, Terrell 2012, Case and Light 2011, Ranjit 2011).

To investigate the research objective as previously described, this study adopted a compromise approach, utilising a set of qualitative indicators (the inclusion or absence of biodiversity information) to quantifiably assess the use of these biodiversity products, and thus deduce their influence to decision-making. This combination can be viewed within its constructivist (qualitative) paradigm in the nature of the research question being asked, to acknowledge the reality of subjective human creation of meaning, but also to respect the presence of objectivity (Baxter and Jack 2008). At the same time, through the structured nature of the research design, the confinement of the study sample and the rigid research objective, the methodology takes on a positivist (quantitative) approach to the research question (Terrell 2012).

Content analysis is one of such mixed-method approaches (Zhang and Wildemuth 2005), whereby the assignment of value to the text (or spatial data) is qualitative, and the analysis of the frequencies of the values is typically quantitative. Content analysis was used in this study, and assumes a positivistic position fulfilling the requirements as outlined in Mayring (2014). In this study, the quantitative content analysis method has been used to measure, record and quantify applicable aspects of the text and spatial data, which were automatically detected; their frequencies analysed, and therefore the results of the analysis claim objectivity.

4.2 Data Collection:

4.2.1 Method of Data Collection

Data was gathered from EMPs and their associated specialist studies within the EIA process for marine oil and gas applications. As discussed in Chapter 2, these documents are meant to provide the authorising body for mining rights allocation all the necessary information on the affected environment and which mitigation measures have been proposed to minimise

foreseen negative impacts on the environment. These documents also inform the manner in which the project will endeavour to ensure appropriate environmental management within the exploration right area under application. These were received by SANBI from the Petroleum Agency South Africa over a period of 4 years as part of their stakeholder consultation process. The Petroleum Agency South Africa (PASA) is the national entity whose mission is “To promote, facilitate and regulate exploration and sustainable development of oil and gas in South Africa” (PASA 2013).

One of the identified criticisms of the use of content analysis is the selection of documents or material that are inappropriate for analysis to answer the research question, and therefore do not contribute towards the research aim or objective (Brown 2010). This study has therefore selected EMPs that meet the requirements of the research objective: EIAs should be within the time period that is appropriate (i.e. not older than 2005), span the extent of the study area (see section 1.2 in Chapter 1), and are limited to exploration activities within the oil and gas sector.

4.2.2 Text data collection

An Excel data template was developed to extract information that would be useful in determining whether selected biodiversity information had been incorporated into the project planning and informed mitigation recommendations put forward in the EIA process for each project. This template is provided in Table 3. Data extracted using this template is captured under Appendix V.

Of the documents that were received from the PASA, 21 applications or EMPs that were relevant to this study were selected for analysis. Details of these applications are provided in Table 4.

The documents listed in Table 4 were analysed for references to the following documents:

- The National Spatial Biodiversity Assessment 2004: Marine Component (Lombard et al. 2005) – NSBA 2005
- The National Biodiversity Assessment 2011 Volume 4: Marine Technical Report (Sink et al. 2012a) – NBA 2011
- Spatial planning to identify focus areas for offshore biodiversity protection in South Africa. (Sink et al. 2011) – The OMPA Report - OMPA

Note: Document P3 and P6 were only analysed for references to the NSBA 2004 as they were completed prior to the publishing of the OMPA report and the NBA 2011.

Table 3: Data template with heading definitions.

Heading	Definitions
Name of document	The title of the document as stated on the cover of the document
Date	The date the document was completed
Author/Lead consultant	The name of the company or consultancy that undertook to complete the document.
Applicant	The name of the applicant, i.e. the name of the company applying for the mining right/lease
Consultants/Specialist studies	The name of the consultancies that provided expert advice as well as the aspect they gave advice on.
Location	The location of the mining lease area in relation to the coast and depth range
Scan of map	Image of the map of the proposed lease area
Proposed activities	The list of mining activities proposed or planned for in the document
Ecosystem map	The ecosystem map used in the document under the Affected Area section
Ecosystem threat status	The map on ecosystem threat status used in the document
Does it overlap	Yes or No based on whether the consultant acknowledged the ecosystem threat status map.
Have any mitigation measures been recommended?	Yes or No based on whether the consultant acknowledged the ecosystem threat status map.
Does it overlap with OMPA focus areas?	Yes or No based on whether the consultant acknowledged the OMPA focus areas map.
Which focus area does it overlap with?	List of OMPA focus areas identified by the consultant that fall within the planned lease area
Have any mitigation measures been recommended?	Yes or No based on whether the consultant acknowledged the OMPA focus areas map.

Table 4: List of documents used in the study. Documents were numbered in order of analysis.

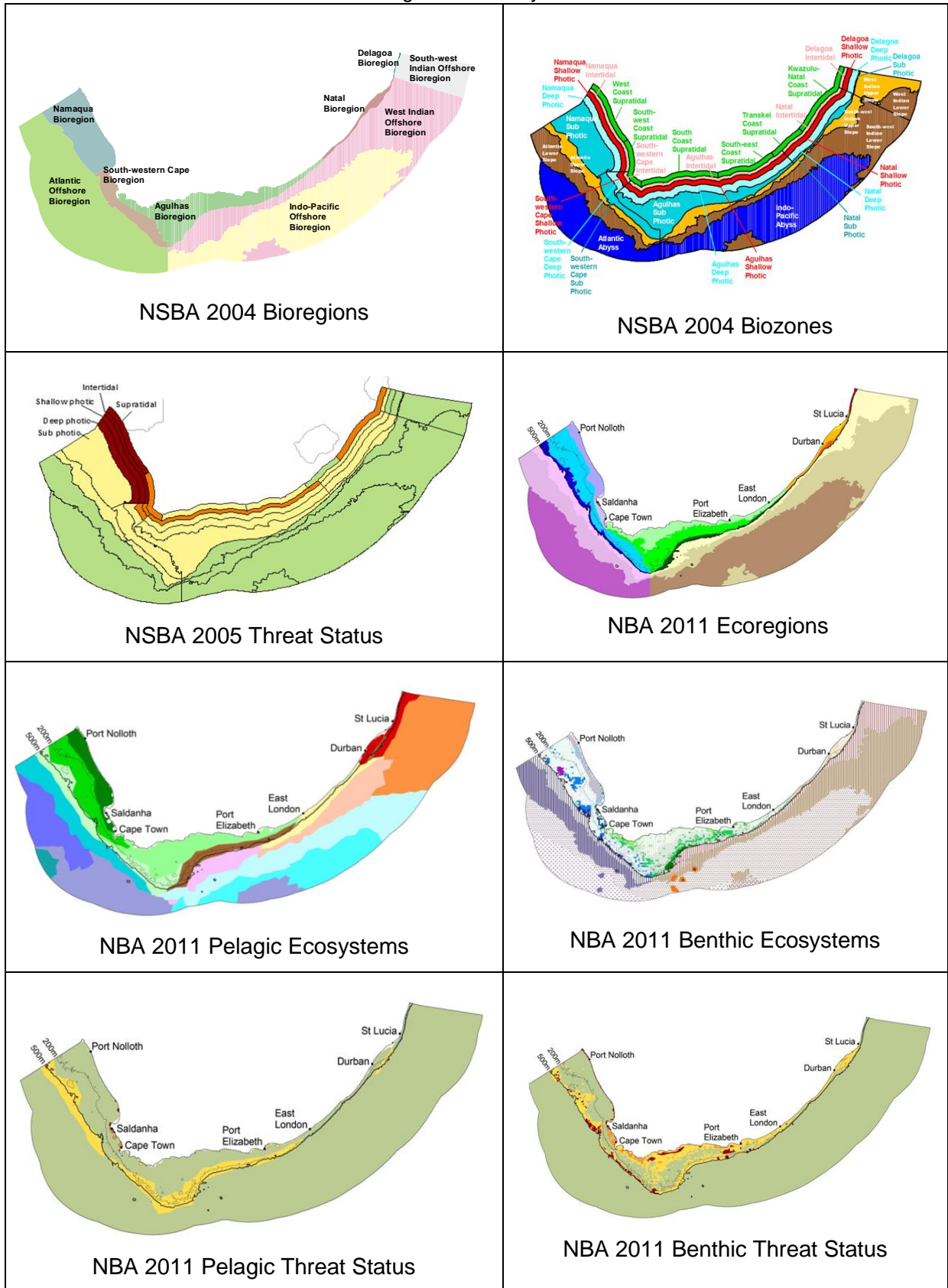
Document number	Date Report Completed	Applicant	Name of document
P1	11 April 2014	New Age Global Energy South Africa PTY LTD	South West Orange Basin Deepwater Exploration Area: Final Environmental Management Programme (EMPr)
P2	03 October 2012	New African Global Energy South Africa (New AGE)	Amended Environmental Management Programme for Seismic Surveys in the Algoa/Gamtoos Block
P3	29 June 2010	Bayfield Energy Limited	Environmental Management Programme for a proposed seismic survey in the Pletmos inshore area off the South Coast Of South Africa
P4	21 June 2012	CGGVeritas Services	Environmental Management Programme for a proposed 2D speculative seismic survey off the East Coast of South Africa.
P5	14 December 2012	Sasol Petroleum International (Pty) Ltd	Environmental Management Programme for a proposed 2D speculative seismic survey in the Durban and Zululand Basins off the East Coast of South Africa
P6	27 May 2010	Silver Wave Energy (Pte) Ltd	Environmental Management Programme for a seismic survey in Blocks 2931C, 2931D, 2932A and 2932C, East Coast, South Africa.
P7	26 October 2012	Total E and P South Africa (Pty) Ltd	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.
P8	01 October 2012	Petroleum Geo-Services	Environmental Management Plan for a proposed 2D speculative seismic survey off the South and East Coasts of South Africa.
P9	26 June 2013	Impact Africa	Transkei and Algoa Exploration Area: Environmental Management Programme
P10	23 July 2013	Anadarko South Africa (Pty) Lts	Environmental Management Programme Addendum for a proposed seafloor geochemical sampling programme in Licence Blocks 5/6 (ER #224) and 7 (ER #228), South- West Coast, South Africa.
P11	08 March 2013	Impact Africa	West Bredasdorp Exploration Area: Environmental Management Programme
P12	24 July 2013	OK Energy Ltd	Northwest Pletmos Exploration Area: Environmental Management Programme
P13	05 April 2013	Anadarko South Africa (Pty) Ltd	Environmental Management Programme for Proposed oil and gas exploration programme in licence block 2C, off the West Coast of South Africa.
P14	08 March 2013	Impact Africa Limited	Environmental Management Programme for a proposed oil and gas exploration programme in the Tugela North area off the East Coast of SA

Document number	Date Report Completed	Applicant	Name of document
P15	11 November 2013	Spectrum ASA	Environmental Management Plan for a reconnaissance permit to undertake a speculative 2D seismic survey in the Orange Basin off the West Coast of SA
P16	26 September 2013	Petroleum Geo-Services	An Environmental Management Plan Addendum for a proposed 2D speculative seismic survey off the South Coast of South Africa.
P17	14 March 2014	Exxon Mobil Exploration and Production South Africa Limited	Deepwater Durban Exploration Area: Environmental Management Programme
P18	04 April 2014	OK Energy Limited	Environmental Management Programme for an Exploration Right in the Northern Cape Ultra-deep Licence Areas in the Orange Basin, West Coast of South Africa.
P19	01 April 2014	Silver Wave Energy PTE LTD	Environmental Management Programme: Exploration Right for oil and gas in Blocks 2734, 2735, 2834, 2835, 2934, 2935 and 3034 located off the KwaZulu-Natal coast.
P20	14 August 2014	The Petroleum Oil and Gas Corporation of South Africa (SOC) Ltd.	Environmental Management Programme: Exploration and geophysical surveys in Licence Block 3A/4A, off the West Coast of South Africa
P21	29 April 2014	Petroleum Geo-Services	Environmental Management Plan for a proposed 2D speculative seismic survey off the South Coast of South Africa

4.2.3 Visual Data Collection:

Presence-absence data was collected for maps depicting the NSBA 2004 Bioregions (Figure 13) and Biozones (Figure 14), the NSBA 2004 Threat Status map (Figure 15), the NBA 2011 Ecoregion map (Figure 16), the NBA 2011 Ecosystem Types maps for Pelagic (Figure 18) and Benthic (Figure 17) ecosystems, the NBA 2011 Ecosystem Threat Status maps for Benthic (Figure 20) and Pelagic (Figure 21) ecosystems, as well as the OMPA Focus Areas map (Figure 23). These maps are reproduced in Table 5 for ease of reference.

Table 5: Table of visual data detected using content analysis.



4.3 Data Analysis:

Elements for text and spatial data were analysed using content analysis as described by Welman et al. 2005 and recorded as presence-absence data. The success of a biodiversity product to achieve mainstreaming was measured on utilisation (whether they were included in the proposed mining project's EMP) and on level of influence (whether they formed the basis for mitigation recommendations). The restriction to the absence-presence indexing method of content analysis is a simple, yet powerful measure of interpreting the sample data, while maintaining objectivity (Hsieh and Shannon 2005), is reproducible and fulfils the classic quality criteria of reliability and validity, typically required of qualitative research methodology, as described in Mayring (2014).

To avoid the danger of pseudo-quantification in this study, the moderate sample size is acknowledged, and statistical analysis is avoided.

4.4 The Case for the Case Study:

"The purpose of using a case study is to get in-depth details as much as possible about an event, person or process" (Njie and Asimiran 2014), with the added advantage of studying them in their real-world context (Yin 2012). The relevance of results extracted is of contextual value to the research question. This study includes an instrumental case study of an EMP completed by Green Flash (as described in Chapter 3), with the intent that its content serves to exemplify the execution of good practice in effective decision-making processes in EIAs, and can be used as a reference case (Baxter and Jack 2008). In using case studies, the sample size is of less importance than in quantitative analysis, owing to the depth and detail of information exposed on an isolated topic (Njie and Asimiran 2014).

In this study, the merits of a compromise methodology have been maximised, since a qualitative approach *"can inform professional practice or evident-informed decision making"* (Baxter and Jack 2008), while Mayring (2014) states that within qualitative research, maintaining a positivistic approach is sufficient to ensure scientific rigor. The relationship of both methodologies contributes to the value of the research, especially in evaluating the outcome of evidence-based policy (Brown 2010).

4.5 Geographical Information Systems (GIS):

GIS is the computerised system by which spatial information can be utilised to visualise, query, evaluate, and interpret data to understand relationships, patterns, and trends (ESRI 2015). This technology emerged in the 1960s (Geriner 2007) and revolutionised the way in

which planning in the public and private sector takes place (Walford 1999). This technology is utilised in almost every industry (e.g. archaeology (Robinson 2010), meteorology (Chapman and Thornes 2003), health (Joyce 2009), marketing (Turk et al. 2014), to name a few) as well as the more obvious sectors such as land-use planning and environmental management (Bona et al. 2006, Liu et al. 2006, Lavendal 2002, Rodriguez-Bachiller 2000, Bradshaw and Muller 1998). GIS is extremely useful in the assessment arena, as information on a particular project can be overlaid onto biodiversity maps to determine the extent to which biodiversity will be impacted. It also allows for the incorporation of subjective decision-making rules or criteria to establish thresholds for appropriate action (Aswani and Lauer 2006, Gomes and Lins 2002).

4.5.1 GIS Methods

In this study, ArcGIS 10 was used to overlay the EMP areas that were identified to have potentially ecosystem degrading exploration methodology as part of the exploration project with the NBA 2011 Benthic Ecosystem Threat Status map. This was done to illustrate the project-level, fine-scale planning potential of the NBA 2011 information to be utilised in EIA mitigation recommendations, using the case study in Chapter 3 as the model approach.

4.6 Limitations to the research method, research alternatives:

As this study can be described as explorative (Strydom 2013), the focus was limited to the efficacy of the decision-making processes (EIAs) in relation to use of biodiversity information, incorporating a quantitative content analysis method. As a means of “*binding the case*” (Njie and Asimiran 2014, Baxter and Jack 2008), interpretations of the content of the sample data were avoided, which was necessary to allow better focus on the research question. For interpretation of the content analysed, a deeper qualitative approach would be necessary. That descriptive / consultative study could at that stage involve interviews with the practitioners executing the decision-making processes, in which the individuality of the people involved would reflect the subjectivity of the EIA processes (Ambrose et al. 2005), an endeavour too large for the scope of this study.

A practical limitation of this quantitative research method is the moderate sample size which excludes the inference of statistical meaning. However, this limitation is brought about by the need to contain the sample data to EMPs that are applicable for the marine oil and gas sector in order to be relevant to the study.

CHAPTER 5: FINDINGS

This chapter presents the findings of the study using content analysis methodology for 21 EMPs and their associated specialist studies. EMPs were examined to assess the mainstreaming success of biodiversity information from the NSBA 2004, the OMPA Project and the NBA 2011. EMPs and specialist studies were examined for in-text referencing of the afore-mentioned biodiversity products as well as the use of related maps. The level of success of mainstreaming was determined by the inclusion of mitigation methods that were directly attributed to the selected biodiversity products, as shown in the case study presented in Chapter 3.

5.1 Exploration Methods:

Seven different methods were found. Table 6 shows the differing methods used in the proposed projects represented in each EMP. A Value of 1 was assigned where an EMP made use of a specific exploration activity, and a value of 0 used to capture those methods that were not used by a specific project.

2D seismic survey was the most utilised of the exploration methods and was present in 20 EMPs, whilst 3D seismic surveys were only found in nine of the 21 EMPs analysed. Multibeam echo sounder, Water column sampling and Seabed Sampling were found in 10 EMPs. Seabed surface heat flow measurements were used in eight of the EMPs, whilst sub-bottom profiling was only used in four of the 21 EMPs.

Table 6: Presence-absence data for the different exploration activities collected from the study EMPs which are listed in chronological order. Highlighting is used to draw attention to activities with direct impacts or disturbance to benthic ecosystems.

EMP Number	Date	2D Seismic Survey	3D seismic survey	Multibeam Echo Sounder	Sub-bottom Profiling	Water Column Sampling	Seabed Surface Heat Flow Measurements	Seabed Sampling
P6	27 May 2010	1	0	0	0	0	0	0
P3	29 June 2010	1	0	0	0	0	0	0
P4	21 June 2012	1	0	0	0	0	0	0
P8	01 October 2012	1	0	0	0	0	0	0
P2	03 October 2012	1	1	0	0	0	0	0
P7	26 October 2012	1	0	1	1	1	0	1
P5	14 December 2012	1	0	0	0	0	0	0
P11	08 March 2013	1	0	1	0	1	1	1
P14	08 March 2013	1	1	1	0	1	1	1
P13	05 April 2013	1	1	0	0	0	1	0
P9	26 June 2013	1	1	1	0	1	0	1
P10	23 July 2013	0	0	1	0	1	1	1
P12	24 July 2013	1	1	1	0	1	1	1
P16	26 September 2013	1	0	0	0	0	0	0
P15	11 November 2013	1	0	0	0	0	0	0
P17	14 March 2014	1	1	1	1	1	1	1
P19	01 April 2014	1	0	0	0	0	0	0
P18	04 April 2014	1	1	1	0	1	0	1
P1	11 April 2014	1	1	1	1	1	1	1
P21	29 April 2014	1	0	0	0	0	0	0
P20	14 August 2014	1	1	1	1	1	1	1
21	TOTAL	20	9	10	4	10	8	10

5.2 Biodiversity References (including Maps)

5.2.1 Results for the main text of the EMP

Table 7 shows presence-absence results for the inclusion of the selected biodiversity products (reports and maps) in the EMP document. No EMP made reference to a biodiversity report without displaying at least one associated map, thus presence-absence data is displayed as a combined value to illustrate the presence of in-text referencing and visual presentation of a specific map. A value of 1 was assigned where an EMP made use of a specific biodiversity report (inclusive of in-text reference and visual content), and a value of 0 used to capture those that were excluded.

Table 7: Presence-absence data for inclusion of SANBI biodiversity data in the EMPs from 2010 to 2014. A value of 1 indicates the presence of a specific biodiversity report with associated map (highlighted), and a value of 0 used to capture those that were excluded. Grey highlighting is used to indicate the exclusion of a document from analysis as it was prepared before the publication of the NBA 2011.

EMP Number	Date	NSBA 2004 Bioregion Map	NSBA 2004 Threat Status Map	NBA 2011 Ecoregions Map	NBA 2011 Benthic and Coastal Ecosystem types	NBA 2011 Pelagic Ecosystem types	NBA 2011 Benthic Threat Status Map	NBA 2011 Pelagic Threat Status Map	OMPA Focus Areas
P6	27 May 2010	0	0						
P3	29 June 2010	0	0						
P4	21 June 2012	0	0	0	0	0	0	0	0
P8	01 October 2012	1	0	0	0	0	1	0	1
P2	03 October 2012	0	0	0	0	0	0	0	0
P7	26 October 2012	1	0	0	0	0	1	0	1
P5	14 December 2012	1	0	0	1	0	1	1	1
P11	08 March 2013	1	0	0	0	0	0	0	1
P14	08 March 2013	1	0	0	0	0	1	1	1
P13	05 April 2013	1	0	0	0	0	1	1	1
P9	26 June 2013	1	0	0	0	0	0	0	1
P10	23 July 2013	1	0	0	0	0	1	1	1
P12	24 July 2013	1	0	0	0	0	0	0	1
P16	26 September 2013	1	0	0	0	0	1	1	1
P15	11 November 2013	1	0	0	0	0	1	1	1
P17	14 March 2014	1	0	0	1	0	0	0	1
P19	01 April 2014	1	0	0	1	0	1	0	0
P18	04 April 2014	1	0	0	0	0	1	1	0
P1	11 April 2014	1	0	0	1	0	1	1	1
P21	29 April 2014	1	0	0	0	0	1	1	1
P20	14 August 2014	1	0	0	0	0	1	1	0
21	TOTAL	17	0	0	4	0	13	10	14

5.2.2 Results for the Specialist Reports

Four types of specialist studies were found and their titles are listed below:

- “Specialist Study on the Impact on Fisheries”
- “Marine Faunal Impact Assessment”
- “Description of the Offshore Environment of the East Coast”
- “Marine Archaeology”

The specialist studies regarding the “Marine Archaeology” and “Description of the Offshore Environment of the East Coast” were not submitted as part of the EMP and therefore were not available for analysis. In addition the specialist study on archaeology was referred to in

only one EMP, whilst the specialist study titled “Description of the Offshore Environment of the East Coast” was only presented in two of the 21 EMPs. These specialist reports therefore are not considered in the current study and no effort was made to source them.

This meant that only the studies on the impact on fisheries and marine fauna were analysed. The specialist study on fisheries was present in all EMPs. The specialist studies on impacts to fisheries were all from one consultancy and made no reference to the selected biodiversity information, and consequently are not presented further in this thesis.

The specialist studies on the marine fauna were all from one consultancy. This specialist study was not included in the supporting documents for P2 and this EMP has therefore been excluded from the analysis. As the Marine Faunal Impact study is the only specialist study included in the analysis, it will hereafter only be referred to as “the specialist study”.

Table 8 shows presence-absence results for the inclusion of various biodiversity products (reports and maps) in the specialist studies considering impact on marine fauna in the EMP. A value of 0 was given where no reference or map could be detected for the selected biodiversity information. A value of 1 was allocated where a reference was detected. A value of 2 was given where a reference and associated map was detected.

To assess if there was a correlation between presence in the specialist study and presence in the EMP, the data was normalised to represent the coding used in Table 8 (i.e. 0 = no reference or map, 1 = reference only, 2 = reference and map) and is presented under the following sub-headings.

Table 8: Presence-absence data for inclusion of SANBI biodiversity products in the specialist studies on marine faunal impacts. A value of 0 was given where no reference or map could be detected for the selected biodiversity information. A value of 1 was given where a reference was detected (orange highlighting). A value of 2 was given where a reference and associated map was detected (green highlighting). Grey highlighting is used to indicate the exclusion of a document from analysis as it was prepared before the publication of the NBA 2011. Totals are omitted to avoid pseudo-quantification.

EMP Number	Date	NSBA 2004 Bioregion	NSBA 2004 Threat Status	NBA 2011 Benthic and Coastal Ecosystem types	NBA 2011 Pelagic Ecosystem types	NBA 2011 Ecoregions	NBA 2011 Benthic Threat Status	NBA 2011 Pelagic Threat Status	OMPA Focus Areas
P6	27 May 2010	0	0						
P3	29 June 2010	0	0						
P4	21 June 2012	1	0	0	0	0	0	0	0
P8	01 October 2012	0	0	0	0	0	0	0	0
P7	26 October 2012	2	0	0	0	0	0	0	0
P5	14 December 2012	1	0	0	0	0	0	0	1
P11	08 March 2013	2	0	0	0	0	0	0	0
P14	08 March 2013	1	0	0	0	0	0	0	1
P13	05 April 2013	1	0	0	0	0	0	0	0
P9	26 June 2013	1	0	1	0	0	0	0	0
P10	23 July 2013	1	0	0	0	0	0	0	0
P12	24 July 2013	2	0	0	0	0	0	0	0
P16	26 September 2013	2	0	0	0	0	0	0	0
P15	11 November 2013	0	0	0	0	0	0	0	0
P17	14 March 2014	2	0	2	0	0	0	0	1
P19	01 April 2014	0	0	0	0	0	0	0	0
P18	04 April 2014	2	0	0	0	0	2	2	0
P1	11 April 2014	2	0	2	0	0	2	2	0
P21	29 April 2014	2	0	0	0	0	0	0	0
P20	14 August 2014	0	0	0	0	0	0	0	0

5.2.3 National Spatial Biodiversity Assessment 2004

All EMPs received were used to assess the level of impact of the NSBA 2004. The map illustrating the Bioregions was used in 17 of 21 EMPs with the exception of P2, P3, P4 and P6.

Specialist studies on marine faunal impacts showed intermittent use of this biodiversity information over time for, with no reference made in P3, P15, P19 and P20. Figure 27 shows no pattern between the presence of the biodiversity information in the specialist study and its presence in the EMP.

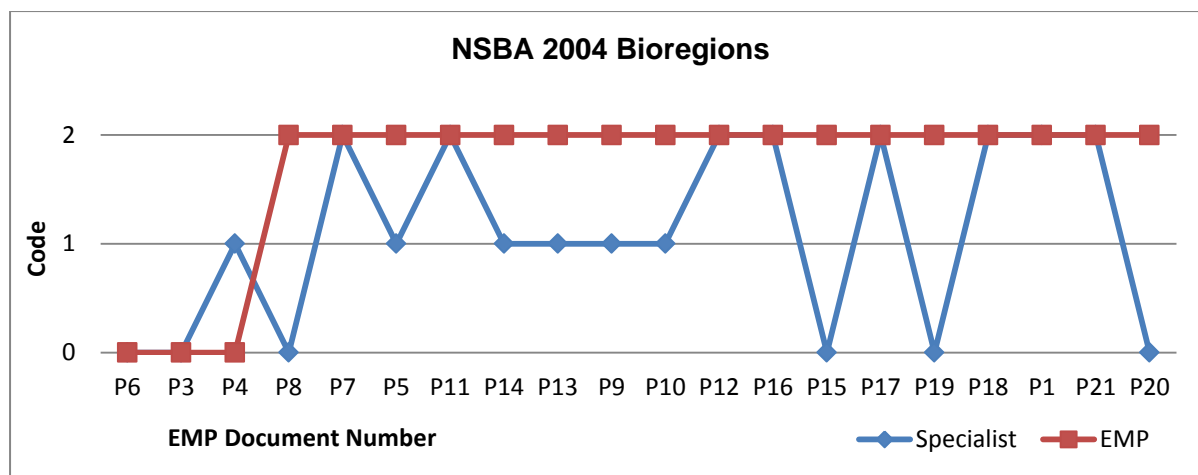


Figure 27: Line graph depicting presence-absence for the NSBA 2004 Bioregions in the EMP and the specialist study. Specialist studies are chronologically listed from left to right.

Neither EMPs nor their associated specialist study made reference to the NSBA 2004 threat status of marine ecosystems.

5.2.4 Offshore Marine Protected Areas focus areas

Document P3 and P6 were excluded for analysis of use of the OMPA report as they were completed before the release of the OMPA report.

Fourteen of the 19 EMPs were found to have referenced the OMPA report and used the OMPA focus areas. Where this document was used, a note was made that the focus areas were earmarked for potential management and MPA proclamation and that project planning would need to consider this going forward. It should be noted that all EMPs analysed from 2013 made use of the OMPA report and focus area map.

The specialist studies showed very limited/low use of the OMPA report, with it only being referenced in three of the 18 studies (P5, P14 and P17). The OMPA focus area map was not used in any of the specialist study reports.

5.2.5 National Biodiversity Assessment 2011:

Document P3 and P6 were excluded for analysis of use of the NBA 2011 Marine Technical report as they were completed before the release of the NBA 2011. Fourteen of the 19 EMPs made reference to the NBA 2011, and this was separately examined for each of the maps for ecoregions, benthic ecosystem, pelagic ecosystem, benthic threat status and pelagic threat status, as reported in **Table 7**. Only four EMPs made reference to the NBA 2011 Coastal and Benthic Ecosystem map, these being P1, P5, P17 and P19. These EMPs also made reference to the NSBA 2004 Bioregion map. The NBA 2011 Ecoregion and Pelagic Ecosystem maps were not referenced in any of the EMPs. The NBA 2011 Benthic

Threat Status map was utilised in 13 EMPs, whilst the NBA 2011 Pelagic Threat Status map was only utilised in 10 of the 19 EMPs. All EMPs that referred to the pelagic threat status also referred to benthic threat status. EMPs P7, P8 and P19 referred to benthic threat status only.

The specialist studies showed very low levels of use for the NBA 2011 biodiversity information. Only two of 18 specialist studies made reference to the NBA 2011 Coastal and Benthic Ecosystem map, these being P1 and P17. Figure 28 shows no correlation between the presence of the NBA 2011 Coastal and Benthic Ecosystem information in the specialist study and its presence in the EMP. Similar low levels of use were found for the NBA 2011 Benthic Threat Status, as shown in Figure 29, with threat status for benthic and pelagic ecosystems only being included in P1 and P18. No reference was made to the NBA 2011 Ecoregion and Pelagic Ecosystem maps.

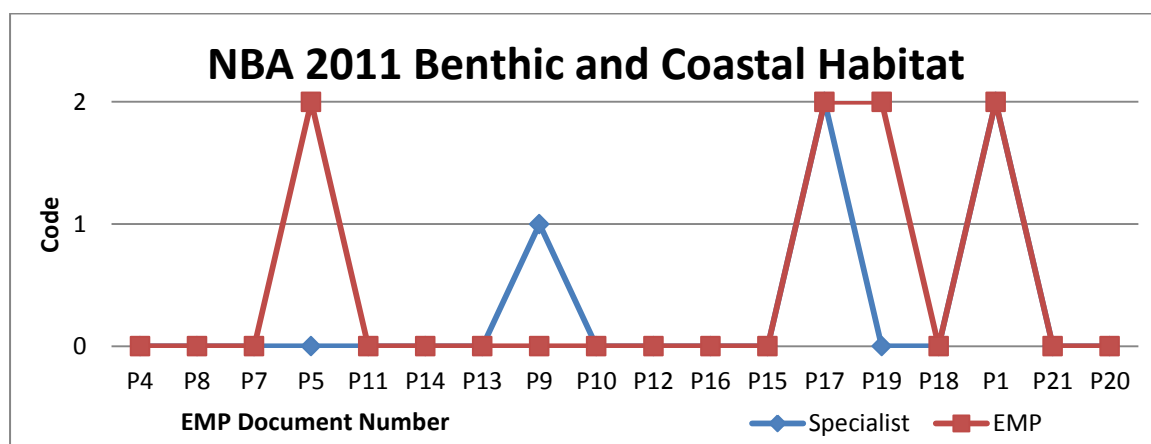


Figure 28: Line graph depicting presence-absence of the NBA 2011 Benthic and Coastal Ecosystem information in the EMP and specialist study. EMPs are chronologically listed from left to right.

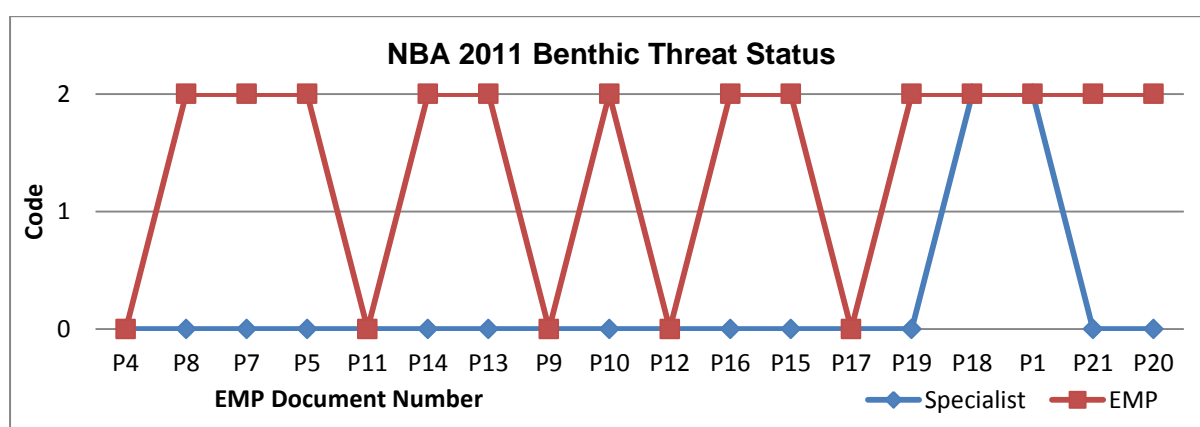


Figure 29: Line graph depicting presence-absence of the NBA 2011 Benthic Threat Status information in the EMP and specialist study. EMPs are chronologically listed from left to right.

5.3 Results for Relationships between Exploration Methods and Biodiversity Information

Due to the moderate sample size, no statistical analysis of the relationship between exploration methods and biodiversity data could be carried out. However, nine of the eleven EMPs that had an element of potentially ecosystem degrading methods made use of the OMPA Focus Areas map (Figure 30).

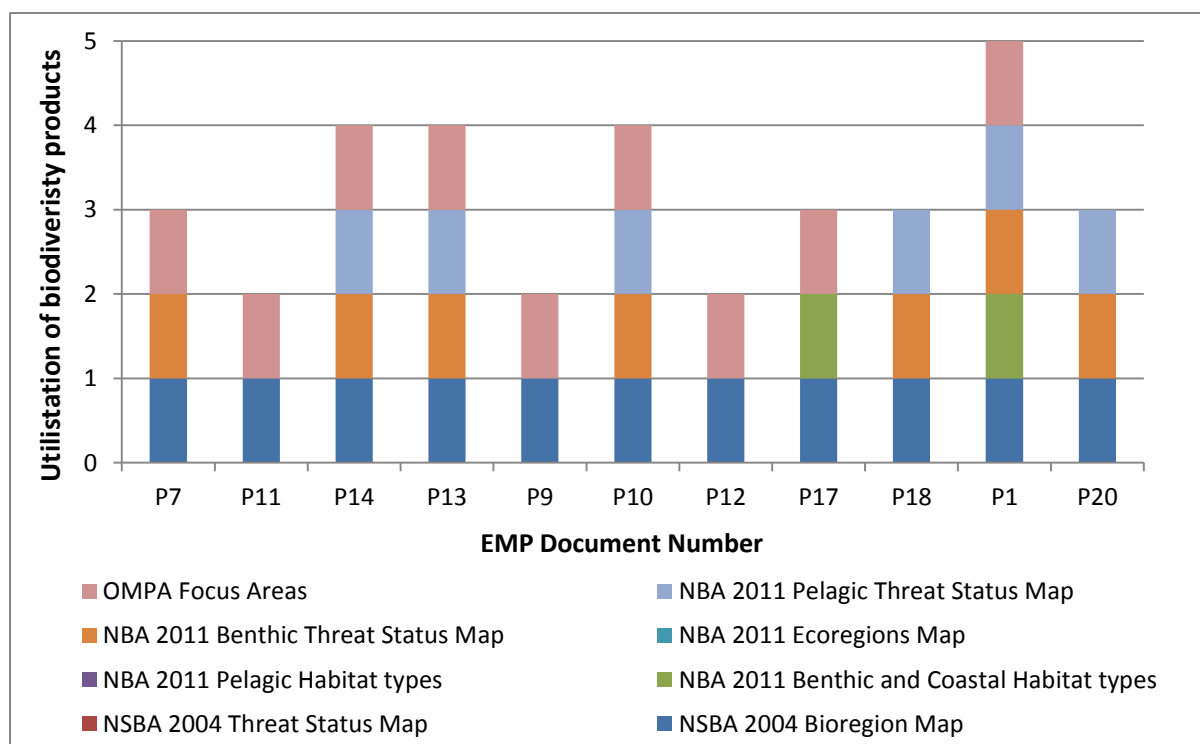


Figure 30: Chart depicting how proposed projects that included ecosystem degrading methods sourced biodiversity information in the EMP. EMPs are chronologically listed from left to right.

The specialist studies showed very low levels of use for the biodiversity information when compared with the main text of the EMPs that contained potentially habitat degrading methods. Figure 31 shows an increase in the use of biodiversity information for the period March to April 2014 for P1, P17 and P18 but P20, completed in August 2014, was the only specialist study that did not contain any biodiversity information from the selected biodiversity products and is therefore not included in the graph.

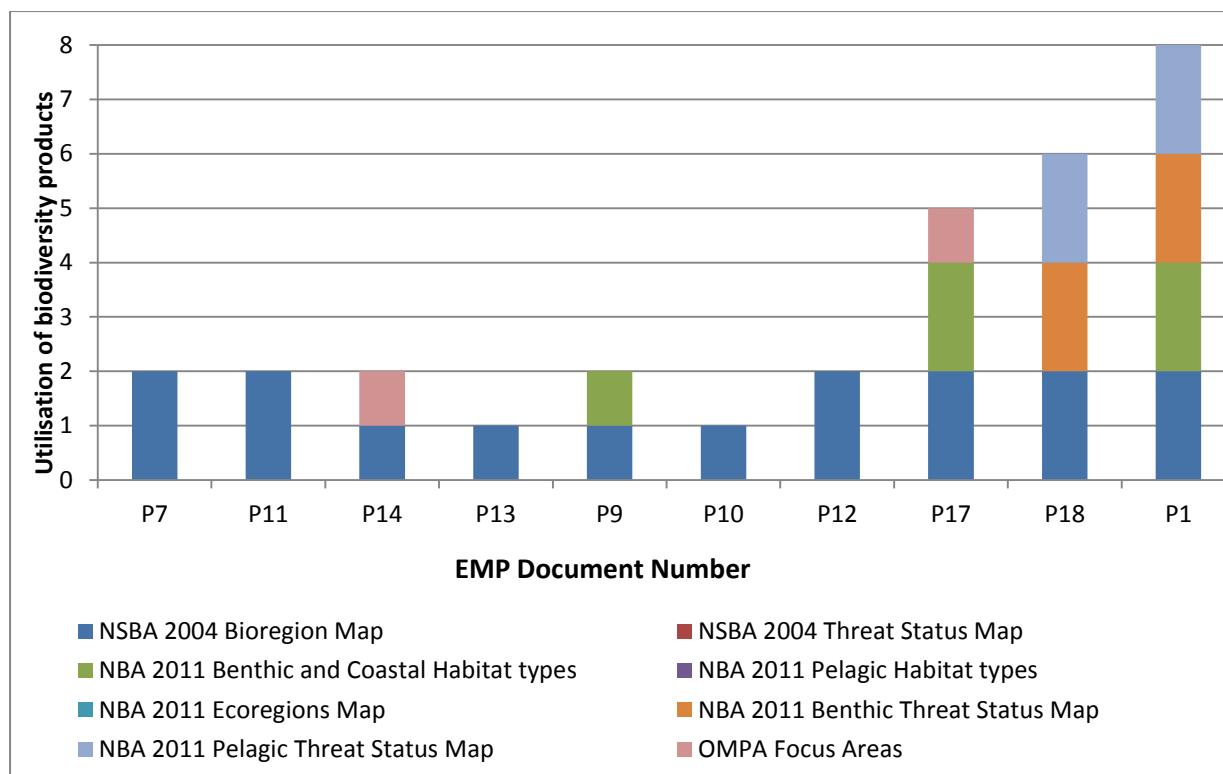


Figure 31: Chart depicting how specialist studies associated with EMPs that included ecosystem degrading methods sourced biodiversity information (listed chronologically from left to right). Biodiversity information with a value of 1 capture in-text referencing, whilst a value of 2 showed in-text referencing and display of associated map.

5.4 Mitigation Recommendations linked to Selected Biodiversity Information

This study expected to find that where mentioned, the information on ecosystem threat status as well as the OMPA focus areas would lead to the inclusion of mitigation methods directly related to these biodiversity products. Mitigation methods were expected to include avoidance of impacts to the aforementioned areas due to their significance as biodiversity priority areas or as threatened ecosystems, with the minimum expectation that Critically Endangered ecosystems would receive the most attention. However, no mitigation recommendations were found in any of the EMPs and their associated specialist studies that were directly related to the selected biodiversity reports.

5.5 Spatial Analysis for Threatened Ecosystems

Maps were created using ArcGIS 10 to illustrate the overlap of EMPs that had an element of potentially ecosystem degrading methods in the project plan with the benthic threatened ecosystem map from the NBA 2011. This was done to illustrate the fine-scale planning capability of the NBA 2011 in EIAs – as discussed in Chapter 3 – and to assess the level of overlap an EMP had with threatened ecosystems. The maps for EMPs that were found to have overlap with threatened ecosystems are presented in Appendix VI.

CHAPTER 6: DISCUSSION OF FINDINGS

This chapter outlines the implications of this study in evaluating the effectiveness of marine biodiversity information to influence environmental management within the EIA framework of oil and gas exploration. The expectation as put forward in Chapter 1 was that the selected biodiversity reports and plans would be utilised to not only assess the level of impact of the proposed mining project on the different ecosystem types, but that they would also inform mitigation recommendations as a measure of their mainstreaming success.

6.1 Addressing the Research Questions:

6.1.1 Are the selected biodiversity products utilised in EIAs?

This study found that all the biodiversity products examined had limited achievement in terms of biodiversity mainstreaming. It also found that the NSBA 2004, with specific emphasis on the Bioregions map, was the most successful in achieving utilisation. The map illustrating the Bioregions was used in almost all of the EMPs, with it being included in all EMPs from 2013 and 2014. This was the first national map for marine ecosystem types for South Africa, and this may be the reason it is still so widely used currently. Another possibility is that it is the oldest of the selected biodiversity information, and as such has had a longer timeframe to be accepted within the marine EIA sector. This would also explain the seemingly low level of use of the NBA 2011 ecosystem maps. However, it is concerning to note that although the NSBA 2004 Bioregions map was utilised, no mention was made of the NSBA 2004 Marine Threat status map or list.

In biodiversity sectors, the threat status of a species or habitat/ecosystem type is considered vital information when making decisions around management and utilisation. This study found low levels of use of threat status information for all threat status maps in the EMPs.

6.1.2 Where utilised, does the EIA give appropriate consideration to threatened habitats/ecosystems and priority biodiversity areas through mitigation recommendations?

This study determined that EMPs that used the relevant information but did not have overlap with any threatened ecosystems in the project area of interest were justified in not considering the threat status of ecosystems in mitigation.

EMPs that used less degrading methods (especially seismic surveys) and had overlap with threatened ecosystems did not give appropriate consideration to impacts on threatened ecosystems. For those EMPs that did include ecosystem degrading methodology and had

overlap with threatened ecosystems types, especially Critically Endangered ecosystem types, it was determined that they also did not give appropriate consideration for these ecosystems. This is evidenced by the lack of mitigation recommendations to avoid impact to these areas. It was noted that in some EMPs such as P12, interaction with marine ecosystems listed as vulnerable were unavoidable (see Figure 42 in Appendix VI). However, impacts on Critically Endangered ecosystems were not considered in any of the EMPs. Due to the limited spatial range of the Critically Endangered ecosystems, it is not unreasonable therefore to expect EAPs to recommend that seabed sampling and seabed surface heat flow measurements not be undertaken in these areas. This is in stark contrast with the sea bed mining example illustrated in section 3.4.2.

Although threat status information was referenced, it was presented merely as background information as it did not inform any mitigation recommendations and thus had no impact on any of the proposed project plans. This is especially concerning for those projects that included exploration methods that may have direct impact or disturbance to benthic ecosystems. This might be related to the disconnect between the marine national threat status assessment and associated list of threatened ecosystem types and the publication of Gazette Notice for Listed Threatened Ecosystems (RSA 2009) as this notice refers only to terrestrial ecosystems. Marine threatened ecosystems are not listed under a general notice, and consequently relevant legislation that would aid in improving management of these threatened ecosystems does not apply.

6.1.3 Do specialist studies, where present, provide sufficient information and/or recommendations on threatened habitats/ecosystems?

The specialist studies used in the analysis (Marine Faunal Impacts) showed low levels of use of the selected biodiversity products and did not make any mitigation recommendations related to the threat status of ecosystems. However, this is not unexpected when viewed in conjunction with the terms of reference provided by the applicant to the specialist. The terms of reference (under the heading "Scope of Work") in the specialist report included in P5 is provided below as a generic example:

- *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 survey on the local marine fauna, focussing particularly on marine mammals and turtles, but including generic effects on fish 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.*

As shown above, the terms of reference for the specialist makes no mention of impacts to ecosystems. In light of the terms of reference, any citation for ecosystem threat status can be deemed as unnecessary on the part of the specialist as it does not form part of the scope of work required by the applicant. This may also clarify why there was no pattern or correlation found in the presence of a specific biodiversity product in the main text of the EMP, and its presence in the specialist study (as shown in Figure 27 and Figure 28). The implication is that the EAP, and not the specialist, is intended to consider threat status of ecosystems in their assessment of impacts, as clearly evidenced in the results shown by Figure 29. This also implies that any mention of threat status of ecosystems and the OMPA focus areas, or any other potential protection areas, in relation to ecosystem protection by the specialist goes over-and-above the expectations laid out in the terms of reference. The appropriate response to this gap would be to amend the terms of reference to the specialist in marine faunal impacts, or to procure an additional specialist report on habitat/ecosystem impacts.

6.1.4 Is the EIA process sufficient in ensuring sustainable development in the marine environment?

The results of this study show that the EIA process, in isolation, is not sufficient to ensure sustainable development in the marine environment when assessing the consideration for threatened ecosystem types, especially Critically Endangered ecosystems, by EAPs in the EMPs for the marine oil and gas sector. As discussed in Chapter 3 and evidenced in Appendix VI, the NBA 2011 ecosystem threat status maps not only provide national context, but also allow for the level of fine-scale planning that is required at the project level to avoid unnecessary ecosystem degradation and impacts on biodiversity priority areas.

6.2 General Findings:

This study determined that all the biodiversity products had limited achievement in terms of biodiversity mainstreaming. Although products were cited, no mitigation recommendations were directly linked to these products despite their inclusion in the selected EMPs. All biodiversity products and their respective maps were presented as supplementary information that provided environmental context rather than as the basis for decision-making around the proposed mining project plan. As the success of a biodiversity product in terms of mainstreaming was measured on both utilisation and level of influence as evidenced by

related mitigation methods, the lack of mitigation measures indicated poor levels of influence of these products.

6.2.1 OMPA 2011

The OMPA report and Offshore Focus Areas map showed very high levels of use but low levels of influence, and are another example of biodiversity information that has no legislated support. The high level of use can be attributed to the strong stakeholder engagement process that was undertaken during the project implementation, and therefore shows the power of continuous stakeholder engagement to improve the uptake of information in the public and private sector (Adams et al. 2014, Hughes and Dann 2009). However, the lack of mitigation recommendations that were directly linked to this document could be an indication of the lack of engagement with the key factors that have driven the selection of these areas for biodiversity and fisheries management. The OMPA report and Offshore Focus Areas map form part of the National Protected Area Expansion Strategy to aid South Africa in achieving its Aichi targets by 2020. Although it was found that there was a medium to high level of use of this document (present in all EMPs from 2013) there was no indication of any deeper engagement with the information presented in the document. OMPA results were put forward as additional information on the environment with a note portraying any future proclamation as a possible “threat” to the proposed project. Under the section 2.4.3 in Chapter 2, a brief description is given of SEAs. The OMPA report should be viewed as an SEA and therefore is the most complementary tool to the marine environmental management framework. More emphasis should be placed on the OMPA focus areas in mining mitigation recommendations and project plans for sound decisions around biodiversity management to be possible, as these areas represent key biodiversity that has been identified for future protection as part of the aims of achieving sustainable development.

6.2.2 NSBA 2004

This study found that the NSBA 2004 was the most utilised of the selected biodiversity reports within the EIA framework for marine petroleum applications. The OMPA report was also noted as being increasingly referenced in EIAs for years 2013 and 2014. Very little uptake was noted for the NBA 2011 maps for pelagic and benthic ecosystems. The NBA 2011 ecosystem map publication was also found to have no impact on the use of the NSBA 2004 ecosystem map as the NBA 2011 has been shown to be more detailed and provide more accurate information upon which to build project plans. This was attributed to the long amount of time that EIA practitioners have had to assimilate the information in the NSBA 2004 and could be indicative of a lack of resources allocated to EIAs for exploration rights.

Concern was raised by the general lack of reference to the ecosystem threat status information available in both the NSBA 2004 and the NBA 2011. No recommendations were detected that were directly related to the selected biodiversity reports, which would indicate a lack of influence on the project plan (in contrast with the case study example in Chapter 3).

6.2.3 NBA 2011

The NBA 2011 ecosystem maps showed very little uptake into the EIA framework. The benthic map was only used four times, whilst no mention of the pelagic map was found in any of the 19 analysed EMPs produced after its release. An interesting outcome was that the publication of the NBA 2011 did not appear to have any effect on the continued use of the NSBA 2004, as documents that referred to the NBA 2011 Benthic map also referred to the NSBA 2004 Bioregions map to describe the affected environment within the project. The NBA 2011 ecosystem maps are more detailed and at a finer scale, and therefore it is reasonable to assume that as it represents the most recent and best available data, it would've replaced the NSBA 2004 in the EMPs. This may be attributed to the long time that the marine impact assessment sector has had to assimilate the NSBA 2004. As mentioned under Section 2.4.3, the amount of budget allocated for EIAs could be a determining factor in the amount of effort an EIA practitioner may assign to each project (Southalan 2012). This could lead to an over-reliance on previously collated information, i.e. where a lot of effort has already been invested in collating and writing up of general environmental information, it is deemed unnecessary to repeat that effort for future or current projects as this general information is still relevant. Although it was not included in the objectives of this study, it was noted that information on the affected environment that was presented in the analysed EMPs were very similar in format and language, and did not discuss the ecosystem types or their associated threat status in any detail. A deeper inquiry is needed to formulate solutions to address the over-reliance on previously completed (albeit well-written and well-referenced) general information without the necessary engagement with new or more fine-scale information on the specific ecosystem types that are being affected as a challenge within marine EIAs going forward. One possible opportunity to address this could be in the next iteration of the Mining and Biodiversity Guidelines (Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, and South African National Biodiversity Institute, 2013) by including a stronger focus on marine issues and management with specified guidelines on the appropriate level of biodiversity information required.

6.2.4 Types of Exploration Methods and Impacts

No clear relationship could be established between the types of exploration methods used in the projects (Table 6) and the biodiversity information selected for inclusion in the EMP (Table 7) despite the impacts of these activities (see **Table 1** and Appendix I). Data on marine ecosystems is sparse and expensive to collect, and as such it is not surprising that there was a large focus of exploration activities for South Africa on 2D seismic surveys (see **Table 6**) as these are the most inexpensive sampling method used in the marine environment. Mitigation recommendations for seismic surveys were focused on impacts to large marine fauna and the fisheries sector, with no mitigation recommendations put forward for seabed/benthic ecosystems. This could indicate the gap in understanding on how seismic surveys affect the benthic environment and the associated species. Physical damage as well as avoidance behaviour has been reported for some fish species at close range (McCauley et al. 2003). The EMPs all recommended soft-start booms to allow mobile animals in the area an opportunity to move away before each survey began. It is unclear if this mitigation method is effective for benthic mobile species and further studies are needed to assess the impact on behaviour of burrowing and sessile species, in addition to impacts on rare or vulnerable ecosystems such as cold water corals. As illustrated in Figure 21, the majority of the pelagic environment is considered Least Concern in South Africa. Impacts of exploration activities were not considered in the NBA 2011 due to the transient nature of these activities. Due to the large number of exploration applications utilising acoustic surveys in the marine environment, the SANBI may need to revisit the decision to exclude exploration activities from threat status analysis for the next NBA.

Impacts of seismic surveys on pelagic biodiversity are often rated as very low with only impacts to seabirds and turtles included in EMPs. Little attention is given to other organisms found in the water column, including larvae, plankton and fish despite recorded impacts and concerns for these taxa (See Table 1). As the sound source is submerged between 5-20m below the surface, the focus of seismic impacts is on the reflected sound once it has rebounded from the ocean surface (Dr Sue Horsefield – Supervisor : South Africa, North and East Africa Operations of Exxon Mobil, pers. comm.). This may suggest a 2-dimensional bias in the way in which industry and EAPs perceive the pelagic environment that leans toward impacts that can be viewed on the surface or upper waters of the water column only. This may account for the low significance of impacts attributed to seismic and sonar survey, and the lack of consideration for pelagic systems within EMPs. However, very little is understood of how suspended pelagic species that are at the mercy of the currents respond and/or are impacted upon by seismic booms. Further research is required to assess the impact this activity might have on fish recruitment of species that use currents as part of their

life-cycle, as this might have a negative impact on the sustainability of commercial fisheries (Dalen et al. 2007).

The lack of engagement within the fisheries specialist studies with any of the biodiversity products is also of concern, as sustainable fisheries rely heavily on functioning and well-managed ecosystems. It would therefore be expected that the fisheries specialist studies would have a deeper understanding of the OMPA, and further engagement with this sector is required to clarify why such low consideration is given for products that have such strong fisheries sustainability focus. The fishing industry and its Government department are considered the key interested and affected parties to be consulted as part of the EIA process (Atkinson and Sink 2008). As such, opportunities may exist outside the petroleum EIA sector to strengthen mainstreaming of biodiversity products that would still have an impact in the petroleum EIA sector through the public participation process. This will aid in encouraging appropriate biodiversity management of areas that provide ecosystem services that contribute to fisheries sustainability.

The seriousness of impacts of potentially destructive methods used in exploration is dependent upon the receiving environment. Concern has been raised in this study regarding the lack of consideration of impacts of exploration activities on Critically Endangered ecosystems, as evidenced by the lack of mitigation recommendations to avoid these ecosystems (see section 5.4). Due to the challenges related to in situ observation and monitoring of impacts and rates of recovery of deep sea ecosystems, the need for a deeper engagement with appropriate information before action is taken is especially important with regards to already threatened ecosystems. This illustrates the need to apply the precautionary approach when dealing with areas of high biodiversity value or concern to avoid unnecessary degradation of these areas.

6.2.5 Limited Number of EAPs

An unexpected finding of this research was the limited number of EAPs participating within the marine oil and gas sector, as well as the presence of only four specialist/consultants that were utilised in the preparation of specialist studies for the petroleum sector in general. Only one consultancy was used to comment on impacts to fisheries, and another to comment on impacts to marine fauna. This indicates a lack of human resource capacity in the broader marine biodiversity sector of South Africa that may present a challenge to effective management in the marine environment, reiterating the challenge of developing countries to implement EIAs effectively (Alshuwaikhat 2005). The implication is that only a single source capable of producing the requested specialist report exists, and that should the importance of ecosystem degradation and threat status be elevated in the petroleum EIA framework, the

competency of the specialist/consultant could be a limiting factor in properly assessing these impacts. This may also suggest that there is a lack of competitiveness within these knowledge arenas.

Van Reenen (2011) found that competition was necessary to improve the productivity and management of production sectors in the UK, and that to avoid problems such as collusion within a sector, government intervention was required to ensure that a sector was competitive. The lack of competition in the South African context in the biodiversity arena implies that there is a monopoly of the sector by individual consultancies making it uncompetitive and limiting the choice of specialists for EAPs. This highlights the need for capacity development to increase the human resource base necessary to achieve appropriate levels of competition (Folke et al. 2002). However, this might also present an opportunity for targeted mainstreaming of the selected biodiversity products as the limited number of specialists/consultants involved in specialist studies implies that interventions to improve the use of biodiversity products could be done fairly quickly with very little financial resources, as time and financial constraints are the main challenges to mainstreaming initiatives at SANBI due to the small Marine Programme.

RECOMMENDATIONS AND CONCLUSION

7.1 Recommendations:

The following recommendations have been identified that, if undertaken, would greatly serve to improve the ability of the SANBI to achieve influence in maritime development in general.

- Failure to utilise the existing legislative framework to improve the use of these products was put forward as a challenge to marine biodiversity management. SANBI should endeavour to work closely with the Dept. of Environmental Affairs to align the publication of these documents to ensure that the latest and most accurate information is included in the Government Gazette. Current marine and coastal threatened ecosystems should be included in the next iteration of the Government Notice for Listed Threatened Ecosystems to give effect to these products.
- Future national assessments should aim to align the process of ecosystem assessment publication with the legislative drafting process. This would assist in improving coordination between the government and biodiversity sector as well as ensure that the current list of threatened species included in the next General Notice is the most up to date and accurate list available.
- Owing to ethical considerations, the relationship of biodiversity information utilised and EAP competency was not investigated and could be considered as part of an audience targeting exercise.
- Further study is also required to assess the level of understanding of the EIA practitioners on how these products should be used in relation to project planning and mitigation which could in turn be used to inform the mainstreaming communication strategy for these products.
- This could also lead to more focussed revisions of the Mining and Biodiversity Guidelines that include specific details on the type of information that should be included when considering biodiversity impacts, and influence the improvement of the NBA to facilitate updating the map (Figure 5) in the Mining and Biodiversity Guidelines of biodiversity areas of high value or concern that pose a risk to the project plan that allows EAPs.
- Studies such as this one should be carried out at regular intervals to provide deeper insight into the level of effectiveness of biodiversity products to influence EIAs and

decision making to feed into an adaptive environmental management framework. This would assist in determining where mainstreaming is most needed and to what extent further training in the EIA sector is required. This will also provide insight into the types of products that are most useful as well as the best means of making them available.

- Mainstreaming of new biodiversity products should be included within the project design of national assessments and other marine biodiversity projects going forward.

Implementation of these recommendations would greatly improve the EIA process but the EIA process alone is insufficient in ensuring sustainable development. Integrated Marine Spatial Planning and a representative network of Marine Protected Areas in conjunction with a strengthened EIA system would provide the necessary framework to enable a sustainable ocean economy in South Africa.

7.2 Conclusion:

This study found that only the NSBA 2004 Bioregions map had acceptable levels of utilisation within EIAs for the petroleum sector. Very few EIAs used any of the maps for threat status. The OMPA map also showed low levels of use, and were often only included as contextual information as a future threat to project. Specialist studies on impacts to fisheries made no mention of the selected biodiversity information, whilst studies on impacts to marine fauna showed low levels of use for all products. This was attributed to the absence of habitat or ecosystem impacts within the terms of reference provided to specialists. Ultimately, no mitigation recommendations were detected that could be attributed to the selected biodiversity products. This study therefore determined that mainstreaming of these products was unsuccessful based on the apparent lack of influence that this information had on the project plan.

The SANBI Marine Programme has limited capacity with only two permanent staff members to address all the marine biodiversity issues for the country. Strategic intervention is therefore required to enable this small team to be as effective as possible at achieving SANBI's mandate in support of sustainable development. This initial study of the influence of SANBI's mainstreaming products in the pre-approval phase of the EIA decision-making framework has identified a gap in the understanding of the intention of biodiversity products within the environmental management decision-making framework. Further engagement is required to bridge this gap and enable a feedback loop between the biodiversity sector and industry to achieve a common understanding of the role of biodiversity assessments and spatial planning products in the EIA framework to support sustainable development into the

future. Implementation of the recommendations made in this study would greatly improve the EIA process but the EIA process alone is insufficient in ensuring sustainable development and should form part of a broader strategy to facilitate a sustainable ocean economy.

REFERENCES

- Adams AE, Nnawulezi NA, Vandenberg L. 2014. "Expectations to Change" (E2C): A Participatory Method for Facilitating Stakeholder Engagement With Evaluation Findings. *American Journal of Evaluation* **36**: 243-255.
- Adams WM. 2006. The Future of Sustainability: Re-thinking Environment and Development in the Twenty-first Century. Report of the IUCN Renowned Thinkers Meeting, 29-31 January 2006. Cambridge: The World Conservation Union.
- Allsopp M, Page R, Johnston P, Sanhillo D. 2009. *The State of the World's Oceans*. Springer Science: United Kingdom.
- Ambrose S, Huston T and Norman M. 2005. A Qualitative Method for Assessing Faculty Satisfaction. *Research in Higher Education* **46**: 803-830.
- Anstee-Wedderburn J. 2014. Giving a voice to future generations: Intergenerational equity, representatives of generations to come, and the challenge of planetary rights. *Australian Journal of Environmental Law* **1**: 37-69.
- April Y. 2012. An Analysis of the Mineral and Petroleum Resources Development Act 28 of 2002, and the Nationalisation of Minerals Debate in South Africa. *Africa Insight* **42**: 115-127.
- APSC (Australian Public Service Commission). 2007. *Changing Behaviour: A Public Policy Perspective*. Australia: Commonwealth of Australia.
- Arebo SG. 2005. *Improving Environmental Impact Assessment for Enhancing Sustainable Water Resources Developments in Ethiopia*. MSC thesis. Delft: UNESCO-IHE Institute of Water Education.
- Alshuwaikhat HM. 2005. Strategic environmental assessment can help solve environmental impact assessment failures in developing countries. *Environmental Impact Assessment Review* 25(4): 307-317.
- Aswani S, Lauer M. 2006. Incorporating Fishermen's Local Knowledge and Behavior into Geographical Information Systems (GIS) for Designing Marine Protected Areas in Oceania. *Human Organization* **65**: 81-102.
- Atkinson L, Sink K. 2008. *User profiles for the South African offshore environment*. Pretoria: South African National Biodiversity Institute.
- Atkinson L. 2013. Putting South Africa on the map in deep-sea research. SAEON eNews. Available at <http://www.saeon.ac.za/enewsletter/archives/2013/february2013/doc07> [Accessed on 30 August 2015]
- Ball IR, Possingham HP. 2000. *MARXAN (V1.8.2): Marine Reserve Design Using Spatially Explicit Annealing, a Manual. A Manual Prepared for The Great Barrier Reef Marine Park Authority*. Australia: The Great Barrier Reef Marine Park Authority.
- Bataineh RH. 2007. The effectiveness of the Environmental Impact Assessment (EIA) follow-up with regard to biodiversity conservation in Azerbaijan. *Management of Environmental Quality: An International Journal* **18**: 591 – 596.
- Baxter P and Jack S. 2008. Qualitative Case Study Methodology: Study Design and Implementation for Novice Researchers. *The Qualitative Report* **13**: 544-559.
- Benson C, Twigg J, Rossetto T. 2007. *Tools for Mainstreaming Disaster Risk Reduction: Guidance Notes for Development Organisations*. Geneva: ProVention Consortium.

BGIS. 2015. BGIS Profile. Available at <http://bgis.sanbi.org/website.asp> [Accessed on 30 August 2015]

Bona F, Badino G, Isaia M. 2006. Designing a “tailor-made” ecological network using geographical information systems. *Ecological Research* **21**: 605-610.

Bosselmann K. 2004. In search of global law: The significance of the Earth Charter. *Worldviews: Global Religions, Culture, and Ecology* **8**: 62-75.

Boyd SE, Rees HL. 2003. An examination of the spatial scale of impact on the marine benthos arising from marine aggregate extraction in the Central English Channel. *Estuarine, Coastal and Shelf Science* **57**: 1-16.

Bradshaw TK, Muller B. 1998. Impacts of Rapid Urban Growth on Farmland Conversion: application of New Regional Land Use Policy Models and Geographical Information Systems. *Rural Sociology* **63**: 1-25.

Branch G, Branch M. 1981. *The Living Shores of Southern Africa*. Struik Publishers: Cape Town.

Branch GM, Clarke BM. 2006. Fish stocks and their management: The changing face of fisheries in South Africa. *Marine Policy* **30**: 3–17.

Brown AP. 2010. Qualitative method and compromise in applied social research. *Qualitative Research* **10**: 229-248.

Brown Weiss E. 1992. Intergenerational equity: a legal framework for global environmental change IN: Brown Weiss E (ed) *Environmental change and international law: New challenges and dimensions*. Tokyo: United Nations University Press.

Brownlie, S. 2005. *Guideline for involving biodiversity specialists in EIA processes: Edition 1*. CSIR Report No ENV-S-C 2005 053 C. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town.

Burns M, Audoin M, Weaver A. 2006. Advancing sustainability science in South Africa. *South African Journal of Science* **102**: 379-384.

Canada (Federal, Provincial and Territorial Governments of Canada). 2010. *Canadian Biodiversity: Ecosystem Status and Trends 2010*. Ottawa: Canadian Councils of Resource Ministers.

Carlton JT. 1987. Patterns of transoceanic marine biological invasions in the Pacific Ocean. *Bulletin of Marine Science* **41**: 452-465.

Carter N. 2001. *The Politics of the Environment: Ideas, Activism, Policy*. Cambridge: Cambridge University Press.

Case JM, Light G. 2011. Emerging Methodologies in Engineering Education Research. *Journal of Engineering Education* **100**: 186-210.

Cawood FT. 2004. New South African Mineral and Petroleum Resources Development Act: Shaping a New Investment Environment to Reflect a Diverse Society. *Journal of Energy and Natural Resources Law* **22**: 121-147.

CBD (Convention on Biological Diversity). 2012. Strategic Plan for Biodiversity Targets: Aichi Biodiversity Targets. Available at <http://www.cbd.int/sp/targets/> [Accessed on 6 June 2014]

Celliers L, Breetzke T, Moore L, Malan D. 2009. *A User-friendly Guide to South Africa's Integrated Coastal Management Act*. The Department of Environmental Affairs and SSI Engineers and Environmental Consultants. Cape Town, South Africa.

- Chamber of Mines. 2013. Facts about South African Mining: Fact Sheet (August 2013). Chamber of Mines of South Africa.
- Chapman L, Thornes JE. 2003. The use of geographical information systems in climatology and meteorology. *Progress in Physical Geography* **27**: 313-330.
- Chaudhury M, Vervoort J, Kristjanson P, Ericksen P, Ainslie A. 2013. Participatory scenarios as a tool to link science and policy on food security under climate change in East Africa. *Regional Environmental Change* **13**: 389–398.
- Chothia SS. 2010. Mainstreaming environment and sustainability: an analysis of a master's in environmental science and a tree-planting project at Chancellor College, University of Malawi. *International Review of Education* **56**: 287 – 298.
- Christian JR, Bocking RC. 2010. Appendix D: Review of the effects of air gun sounds on marine invertebrates and fish. Programmatic EIS/OEIS NSF-Funded Marine Seismic Research.
- Clarke RB. 1984. Impact of oil pollution on seabirds. *Environmental Pollution* **33**: 1-22.
- Cohen B. 2010. A guidance framework for mainstreaming resource efficiency and sustainable consumption and production in a developing country context. *Environment, Development and Sustainability* **12**:1051–1068.
- COMEST (World Commission on the Ethics of Scientific Knowledge and Technology). 2005. The Precautionary Principle. Paris: United Nations Educational, Scientific and Cultural Organization.
- Conlin S, Stirrat RL. 2008. Current Challenges in Development Evaluation. *Evaluation* **14**: 193-208.
- Costanza R, d'Arge R, de Groot R, Farber S, Grasso M, Hannon B, Limburg K, Naeem S, O'Neill RV, Paruelo J, Raskin RG, Sutton P, van den Belt M. 1997. The value of the world's ecosystem services and natural capital. *Nature* **387**: 253-260.
- Cousin G. 2009. *Researching learning in higher education: An introduction to contemporary methods and approaches*. New York: Routledge.
- Coutts A, Taylor M, Hewitt C. 2007. Novel method for assessing the en route survivorship of biofouling organisms on various vessel types. *Marine Pollution Bulletin* **54**: 97-116.
- Cranford PJ, Gordon DC, Lee K, Armsworthy SL, Tremblay GH. 1999. Chronic toxicity and physical disturbance effects of water- and oil-based drilling fluids and some major constituents on adult sea scallops (*Placochelys magellanicus*). *Marine Environmental Research* **48**: 225- 256.
- Crawford RJM, Davis SA, Harding R, Jackson LF, LeshoroTM, Meyer MA, Randal, RM, Underhil, LG, Upfold L, Van Dalsen AP, Van der Merwe E, Whittington PA, Williams AJ, Wolfaart AC. 2000. Initial impact of the Treasure oil spill on seabirds off western South Africa. *South African Journal of Marine Science* **22**: 157-176.
- Cresswell JW and Miller GA. 1997. Research Methodologies and the Doctoral Process. *New Directions for Higher Education* **99**: 33-46.
- Currie DR, Isaacs LR. 2005. Impact of exploratory offshore drilling on benthic communities in the Minerva gas field, port Campbell, Australia. *Marine Environmental Research* **59**: 217-233.
- Daan R, Mulder M. 1996. On the short-term and long-term impact of drilling activities in the Dutch sector of the North Sea. *ICES Journal of Marine Science* **53**: 1036–1044.
- Daan R, Van Het Groenewoud H, de Jong SA, Mulder M. 1992. Physico-chemical and biological features of a drilling site in the North Sea, 1 year after discharges of oil-contaminated drill cuttings. *Marine Ecology Progress Series* **91**: 37-45.

DAFF (Department of Agriculture, Forestry and Fisheries). 2012. Policy for the Small Scale Fisheries Sector in South Africa. Government Notice No. 474. Government Gazette, South Africa (35455).

Dalal-Clayton B, Bass S. 2009. The challenges of environmental mainstreaming: Experience of integrating environment into development institutions and decisions. Environmental Governance No. 3. International Institute for Environment and Development. London.

Dalen J, Dragsun E, Næss A, Sand O. 2007. Effects of seismic surveys on fish, fish catches and sea mammals. Report prepared for Cooperation group - Fishery Industry and Petroleum Industry. Report no.: 2007-0512.

Dalen J, Knutsen GM. 1987. Scaring effects in fish and harmful effects on eggs, larvae and fry by offshore seismic explorations. In: Merklinger. H.M.ed: *Progress in Underwater Acoustics*. New York: Plenum Press.

Dalen J, Mæsted K. 2008. The impact of seismic surveys. *Marine Research News* 5.

Dansen E (ed). 2005. Geotechnical and Geophysical Investigations for Offshore and Nearshore Developments. Prepared for the International Society for Soil Mechanics and Geotechnical Engineering.

Davies JM, Hardy R, McIntyre AD. 1981. Environmental effects of North Sea oil operations. *Marine Pollution Bulletin* 12: 412-416.

DBSA (Development Bank of Southern Africa). 2008. What Works For Us: A South African Country Report on Tactics, Tools and Methods for Integrating Environment and Development. (A South African case study in partnership with the IIED). South Africa: Development Bank of Southern Africa.

de Jager P. 2001. Resistance to change: A new view of an old problem. *The Futurist* 35: 24-27.

De Villiers C, Brownlie S, Manuel J. 2008. 'Biodiversity Mainstreaming' and EIA: Art, Science or Myth? IAIA08 Conference Proceedings', The Art and Science of Impact Assessment 28th Annual Conference of the International Association for Impact Assessment, 4-10 May 2008, Perth Convention Exhibition Centre, Perth, Australia (www.iaia.org).

DEAT (Department of Environmental Affairs and Tourism). 2004a. Overview of Integrated Environmental Management, Information Series 0. Pretoria: Council for Scientific and Industrial Research.

DEAT (Department of Environmental Affairs and Tourism). 2004b. Strategic Environmental Assessment, Integrated Environmental Management, Information Series 10. Pretoria: Department of Environmental Affairs and Tourism.

DEAT (Department of Environmental Affairs and Tourism). 2007. Environmental Governance in South Africa IN South Africa Environmental Outlook – A Report on the State of the Environment. DEAT: Pretoria. Pp 53-85.

DEAT (Department of Environmental Affairs and Tourism). 2008. *People - Planet - Prosperity: A National Framework for Sustainable Development in South Africa*. Pretoria: Republic of South Africa.

DEFRA (Department for Environment, Food and Rural Affairs). 2014. *Biodiversity 2020: a strategy for England's wildlife and ecosystem services: Indicators summary*. London: Department for Environment, Food and Rural Affairs of the United Kingdom.

Denny P. 2001. Research, capacity-building and empowerment for sustainable management of African wetland ecosystems. *Hydrobiologia* 458: 21–31.

Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, and South African National Biodiversity Institute, 2013. Mining and Biodiversity Guideline: Mainstreaming biodiversity into the mining sector. Pretoria.

Department of Mineral Resources. 2011. A Guideline for a Mining Work Programme to Submitted for Applications for a Mining Right in terms of the Mineral and Petroleum Resources Development Act, 2002, (Act No 28 of 2002). DMR: Pretoria.

Doran P. 2002. World Summit on Sustainable Development (Johannesburg) – An assessment for IISD. Briefing Paper prepared for the International Institute of Sustainable Development. Available at http://www.iisd.org/pdf/2002/wssd_assessment.pdf [Accessed on 21 October 2015]

Dow FK, Davies JM, Raffaelli D. 1990. The effect of drilling cuttings on a model marine sediment system. *Marine Environmental Research* **29**: 103-124.

Downs TJ. 2001. Making Sustainable Development Operational: Integrated Capacity Building for the Water Supply and Sanitation Sector in Mexico. *Journal of Environmental Planning and Management* **44**: 525–544.

Drexhage J, Murphy D. 2010. Sustainable Development: From Brundtland to Rio 2012. Background Paper* prepared for consideration by the High Level Panel on Global Sustainability at its first meeting, 19 September 2010. Available at http://www.un.org/wcm/webdav/site/climatechange/shared/gsp/docs/GSP1-6_Background%20on%20Sustainable%20Devt.pdf [Accessed on 30 September 2015]

Driver A, Maze K, Rouget M, Lombard AT, Nel J, Turpie JK, Cowling RM, Desmet P, Goodman P, Harris J, Jonas Z, Reyers B, Sink K, Strauss T. 2005. National Spatial Biodiversity Assessment 2004: priorities for biodiversity conservation in South Africa. *Strelitzia* **17**. South African National Biodiversity Institute, Pretoria.

Driver A, Sink KJ, Nel JN, Holness S, Van Niekerk L, Daniels F, Jonas Z, Majiedt PA, Harris L, Maze K. 2012. *National Biodiversity Assessment 2011: An assessment of South Africa's biodiversity and ecosystems. Synthesis Report*. South African National Biodiversity Institute and Department of Environmental Affairs, Pretoria.

Driver M. 2005. South Africa's First National Spatial Biodiversity Assessment. *Veld & Flora* **91**: 11.

Driver, A, Maze, K, Rouget, M, Lombard, AT, Nel, J, Turpie, JK, Cowling, RM, Desmet, P, Goodman, P, Harris, J, Jonas, Z, Reyers, B, Sink, K & Strauss, T. 2005. National Spatial Biodiversity Assessment 2004: Priorities for Biodiversity Conservation in South Africa. *Strelitzia* **17**. Pretoria: South African National Biodiversity Institute.

Dunaway ME, Schroeder P. 1988. Minimising anchoring impacts during construction of offshore oil and gas facilities. Oceans '88 Conference and Exhibition, Baltimore.

Earth Charter International. 2012a. South Africa. Available at <http://www.earthcharterinaction.org/content/categories/Countries/South-Africa/#>. [Accessed on 2 June 2015]

Earth Charter International. 2012b. History. Available at <http://www.earthcharterinaction.org/content/pages/History.html>. [Accessed on 2 June 2015]

ECORYS. 2014. Study to investigate state of knowledge of deep sea mining. Final report Annex 4 Technology Analysis (FWC MARE/2012/06 – SC E1/2013/04). Prepared for the DG Maritime Affairs and Fisheries.

Edwards M, Helaouet P, Johns DG, Batten S, Beaugrand G, Chiba S, Hall J, Head E, Hosie G, Kitchener J, Koubbi P, Kreiner A, Melrose C, Pinkerton M, Richardson AJ, Robinson K, Takahashi K, Verheye HM, Ward P, Wootton M. 2014. Global Marine Ecological Status Report: results from the

global CPR survey 2012/2013. *SAHFOS Technical Report 10*: 1-37. Plymouth: Sir Alister Hardy Foundation for Ocean Science.

EHP (Department of Environment and Heritage Protection of Australia). 2014. Biodiversity Assessment and Mapping Methodology. Version 2.2. Brisbane: Department of Environment and Heritage Protection.

ELAW (Environmental Law Alliance Worldwide). 2010. *Guidebook for Evaluating Mining Project EIAs*. Environmental Law Alliance Worldwide: USA.

Elliott L. 2004. From Stockholm to Rio to Johannesburg IN *The Global Politics of the Environment*. New York: New York University Press..

Elmgren R, Hansson S, Larsson U, Sundelin B, Boehm PD. 1983. The Tsesis oil spill: acute and long-term impact on benthos. *Marine Biology* **73**: 51-65.

Emery BM, Washburn L, Love M, Nishimoto MM, Carter Ohlmann J. 2006. Do oil and gas platforms off California reduce recruitment of bocaccio (*Sebastes paucispinis*) to natural habitat? An analysis based on trajectories derived from high frequency radar. *Fishery Bulletin* **104**: 391-400.

Engås A, Løkkeborg S, Ona E, Soldal AV. 1996. Effects of seismic shooting on local abundance and catch rates of cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*). *Canadian Journal of Fisheries and Aquatic Sciences* **53**: 2238-2249.

Engås A, Løkkeborg S. 2002. Effects of seismic shooting and vessel-generated noise on fish behaviour and catch rates. *Bioacoustics: The International Journal of Animal Sound and its Recording* **12**: 2-3.

EPA Australia 1995. International Study on the Effectiveness of Environmental Assessment. Canberra, Australia: Environment Protection Agency.

Erwood S (ed). *The Greenpeace Chronicles: 40 Years of Protecting the Planet*. Amsterdam: Greenpeace International.

ESRI. 2015. What is GIS?. ESRI website. Available at <http://www.esri.com/what-is-gis> [Accessed on 30 August 2015]

Essl F, Bacher S, Blackburn TM, Booy O, Brundu G, Brunel S, Cardoso AC, Eschen R, Gallardo B, Galil B, García-Berthou E, Genovesi P, Groom Q, Harrower C, Hulme PE, Katsanevakis S, Kenis M, Kühn I, Kumschick S, Martinou AF, Nentwig W, O'Flynn C, Pagad S, Pergl J, Pyšek P, Rabitsch W, Richardson DM, Roques A, Roy HE, Scalera R, Schindler S, Seebens H, Vanderhoeven S, Vilà M, Wilson JRU, Zenetos A, Jeschke JM. 2015. Crossing Frontiers in Tackling Pathways of Biological Invasions. *BioScience* DOI:10.1093/biosci/biv082

Falk MR, Lawrence MJ. 1973. Seismic exploration: its nature and effects on fish. Canada Technical Report Series No. CEN/T-73-9. Department of Environment, Fisheries and Marine Service, Resource Management Branch, Fisheries Operations Directorate, Central Region (Environment), Winnipeg, MB.

Ferris LA. 2010. The Role of Good Environmental Governance in the Sustainable Development of South Africa. *Potchefstroom Electronic Law Journal* **13**: 73-99.

Fisher AT, Harris RN. 2010. Using seafloor heat flow as a tracer to map subseafloor fluid flow in the ocean crust. *Geofluids*: DOI: 10.1111/j.1468-8123.2009.00274

Folke C, Carpenter S, Elmqvist T, Gunderson L, Holling CS, Walker B. 2002. Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations. *Ambio* **31**: 437-440.

Foster BA, Willan RC. 1979. Foreign barnacles transported to New Zealand on an oil platform. *New Zealand Journal of Marine and Freshwater Research* **13**: 143-149.

Frélichová J, Vačkář D, Pártl A, Loučková B, Harmáčková ZV, Lorencová E. 2014. Integrated assessment of ecosystem services in the Czech Republic. *Ecosystem Services* **8**: 110–117.

Furter L. 2003. Sustainable development debate: environment. *IMIESA* **28**: 51, 53.

GAUSLAND I. 2003. Seismic surveys impact on fish and fisheries. Report for Norwegian Oil Industry Association (OLF). Stavanger. Norway.

George C. 1992. Sustainable Development and Global Governance. *The Journal of Environment & Development* **16**: 102-125.

Geriner L. 2007. Putting Canada on the Map. The Globe and Mail. Available at <http://www.theglobeandmail.com/technology/putting-canada-on-the-map/article1092101/> [Accessed on 30 August 2015]

GISP (Global Invasive Species Program). 2008. Marine Biofouling - An Assessment of Risks and Management Initiatives. Compiled by Lynn Jackson on behalf of Global Invasive Species Program and the UNEP Regional Seas Programme.

Glassner MI. 1986. The new political geography of the sea. *Political Geography Quarterly* **5**: 6-8.

Glazewski J, Haward M. 2005. Towards Integrated Coastal Area Management: A Case Study in Co-operative Governance in South Africa and Australia. *The International Journal of Marine and Coastal Law* **20**: 65-84.

Glazewski J. 1993. Environmental provisions in a new South African Bill of Rights. *Journal of African Law* **37**: 177-184.

Godwin L. 2003. Hull Fouling of Maritime Vessels as a Pathway for Marine Species Invasions to the Hawaiian Islands. *Biofouling* **19**: 123-131.

Gomes EG, Lins MPE. 2002. Integrating Geographical Information Systems and Multi-Criteria Methods: A Case Study. *Annals of Operations Research* **116**: 243–269.

Government of South Africa. 2010. *South African National Protected Area Expansion Strategy: priorities for expanding the protected area network for ecological sustainability and climate change adaptation*. Pretoria: Government of South Africa.

Grant JS, Briggs AD. 2002. Toxicity of sediments from around a North Sea oil platform: are metals or hydrocarbons responsible for ecological impacts? *Marine Environmental Research* **53**: 95-116.

Grant JS, Briggs AD. 2002. Toxicity of sediments from around a North Sea oil platform: are metals or hydrocarbons responsible for ecological impacts? *Marine Environmental Research* **53**: 95-116.

Gray J, Clarke KR, Warwick RM, Hobbs G. 1990. Detection of initial effects of pollution on marine benthos: an example from the Ekofisk and Eldfisk oilfields, North Sea. *Marine Ecology Progress Series* **66**: 285-299.

Gray JS, Bakke T, Beck HJ, Nilssen I. 1999. Managing the environmental effects of the Norwegian oil and gas industry: from conflict to consensus. *Marine Pollution Bulletin* **38**: 525-530.

Green Flash. 2012. Green Flash Prospecting Application - WC 30/5/1/1/2/10023 PR

Griggs D, Stafford-Smith M, Gaffney O, Rockström J, Öhman MC, Shyamsundar P, Steffen W, Glaser G, Kanie N, Noble I. 2013. Sustainable development goals for people and planet. *Nature* **495**: 305-307.

Grove RH. 1992. Origins of Western Environmentalism. *Scientific American* **267**: 42-47.

Haas P, Levy M, Parson T. 1992. Appraising the Earth Summit: How should we judge UNCED's success? *Environment* **34**: 6-33.

Hall SJ. 1994. Physical disturbance and marine benthic communities: Life in unconsolidated sediments. *Oceanography and Marine Biology: An Annual Review* **32**: 179-239.

Hall SJ. 2001. Is offshore oil exploration good for benthic conservation? *Trends in Ecology and Evolution* **16**: 58.

Hallatt TW, Retief FP, Sandham LA. 2015. The Quality of Biodiversity Inputs to EIA in Areas with High Biodiversity Value — Experience from the Cape Floristic Region, South Africa. *Journal of Environmental Assessment Policy and Management* **17**:1550025. DOI:10.1142/S1464333215500258

Halpern BS, Kappel CV, Selkoe KA, Micheli F, Ebert CM, Kontgis C, Crain CM, Martone R, Shearer C, Teck SJ. 2009. Mapping cumulative human impacts to California Current marine ecosystems. *Conservation Letters* **2**: 138-148.

Halpern BS, Walbridge, S, Selkoe KA, Kappel CV, Micheli F, D'Agrosa C, Bruno JF, Casey KS, Ebert C, Fox HE, Fujita R, Heinemann D, Lenihan HS, Madin EMP, Perry MT, Selig ER, Spalding M, Steneck R, Watson R. 2008. A global map of human impact on marine ecosystems. *Science* **319**: 948-952.

Harmer C. 2005. Is Improving the Effectiveness of Environmental Impact Assessment in the UK Dependent on the Use of Follow-up? Views of Environmental Consultants. Masters Thesis. University of East Anglia: School of Environmental Sciences

Harrison M, Baker J, Twinamatsiko M, Milner-Gulland EJ. 2015. Profiling unauthorized natural resource users for better targeting of conservation interventions. *Conservation Biology*. DOI: 10.1111/cobi.12575.

Hassel A, KnutsentT, Dalen J, Skaar K, Løkkeborg S, MISDUND OA, OSTENSEN O, FONN M, HAUGLAND EK. 2004. Influence on seismic shooting on the lesser sand eel (*Ammodytes marinus*). *ICES Journal of Marine Science* **61**: 1165 – 1173.

Hastings MC. 1990. Effects of underwater sound on fish. Document No. 46254-900206-01IM, Project No. 401775-1600, AT&T Bell Laboratories.

Hawkins A, Popper A. 2014. Assessing the Impact of Underwater Sounds on Fishes and Other Forms of Marine Life. *Acoustics Today* **10**: 30-41.

Hey 1993. The Precautionary Principle. *Marine Pollution Bulletin* **26**: 53–54.

Hirst AG, Rodhouse PG. 2000. Impacts of geophysical seismic surveying on fishing success. *Reviews in Fish Biology and Fisheries* **10**: 113-118.

Holdway DA. 2002. The acute and chronic effects of wastes associated with offshore oil and gas production on temperate and tropical marine ecological processes. *Marine Pollution Bulletin* **44**: 185-203.

Hopkins GA, Forest BM. 2010. A preliminary assessment of biofouling and non-indigenous marine species associated with commercial slow-moving vessels arriving in New Zealand. *Biofouling* **26**: 613–621.

Hsieh H and Shannon SE. 2005. Three Approaches to Qualitative Content Analysis. *Qualitative Health Research* **15**: 1277-1288.

- Hughes A, Dann S. 2009. Political marketing and stakeholder engagement. *Marketing Theory* **9**: 243-256.
- Hulme PE. 2009. Trade, transport and trouble: managing invasive species pathways in an era of globalization. *Journal of Applied Ecology* **46**: 10–18.
- Humby T. 2009. The black sheep comes home – incorporating mining into the Environmental Impact Assessment Regime under the National Environmental Management Act, 1998. *South Africa Public Law* **29**: 1-32.
- Hunter Q. 2015. ANC squirms over voter discontent. Mail & Guardian. Available at <http://mg.co.za/article/2015-07-30-anc-squirms-over-voter-discontent> [Accessed on 30 September 2015]
- Hyett N, Kenny A, Dickinson-Swift V. 2014. Methodology or method? A critical review of qualitative case study reports. *International Journal of Qualitative Studies on Health and Well-being* **9**: 23606.
- Hyland J, Hardin D, Steinhauer M, Coats D, Green RH, Neff J. 1994. Environmental impact of offshore oil development on the outer continental shelf and slope off Point Arguello, California. *Marine Environmental Research* **37**: 195-229.
- Ijeoma EOC. 2010. Mainstreaming Government-wide Monitoring And Evaluation Policy in South Africa: An Eye on Impact Assessment. *Journal of Public Administration* **45**: 344-360.
- Jonas Z, Daniels F, Driver A, Malatji KN, Dlamini M, Malebu T, April V, Holness S. 2012. National Biodiversity Assessment 2011: Technical Report. Volume 1: Terrestrial Component. South African National Biodiversity Institute, Pretoria.
- Joyce K. 2009. “To me it’s just another tool to help understand the evidence”: Public health decision-makers’ perceptions of the value of geographical information systems (GIS). *Health & Place* **15**: 831-840.
- Kantor B. 2013. How important is mining to the SA Economy. It depends on how you measure it. ZAEconomist.com. Available at <http://www.zaeconomist.com/sa-economy/how-important-is-mining-to-the-sa-economy-it-depends-on-how-you-measure-it/> [Accessed on 17 July 2014]
- Karnauskas M, Schirripa MJ, Kelble CR, Cook GS, Craig JK (eds.). 2013. Ecosystem status report for the Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFSC-653. Miami, FL: US Department of Commerce.
- Kerr RA, Kintisch E, Schenkman L, Stokstad E. 2010. Five questions on the spill. *Science* **328**: 962-963.
- Khan F. 2002. The Roots of Environmental Racism and the Rise of Environmental Justice in the 1990s IN McDonald DA (ed) *Environmental Justice in South Africa*. Cape Town: UCT Press.
- Kingston PF. 1992. Impact of offshore oil production installations on the benthos of the North Sea. *ICES Journal of Marine Science* **49**: 45-53.
- Kingston PF. 2002. Long-term environmental impact of oil spills. *Spill Science and Technology Bulletin* **7**: 53-61.
- Kloff S, Wicks C. 2004. Environmental management of offshore oil development and maritime oil transport. A background document for stakeholders of the West African Marine Eco Region. IUCN Commission on Environmental, Economic and Social Policy. 73 pp.
- Kochin BF, Levin PS. 2004. Publication of marine conservation papers: is conservation biology too dry? *Conservation Biology* **18**: 1160-1162.

- Lavendal B. 2002. Planning with nature: recent advances in geographical information systems (GIS) hardware and software are allowing planners to utilize a wide range of natural resource information for land use planning. *Journal of Soil and Water Conservation* **57**: 116A.
- Lebel L, Wattana S, Talerngrsi P. 2015. Assessments of ecosystem services and human well-being in Thailand build and create demand for coproductive capacity. *Ecology and Society* **20**: 12.
- Lewis PN, Bergstorm DM, Whinam J. 2006. Barging in: a temperate marine community travels to the subantarctic. *Biological Invasions* **8**: 787-795.
- Liu YB, Gebremeskel S, De Smedt F, Hoffmann L, Pfister L. 2006. Predicting storm runoff from different land-use classes using a geographical information system-based distributed model. *Hydrological Processes* **20**: 533-548.
- Løkkeborg S, Soldal AV. 1993. The influence of seismic exploration with air guns on cod behaviour (*Gadus morhua*) and catch rates. *ICES Marine Science Symposium* **196**:62-67.
- Løkkeborg S. 1991. Effects of geophysical survey on catching success in long-line fishing. Paper presented at the International Council for Exploration of the Sea (ICES) Annual Science Conference. ICES CM B **40**:1-9.
- Lombard AT, Strauss T, Harris J, Sink K, Attood C, Hutchings L. 2005. South African National Spatial Biodiversity Assessment 2004: Technical Report. Volume 4: Marine Component. Pretoria: South African National Biodiversity Institute.
- LRC (Legal Resources Centre). 2012. Annual Report 2011-12. Johannesburg: The Legal Resources Centre.
- Lumby A. 2010. Government and sustainable development in South Africa: The environmental legislative framework in historical context. *South African Journal of Economic History* **20**: 65-82.
- Mackay F, Bilton K. 2003. Learning from Experience: Lessons in Mainstreaming Equal Opportunities. Edinburgh: Scottish Executive of Social Research.
- Margules CR, Pressey RL. 2000. Systematic conservation planning. *Nature* **405**: 243-253.
- Masilela J. 2015. More to Brits protests than meets the eye. Mail & Guardian. Available at <http://mg.co.za/article/2015-03-19-more-to-brits-protests-than-meets-the-eye> [Accessed on 30 September 2015]
- Mayring P. 2014. Qualitative content analysis: theoretical foundation, basic procedures and software solution. Klagenfurt. Available at <http://nbn-resolving.de/urn:nbn:de:0168-ssoar-395173> [Accessed on 30 June 2014]
- Mbatha P, Wynber R. Chapter 4: Mining and the myth of benefits in South African rural communities IN Wynberg R, Hauck M (eds) Sharing Benefits from the Coast. Cape Town: UCT Press.
- McCauley RD, Fewtrell J, Duncan AJ, Jenner C, Jenner MN, Penrose JD, Prince RIT, Adhitya A, Murdoch J, McCabe K. 2000. Marine seismic surveys – A study on environmental implications. *APPEA Journal* **2000**: 692-780.
- McCauley RD, Fewtrell J, Popper AN. 2003. High intensity anthropogenic sound damages fish ears. *Journal of the Acoustic Society of America* **113**: 1-5.
- McKenzie E, Posner S, Tillmann P, Bernhardt JR, Howard K, Rosenthal A. 2014. Understanding the use of ecosystem service knowledge in decision making: lessons from international experiences of spatial planning. *Environment and Planning C: Government and Policy* **32**: 320 – 340.

Menge BA, Chan F, Dudas S, Eerkes-Medrano D, Grorud-Colvert K, Heiman K, Hessing-Lewis M, Iles A, Milston-Clements R, Noble M, Page-Albins K, Richmond E, Rilov G, Rose J, Tyburczy J, Vinueza L, Zarnetske P. 2009. Terrestrial ecologists ignore aquatic literature: Asymmetry in citation breadth in ecological publications and implications for generality and progress in ecology. *Journal of Experimental Marine Biology and Ecology* **377**: 93–100.

Millennium Project. 2006. What they are: Millennium Development Goals. Available at <http://www.unmillenniumproject.org/goals/index.htm>. [Accessed on 2 June 2015]

Moon G. 2007. *Social Impact Assessment*. Enviropaedia. Available at http://www.enviropaedia.com/topic/default.php?topic_id=216. [Accessed on 18 August 2013].

Montagna PA, Harper DE. 1996. Benthic infaunal long term response to offshore production platforms in the Gulf of Mexico. *Canadian Journal of Fisheries and Aquatic Sciences* **53**: 2567-2588.

Munslow B, Fitzgerald P. 1994. South Africa: the sustainable development challenge. *Third World Quarterly* **15**: 227-242.

Naess A. 1973. The shallow and the deep, long-range ecology movement. A summary. *Inquiry* **16**: 95-100.

Naidoo S. 2014. A Discussion Transitional Provisions of the National Environmental Management Act, 1998 and Mineral and Petroleum Resources Development Act, 2002 Amendment Act. Environmental Law E-Bulletin – Werkmans Attorneys. Available at http://www.werkmans.com/virt_e_bulletins/discussion-transitional-provisions-national-environmental-management-act-1998-mineral-petroleum-resources-development-act-2002-amendment-acts/ [Accessed on 23 August 2015]

Naude B. 2002. Crimes Against the Environment. *Acta Criminologica* **15**: 21-38.

NCP (National Planning Commission). 2011 National Development Plan: Vision for 2030. Published by the Department of the Presidency of South Africa.

Neff JM, Bothner MH, Maciolek NJ, Grassle JF. 1989. Impacts of exploratory drilling for oil and gas on the benthic environment of Georges Bank. *Marine Environmental Research* **27**: 77-114.

Nel JL, Driver A. 2012. South African National Biodiversity Assessment 2011: Technical Report. Volume 2: Freshwater Component. CSIR Report Number CSIR/NRE/ECO/IR/2012/0022/A, Council for Scientific and Industrial Research, Stellenbosch.

Nel J, Maree G, Roux D, Moolman J, Kleynhans N, Silberbauer M, Driver A. 2004. South African National Spatial Biodiversity Assessment 2004: Technical Report. Volume 2: River Component. CSIR Report Number ENV-S-I-2004-063. Stellenbosch: Council for Scientific and Industrial Research.

New LF, Clark JS, Costa DP, Fleishman E, Hindell MA, Klanjcek T, Lusseau D, Kraus S, McMahon CR, Robinson PW, Schick RS, Schwarz LK, Simmons SE, Thomas L, Tyack P, Harwood J. 2014. Using short-term measures of behaviour to estimate long-term fitness of southern elephant seals. *Marine Ecology Progress Series* **496**: 99-108.

Newell RC, Seiderer LJ, Hitchcock DR. 1998. The impact of dredging works in coastal waters: A review of the sensitivity to disturbance and subsequent recovery of biological resources on the sea bed. *Oceanography and Marine Biology: An Annual Review* **36**: 127-178.

Newmont. 2012. Mining 101: Understanding the Different Phases of Mine Operations. Newmont website. Available at <http://www.newmont.com/our-voice/post/mining-101-understanding-different-phases-mine-operations> [Accessed on 17 July 2014]

Niu F, Liu Z, Wen H, Xu D, Yang Y. 2012. Behavioural responses of two captive bottlenose dolphins (*Tursiops truncatus*) to a continuous 50 kHz tone. *Journal of the Acoustical Society of America* **131**: 1643-1649.

NIWA (National Institute of Water and Atmospheric Research). 2005. How do we map the seafloor? NIWA website. Available at <http://www.niwa.co.nz/coasts-and-oceans/faq/how-do-we-map-the-seafloor>. [Accessed on 18 July 2014]

Njie B and Asimiran S. 2014. Case Study as a Choice in Qualitative Methodology. *Journal of Research & Method in Education* **4**: 35-40.

NOAA (National Oceanic and Atmospheric Administration). 2012. Ecosystem Status Report for the Northeast Shelf Large Marine Ecosystem - 2011. Northeast Fisheries Science Center Reference Document 12-07. Woods Hole, MA: US Department of Commerce.

Nounou P. 1980. The Oil Spill Age: Fate and Effects of Oil in the Marine Environment. *Ambio* **9**: 297-302.

O'Brien PE, Arnt W, Everson I, Gohl K, Gordon JCD, Goss C, Kremser U, Laws R, Martin T, Ploetz J, Rodhouse PG, Rogers T, Thompson D, Sexton M, Wilson R, Woehler E. 2002. Impacts of marine acoustic technology on the Antarctic environment. SCAR Ad Hoc Group on marine acoustic technology and the environment.

Olesiuk PF, Nichol LM, Sowden MJ, Ford JKB. 2002. Effect of the sound generated by an acoustic harassment device on the relative abundance and distribution of harbor porpoises, *Phocoena phocoena* in Retreat Passage, British Columbia. *Marine Mammal Science* **18**: 843-862.

Olsgard F, Gray JS. 1995. A comprehensive analysis of the effects of offshore oil and gas exploration and production on the benthic communities of the Norwegian continental shelf. *Marine Ecology Progress Series* **122**: 277-306.

Operation Phakisa: Marine Protection Services and Governance Lab. 2014. Unlocking the Economic Potential of South Africa's Oceans Marine Protection Services and Governance Final Lab Report. Durban: Government of South Africa.

Operation Phakisa: Oil and Gas Lab. 2014. Unlocking the Economic Potential of South Africa's Oceans - Offshore Oil and Gas Exploration Final Lab Report. Durban: Government of South Africa.

Oxford Dictionaries. 2015. Mainstream - definition of mainstream in English from the Oxford dictionary. Available at <http://www.oxforddictionaries.com/definition/english/mainstream> [Accessed on 10 March 2015]

Page HM, Dugan JE, Culver CS, Hoesterey JC. 2006. Exotic invertebrate species on offshore oil platforms. *Marine Ecology Progress Series* **325**: 101-107.

ParkSeismic. 2007. What is seismic survey? ParkSeismic.com. Available at <http://parkseismic.com/Whatisseismicssurvey.html>. [Accessed on 20 August 2014]

PASA. 2013. <http://www.petroileumagencysa.com/index.php/home-13/overview> (accessed 20 June 2014)

Penrose JD, Siwabessy PJW, Gavrilov A, Parnum I, Hamilton LJ, Bickers A, Brooke B, Ryan DA, Kennedy P. 2005. Acoustic Techniques for Seabed Classification. Technical Report 32. Australia: Cooperative Research Centre for Coastal Zone Estuary and Waterway Management.

Petersen C, Huntley B. 2005. *Mainstreaming Biodiversity in Production Landscapes: Working Paper 20*. Global Environment Facility: Washington D.C., USA.

Peterson CH, Rice SD, Short JW, Esler D, Bodkin JL, Ballachey BE, Irons DB. 2003. Long-term ecosystem response to the Exxon Valdez oil spill. *Science* **302**: 2082–2086.

PICC (Presidential Infrastructure Coordinating Commission). 2012. A Summary of the South African National Infrastructure Plan. PICC Secretariat: Pretoria.

Pimentel D, Wilson C, McCullum C, Huang R, Dwen P, Flack J, Tran Q, Saltma T, Barbara Cliff B. 1997. Economic and Environmental Benefits of Biodiversity. *BioScience* **47**: 747-757.

Ponti M, Abbiati M, Ugo Ceccherelli V. 2002. Drilling platforms as artificial reefs: distribution of macrobenthic assemblages of the “Paguro” wreck (northern Adriatic Sea). *ICES Journal of Marine Science* **59**: S316-S323.

Popper AN, Fewtrell J, Smith ME, McCauley RD. 2004. Anthropogenic sound: effects on the behavior and physiology of fishes. *The Marine Technology Society Journal* **37**: 35–40.

Popper AN, Smith ME, Cott PA, Hanna BW, MacGillivray AO, Austin ME, Mann DA. 2005. Effects of exposure to seismic airgun use on hearing of three fish species. *Journal of the Acoustical Society of America* **117**: 3958–3971.

Popper AN, Smith ME, Cott PA, Hanna BW, Macgillivray AO, Austin ME, Mann DA. 2005. Effects of exposure to seismic airgun use on hearing of three fish species. *Journal of the Acoustic Society of America* **117**(6): 3958-3971.

Possingham HP, Ball IR, Andelman S. 2000. Mathematical methods for identifying representative reserve networks. In: Ferson S, Burgman M (eds), *Quantitative Methods for Conservation Biology*. New York: Springer.

Pressey RL. 1999. Applications of irreplaceability analysis to planning and management problems. *Parks* **9**: 42-51.

Prieur D. 14997. Editorial. *Biodiversity and Conservation* **6**(11): R1-R2.

Prip C, Gross T, Johnston S, Vierros M. 2010. Biodiversity Planning: an assessment of national biodiversity strategies and action plans. Yokohama: United Nations, University Institute of Advanced Studies.

PTI Environmental Services. 1991. Recommended Guidelines for Measuring Conventional Marine Water-Column Variables in Puget Sound. Report prepared for the U.S. Environmental Protection Agency and the Puget Sound Water Quality Authority.

Rajasekar S, Philominathan P, Chinnathambi V. 2013. Research Methodology. Cornell University Library. Available at arXiv:physics/0601009v3 [Accessed on 14 June 2015]

Ralston S, de Villiers C, Manuel J, te Roller K and Pence G (2009) Where are we going? Fine Scale Systematic Conservation Plans and their Contribution to Environmental Assessment. In: IAIA 2009 National Conference Proceedings, 23-26 August 2009, Wilderness.

Ranjit K. 2011. *Research Methodology. A step-by-step guide for beginners*. 3rd Edition. Sage Publications. London / California / New Delhi

Redford KH. 2014. Scoping Paper: Mainstreaming Biodiversity Conservation IN Huntley BJ and Redford KH (Eds) *Mainstreaming biodiversity in Practice: a STAP advisory document*. Washington, DC :Global Environment Facility.

Report for Norwegian Oil Industry Association (OLF): Seismic Surveys Impact on Fish and Fisheries by Ingebret Gausland Stavanger, March 2003.

Reyers B, Rouget M, Jonas Z, Cowling RM, Driver A, Maze K, Desmet P. 2007. Developing products for conservation decision-making: lessons from a spatial biodiversity assessment for South Africa. *Diversity and Distributions* **13**: 608-619.

Richardson WJ, Greene JR CR, Malme CI, Thomson DH. 1995. *Marine mammals and noise*. San Diego, CA :Academic Press.

Robinson DW. 2010. Land Use, Land Ideology: An Integrated Geographic Information Systems Analysis of Rock Art within South-Central California. *American Antiquity* **75**: 792-818.

Rodriguez-Bachiller A. 2000. Geographical Information Systems and Expert Systems for Impact Assessment. Part II: Expert Systems and Decision Support Systems. *Journal of Environmental Assessment Policy and Management* **2**: 415-448.

Rossouw N, Davis S, Henri F, Rapholo B, de Wit M. 2003. South Africa IN Tarr P (ed.) *Environmental impact assessment in southern Africa: a SAIEA publication*. Windhoek: Southern African Institute for Environmental Assessment.

Rouget M, Reyers B, Jonas Z, Desmet P, Driver A, Maze K, Egoh B, Cowling RM. 2004. South African National Spatial Biodiversity Assessment 2004: Technical Report. Volume 1: Terrestrial Component. Pretoria: South African National Biodiversity Institute.

RSA (Republic of South Africa). 1996. Constitution of the Republic of South Africa No. 108 Of 1996. Government Gazette, South Africa 2083 (17678).

RSA (Republic of South Africa). 1998a. National Environmental Management Act (Act No 107 of 1998). Government Gazette, South Africa 1540 (19519).

RSA (Republic of South Africa). 1998b. Marine Living Resources Act (Act No 18 of 1998). Government Gazette, South Africa 747 (18930).

RSA (Republic of South Africa). 2002. Minerals and Petroleum Resources Development Act (Act No. 28 of 2002). Government Gazette, South Africa 1273 (23922).

RSA (Republic of South Africa). 2003. National Environmental Management: National Protected Areas Act (Act No. 57 of 2003). Government Gazette, South Africa 464 (26025).

RSA (Republic of South Africa). 2004. National Environmental Management: Biodiversity Act (Act No. 10 of 2008). Government Gazette, South Africa 700 (26436).

RSA (Republic of South Africa). 2009. Government Notice 1002: National List of Ecosystems that are Threatened and in Need of Protection. Published under the National Environmental Management: Biodiversity Act (Act No. 10 of 2008). Government Gazette, South Africa (34809).

RSA (Republic of South Africa). 2010a. Publication of the Amendment of the Broad-based Socio-economic Empowerment Charter for the South African Mining and Minerals Industry. Government Notice 838. Government Gazette, South Africa (33573).

RSA (Republic of South Africa). 2010b. National Environmental Management Act, 1998 (Act No. 107 of 1998) Environmental Impact Assessment Regulations (Regulation Gazette No. 9314). Government Gazette, South Africa (33306)

RSA (Republic of South Africa). 2013. Declaration of the Prince Edward Islands Marine Protected Area. Government Notice 426. Government Gazette 36575.

RSA (Republic of South Africa). 2014a. Immigration Act, 2002 (Act No. 13 of 2002) Skills or Qualifications determined to be Critical for the Republic of South Africa in relation to an Application for Critical Skills Visa or Permanent Residence Permit. Notice number 459. Government Gazette 588 (37716).

RSA (Republic of South Africa). 2014b. National Environmental Management: Protected Areas Amendment Act (Act No. 21 of 2014). Government Gazette 588 (37710).

RSA (Republic of South Africa). 2014c. WHITE PAPER ON NATIONAL ENVIRONMENTAL MANAGEMENT OF THE OCEAN. Published under the National Environmental Management: Biodiversity Act (Act No. 10 of 2008). Government Notice 426. Government Gazette, South Africa (37692).

RSA (Republic of South Africa). 2014d. National Environmental Management (Act 107 OF 1998). Environmental Impact Assessment Regulations: Listing Notice 3 OF 2014 Notice No. 546, Gazette No. 33306

RSA (Republic of South Africa). 2015. National Infrastructure Plan. Available at <http://www.gov.za/issues/national-infrastructure-plan#SI-SIPs>. [Accessed on 2 June 2015]

SA Navy. 2006. Maritime Doctrine for the SA Navy – SANGP 100. Simon's Town: Naval Publications Depot. Available at <http://www.navy.mil.za/> [Accessed on 5 June 2015]

Samarakoon M, Rowan JS. 2008. A Critical Review of Environmental Impact Statements in Sri Lanka with Particular Reference to Ecological Impact Assessment. *Environmental Management* **41**: 441–460.

Sammarco PW, Atchison AD, Boland GS. 2004. Expansion of coral communities within the Northern Gulf of Mexico via offshore oil and gas platforms. *Marine Ecology Progress Series* **280**: 129-143

SANBI (South African National Biodiversity Institute). 2013. *Life: The State of South Africa's Biodiversity 2012*. Pretoria: South African National Biodiversity Institute.

SANBI (South African National Biodiversity Institute). 2014. Statistics: Red List of South African Plants version 2014.1. Available at Redlist.sanbi.org [Accessed on 22 August 2015]

Santulli AC, Messina C, Ceffa L, Curatolo A, Rivas G, Fabi G, Damelio V. 1999. Biochemical responses of European sea bass (*Dicentrarchus labraz*) to stress induced by offshore experimental seismic prospecting. *Marine Pollution Bulletin* **38**: 1105 – 1114.

Savage C, Field JG, Sauer WHH, 2001. Comparative meta-analysis of the impact of offshore marine mining on macrobenthic communities versus organic pollution studies. *Marine Ecology Progress Series* **221**: 265-275.

Savage C. 1996. Multivariate analyses of the impact of offshore marine mining on the benthic macrofauna off the west coast of southern Africa. M.Sc thesis. University of Cape Town, South Africa.

Schaanning MT, Trannum HC, Oxnevad S, Carroll J, Bakke T. 2008. Effects of drill cuttings on biogeochemical fluxes and macrobenthos of marine sediments. *Journal of Experimental Marine Biology and Ecology* **361**: 49-57.

Scholes et al 2013. Multi-scale and cross-scale assessments of social-ecological systems and their ecosystem services. *Current Opinion in Environmental Sustainability* **5**: 1-10.

Scholtz W. 2005. The Anthropocentric Approach to Sustainable Development in the National Environmental Management Act and the Constitution of South Africa. *Journal of South African Law (Issue 1 of 2005)*: 69-85.

Serrano A, Sanchez F, Preciado I, Parra S, Frutos I. 2006. Spatial and temporal changes in benthic communities of the Galician continental shelf after the *Prestige* oil spill. *Marine Pollution Bulletin* **53**: 315-331.

Sheng H, Ricci PF, Fang Q. 2015. Legally binding precautionary and prevention principles: Aspects of epistemic uncertain causation. *Environmental Science & Policy* **54**: 185-198.

Sink K, Harris J, Lombard A. 2004. Appendix 1: South African marine bioregions IN Lombard AT, Strauss T, Harris J, Sink K, Attwood C, Hutchings L. 2004: South African National Spatial Biodiversity Assessment 2004: Technical Report. Volume 4: Marine Component. Pretoria: South African National Biodiversity Institute.

Sink K, Holness S, Harris L, Majiedt P, Atkinson L, Robinson T, Kirkman S, Hutchings L, Leslie R, Lamberth S, Kerwath S, von der Heyden S, Lombard A, Attwood C, Branch G, Fairweather T, Taljaard S, Weerts S, Cowley P, Awad A, Halpern B, Grantham H, Wolf T. 2012a. National Biodiversity Assessment 2011: Technical Report. Volume 4: Marine and Coastal Component. South African National Biodiversity Institute, Pretoria

Sink KJ, Atkinson LJ, Kerwath, S and Samaai, T. 2010. Assessment of offshore benthic biodiversity on the Agulhas Bank and the potential role of petroleum infrastructure in offshore spatial management. Report prepared for WWF South Africa and PetroSA through a SANBI initiative.

Sink K, Attwood C. 2008. Guidelines for Offshore Marine Protected Areas in South Africa. SANBI Biodiversity Series 9. South African National Biodiversity Institute, Pretoria.

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

Sink KJ, Wilkinson S, Atkinson LJ, Sims PF, Leslie RW, Attwood CG. 2012b. The potential impacts of South Africa's demersal hake trawl fishery on benthic habitats: historical perspectives, spatial analyses, current review and potential management actions. Unpublished report, South African National Biodiversity Institute. Available at <http://www.sanbi.org/sites/default/files/documents/documents/benthic-report-sadstia-sink-et-al-2012-draft.pdf> [Accessed on 15 March 2013].

Skalski JR, Pearson WH, Malme CI. 1992. Effects of Sounds from a Geophysical Survey Device on Catch-per-Unit-Effort in a Hook-and-Line Fishery for Rockfish (*Sebastes* spp.) *Canadian Journal of Fisheries and Aquatic Sciences* **49**: 1357-1365

Slabbekoorn H, Bouton N, van Opzeeland I, Coers A, ten Cate C, Popper A. 2010. A noisy spring: the impact of globally rising underwater sound levels on fish. *Trends in Ecology and Evolution* **25**: 419–427.

Slootweg R. 2005. Biodiversity assessment framework: making biodiversity part of corporate social responsibility. *Impact Assessment and Project Appraisal* **23**: 37-46.

Slotte A, Hansen K, Dalen J, Ona E. 2004. Acoustic mapping of pelagic fish distribution and abundance in relation to a seismic shooting area off the Norwegian west coast. *Fisheries Research* **67**: 143-150.

Smit C. 2013. The Role of Mining in the South African Economy. KPMG. Available at <http://www.sablog.kpmg.co.za/2013/12/role-mining-south-african-economy/>. [Accessed on 13 July 2014].

Smith ME, Coffin AB, Miller DL, Popper AN. 2006. Anatomical and functional recovery of the goldfish (*Carassius auratus*). *Journal of Experimental Biology* **207**: 427-435.

Smith ME, Kane AS, Popper AN. 2004. Noise-induced stress response and hearing loss in goldfish (*Carassius auratus*). *Journal of Experimental Biology* **207**: 427-435.

Söderman T. 2005. Treatment of biodiversity issues in Finnish environmental impact assessment. *Impact Assessment and Project Appraisal* **23**: 87-99.

Sohn L. 1973. The Stockholm Declaration on the Human Environment. *The Harvard International Law Journal* **14** (3): 423-515.

Southalan J. 2012. *Mining Law and Policy: International Perspectives*. The Federation Press: Sydney, Australia.

Southall BL, Bowles AE, Ellison WT, Finneran JJ, Gentry RL, Greene CR., Kastak D, Ketten DR, Miller JH, Nachtigall PE, Richardson WJ, Thomas JA, Tyack PL. 2007. Marine mammal noise exposure criteria: initial scientific recommendations. *Aquatic Mammals* **33**: 411-522

Steinhauer M, Crecelius E, Steinhauer W. 1994. Temporal and spatial changes in the concentrations of hydrocarbons and trace metals in the vicinity of an offshore oil-production platform. *Marine Environmental Research* **37**: 129-163.

Stergiou, K.I. & Browman, H.I. 2005. Imbalances in the reporting and teaching of ecology from limnetic, oceanic and terrestrial domains. *Marine Ecology Progress Series* **304**: 292-297.

Strydom H. 2013. An Evaluation of the Purposes of Research in Social Work. *Social Work / Maatkaplike Werk* **49**: 149-164.

Strydom HA, King ND (eds). 2005. *Fugle and Rabies Environmental Management in South Africa*. Juta Law: Cape Town.

Sutton P. 2004. What is sustainability? *Eingana: Journal of the Victorian Association for Environmental Education* **27**: 6–9.

Terrell SR. 2012, Mixed-Methods Research Methodologies. *The Qualitative Report* **17**: 254-280.

Turk T, Kitapci O, Dortyol IT. 2014. The Usage of Geographical Information Systems (GIS) in the Marketing Decision Making Process: A Case Study for Determining Supermarket Locations. *Procedia - Social and Behavioral Sciences* **148**: 227-235.

Van Niekerk L, Turpie JK (eds). 2012. National Biodiversity Assessment 2011: Technical Report. Volume 3: Estuary Component. CSIR Report Number CSIR/NRE/ECOS/ER/2011/0045/B. Council for Scientific and Industrial Research, Stellenbosch.

Turpie JK. 2004. South African National Spatial Biodiversity Assessment 2004: Technical Report. Volume 3: Estuary Component. Pretoria: South African National Biodiversity Institute.

Turshen M, Barker C, O'Keefe P. 1988 Editorial. *ROAPE* **48**: 1-4.

UN (United Nations).1972. Declaration of the United Nations Conference on the Human Environment. Legal Citation U.N. Doc. A/Conf.48/14/Rev. 1(1973); 11 ILM 1416 (1972). Stockholm: United Nations General Assembly.

UN (United Nations). 1982. United Nations Convention on the Law of the Sea. Legal Citation 1833 UNTS 3; 21 ILM 1261 (1982). Jamaica: United Nations Secretary-General.

UN (United Nations). 1992. United Nations Framework Convention on Climate Change. New York: United Nations Department of Public Information.

UN (United Nations). 2000. United Nations Millennium Declaration, Resolution Adopted by the General Assembly , 18 September 2000, A/RES/55/2, available at: <http://www.refworld.org/docid/3b00f4ea3.html> [accessed 21 October 2015]

UNCED (United Nations Conference on Environment and Development). 1992. Agenda 21: Programme of Action for Sustainable Development New York: United Nations Department of Public Information.

UNDP. 2011. Mainstreaming Climate Change in National Development Processes and UN Country Programming: A guide to assist UN Country Teams in integrating climate change risks and opportunities. United Nations Development Programme: New York, NY, USA.

UNDP-UNEP (United Nations Development Programme – United Nations Environmental Programme). 2009. Mainstreaming poverty-environment linkages into development planning: A handbook for practitioners, ISBN 978-92-807-2962-7. <http://www.unep.org>. Accessed 18 July 2015.

UNDP-UNEP (United Nations Development Programme – United Nations Environmental Programme). 2015. Mainstreaming Environment and Climate for Poverty Reduction and Sustainable Development A Handbook to Strengthen Planning and Budgeting Processes. UNDP-UNEP POVERTY-ENVIRONMENT INITIATIVE.

UNEP (United National Environmental Programme). 1992a. Rio Declaration on Environment and Development. New York: United Nations Department of Public Information.

UNEP (United National Environmental Programme). 1992b. Convention on Biological Diversity. New York: United Nations Department of Public Information.

UNEP, CBD. 2007. Mainstreaming Biodiversity into Sectoral and Cross-Sectoral Strategies, Plans and Programmes (Module B-3 Training Document). Convention on Biological Diversity website. Available at <https://www.cbd.int/doc/training/nbsap/b3-train-mainstream-en.pdf> [Accessed on 30 August 2015]

Upseis. 2007. What Are Seismic Waves? UPSeis: an educational site for budding seismologists. Available at <http://www.geo.mtu.edu/UPSeis/waves.html> [Accessed on 20 August 2014]

van Reenen J. 2011. How competition improves management and productivity. *CentrePiece* **16**: 10-13.

Walford N. 1999. 'Making More of Maps': Geography and Geographical Information Systems. *Geography* **84**: 129-138.

Wanless RM, Scott S, Sauer WH H, Andrew TG, Glass JP, Godfrey B, Griffiths C, Yeld E. 2009. Semi-submersible rigs: a vector transporting entire marine communities around the world. *Biological Invasions*: DOI 10.1007/s10530-009-9666-2.

Wardle CS, Carter TJ, Urquhart GG, Johnstone ADF, Ziolkowski AM, Hampson G, Mackie D. 2001. Effect of seismic air guns on marine fish. *Continental Shelf research* **21**:1005 – 1027.

Watts ME, Ball IR, Stewart RS, Klein CJ, Wilson K, Steinback C, Lourival R, Kircher L, Possingham HP. 2009. Marxan with Zones: Software for optimal conservation based land- and sea-use zoning. *Environmental Modelling & Software* **24**: 1513-1521.

Watts ME, Ball IR, Stewart RS, Klein CJ, Wilson K, Steinback C, Lourival R, Kircher L, Possingham HP. 2009. Marxan with Zones: Software for optimal conservation based land- and sea-use zoning. *Environmental Modelling & Software* **24**: 1513-1521.

WCED (World Commission on Environment and Development). 1987. *Our Common Future*. Oxford: Oxford University Press.

Weaver A. 2003. EIA and sustainable development: key concepts and tools In: P. Tarr (Ed.), *Environmental Impact Assessment in Southern Africa*. Windhoek: Southern African Institute for Environmental Assessment.

Weilgart L. 2013. A review of the impacts of seismic airgun surveys on marine life. Submitted to the CBD Expert Workshop on Underwater Noise and its Impacts on Marine and Coastal Biodiversity, 25-27 February 2014, London, UK. Available at: <http://www.cbd.int/doc/?meeting=MCBEM-2014-01>.

Weiss EB. 1992. In Fairness to Future Generations and Sustainable Development. *American University Journal of International Law & Policy* **19**: 19-26.

Welman C, Mitchell B, Kruger F. 2005. *Research Methodology*. 3rd Edition. Cape Town: Oxford University Press.

Wentzel W. 2013. A new regulatory regime for the SA mining industry is launched: the MPRDA. Polity: Legal Briefs. Available at <http://www.polity.org.za/article/a-new-regulatory-regime-for-the-sa-mining-industry-is-launched-the-mprda-2013-06-11> [Accessed on 23 August 2015]

WHOI (Woods Hole Oceanographic Institution). 2014. Ocean Instruments: Piston Corer. WHOI website. Available at <http://www.whoi.edu/instruments/viewInstrument.do?id=8087> [Accessed on 18 July 2014]

Wilby A, Hector A. 2008. The Role of Biodiversity. Encyclopedia of Life Sciences. DOI: 10.1002/9780470015902.a0021228

Willoughby S. 2006. BGIS. Cape Action for People and the Environment website. Available at <http://www.capeaction.org.za/index.php/strategic-objectives/knowledge-networks/conservation-education/10-strategic-objectives/biodiversity-planning> [Accessed on 30 August 2015]

WSSD (World Summit on Sustainable Development). 2002. Johannesburg Declaration on Sustainable Development and Plan of Implementation of the World Summit on Sustainable Development: the final text of agreements negotiated by governments at the World Summit on Sustainable Development, 26 August-4 September 2002, Johannesburg, South Africa. New York: United Nations Department of Public Information.

WWF (World Wide Fund for Nature - South Africa). 2012. WWF Position Paper 2012 – Bulk Deep-sea Mining. Cape Town: WWF-SA.

Yeo DCJ, Ahyong ST, Lodge DM, Ng PKL, Naruse T, Lane DJW. 2010. Semisubmersible oil platforms: understudied and potentially major vectors of biofouling-mediated invasions. *Biofouling* **26(2)**: 179-186.

Yin RK. 2012. *Applications of Case Study Research*. 3rd Edition. USA: Sage Publications, Inc.

Zhang Y, Wildemuth M. 2005. Qualitative Analysis of Content. *Analysis* **1**:1-12.

APPENDICES

APPENDIX I: Methods and equipment used in Mining Exploration

Seismic Surveys

Seismic surveys are a form of geophysical survey that aims at measuring the earth's properties by means of physical principles such as magnetic, electric, gravitational, thermal, and elastic theories, and usually form the initial phase of exploration. These are based on the theory of elasticity and therefore try to deduce elastic properties of materials by measuring their response to elastic disturbances called seismic waves (ParkSeismic 2007). In offshore seismic surveys, high energy noise sources are used to assess the seabed by rapidly releasing compressed air to produce an impulsive signal, i.e. a very loud boom (McCauley et al. 2000). These signals penetrate the seafloor and are reflected back by "density or velocity discontinuities within the underlying rock strata" (McCauley et al. 2000). Using seismic data, geologists are able to locate regions below the earth's surface that contain mineral resources. In the marine environment, the high energy sources are dragged behind a vessel along transects and the reflected signals captured by acoustic receivers (Figure 32).

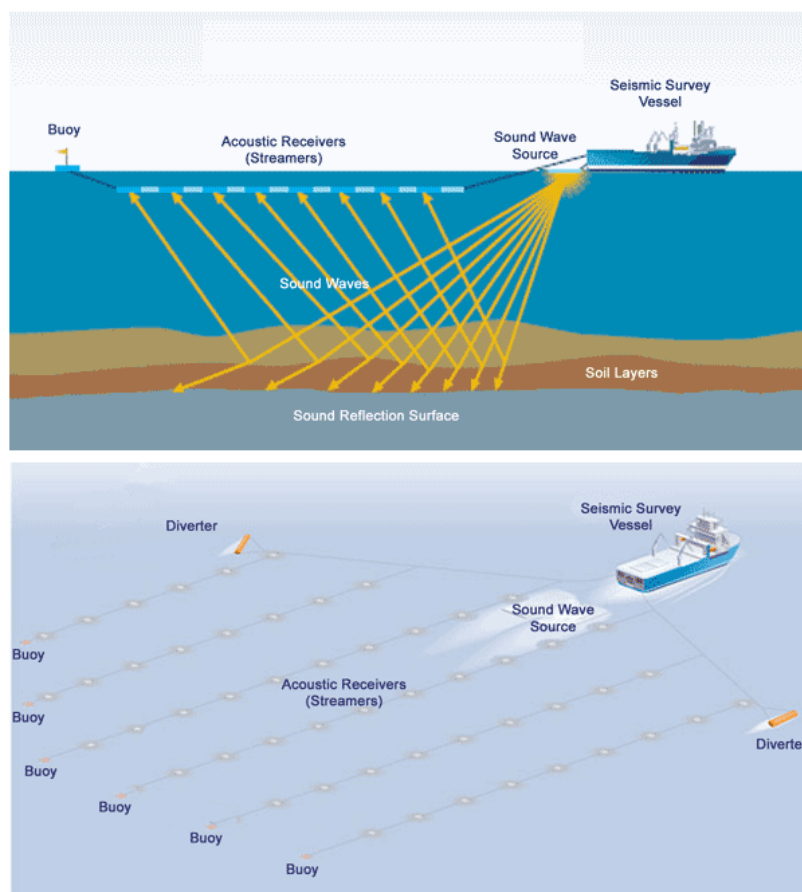


Figure 32: Illustration of a typical offshore seismic survey displaying the position of sound wave source and acoustic receivers (source: Sarah Wilkinson of Capfish Fisheries Monitoring).

There is concern over the impacts of rising underwater ambient noise levels of anthropogenic activities on marine species (Weilgart 2013, Slabbekoorn et al. 2010, McCauley et al. 2003, McCauley et al. 2000). Recent research has shown that seismic noise can impact foraging and spawning behaviour of fish, mammals, turtles and invertebrates (Hawkins and Popper 2014, New et al. 2014).

Seabed Surface Heat Flow Measurements:

Seabed surface heat flow measurements measure the temperature and thermal conductivity of the sediment. These are used to determine the thermal regime (i.e. the amount of heat available) of the area and to assess the potential for hydrocarbon resources. Fisher and Harris (2010) describe the two types of instruments for these measurements (Figure 33):

- (i) instruments that penetrate the seafloor and determine temperatures within shallow sediments (generally <10 m) and
- (ii) instruments deployed within sediments while drilling to greater depths (~30-400m).



Figure 33: Examples of seafloor heat measurement instrumentation (Fisher and Harris 2010).

Water Column Sampling:

Water column sampling is usually undertaken by using a CTD Profiler (Conductivity, Temperature and Depth profiler) shown in Figure 34. This instrument usually consists of multiple water-bottle samplers that collect water samples at various depths. The samplers are usually cylindrical tubes that have stoppers on either end which are triggered by electrical signals to close either manually or at pre-set depths (PTI Environmental Services 1991). Water samples can be analysed for various physical properties such as turbidity and salinity, as well as naturally occurring hydrocarbons and heavy metals. This method is associated with oceanography and no negative impacts to the environment would be expected to emanate from this exercise.

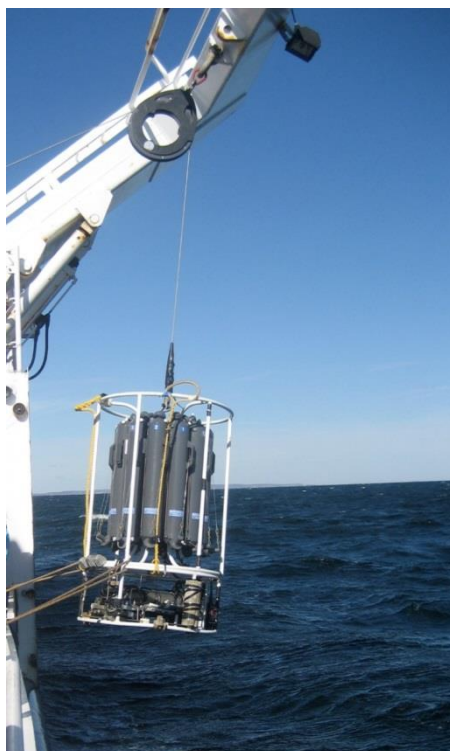


Figure 34: An image of a CTD being deployed from a ship (www.wikipedia.com).

Seabed Sampling:

Seabed column sampling is mainly done using a piston corer (Figure 35). A piston corer is a long metal tube that is used to extract sediment from the seafloor in such a manner that the stratified layers of the sediment are not disturbed (WHOI 2014), thus providing the user with an undisturbed sample of the layers of sediment as they occur on the seafloor. These samples are not only indicative of the substrate being sampled, but are also tested in laboratories for the presence of hydrocarbons to assess the potential for mineral resources in the area.

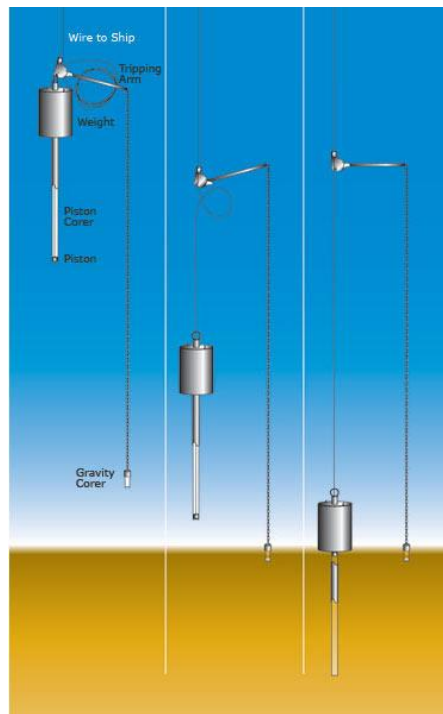


Figure 35: Graphic depiction of the coring action of a typical piston corer for marine sediment sampling (WHOI 2014)

Piston corers are thought to have very localised impacts on the benthic environment as the diameter of the piston ranges from 70 – 90 mm (<http://www.osil.co.uk/>). However, during an exploration exercise numerous cores are collected which could have negative impacts on sensitive and/or endangered ecosystems.

Multibeam Echo Sounder:

Multibeam echo sounders are used to create topographical or bathymetric maps of the ocean floor. This method is similar to seismic surveys in that it uses sound waves that are reflected from the underwater features to create data. Echo sounders make use of high frequency acoustic signals that are sent out in a swath using a transducer where they are also received (Dansen 2005). The reflected information is then analysed to create images of the seafloor similar to topographic terrestrial maps (Figure 36). The length of time taken for the sound to reflect back to the ship is used as an indication of depth, whilst the strength of the returning signal indicates substrate type, i.e. a “soft” signal would indicate soft or muddy sediment whilst a “hard” or strong signal indicates an area of hard ground (NIWA 2005). Multibeam echo sounder results are often used to determine areas where piston coring or seabed sampling would be most appropriate. At the time of this study, no literature was available on the impacts of this method on marine species.

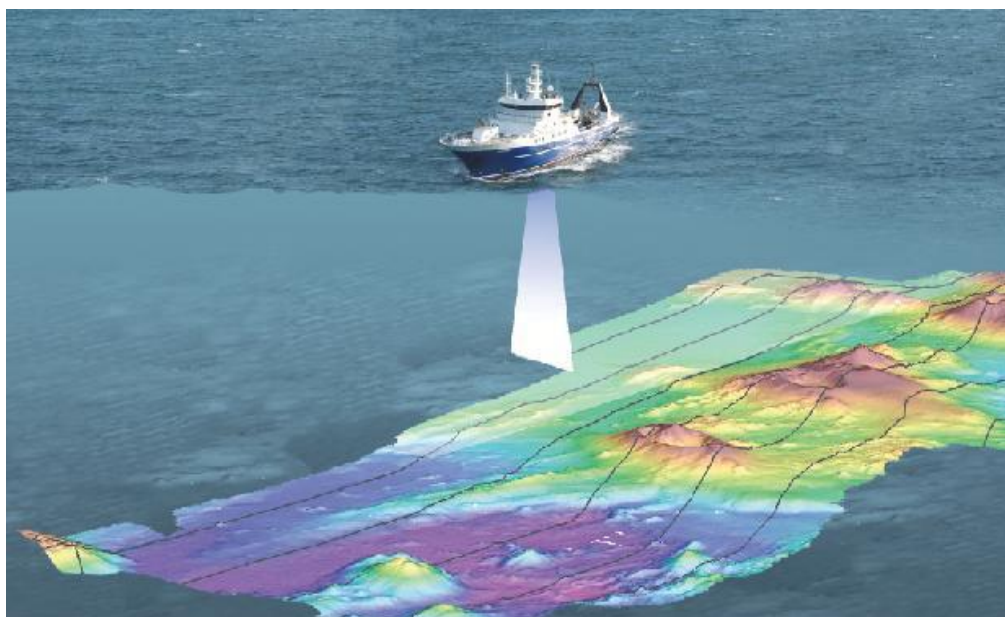


Figure 36: Graphic depiction of a ship collecting swath bathymetry data using a multibeam echo sounder with the 3D data imposed on the seafloor (NIWA 2005).

Sub-bottom Profile:

Sub-bottom profiling is achieved through side-scan sonar and also uses sound as a medium for collecting information of the seafloor and is similar to multibeam echo sounder methods. Sub-bottom profilers however are generally used for shallow water sampling and make use of a “towed fish” (Figure 37). Just like echo sounders, they emit frequencies that measure the shape and reflectivity (hardness) of the substrate. The fish is suspended above the seafloor and dragged along a transect to create fine-scale imaging of the seafloor (Penrose et al. 2005).

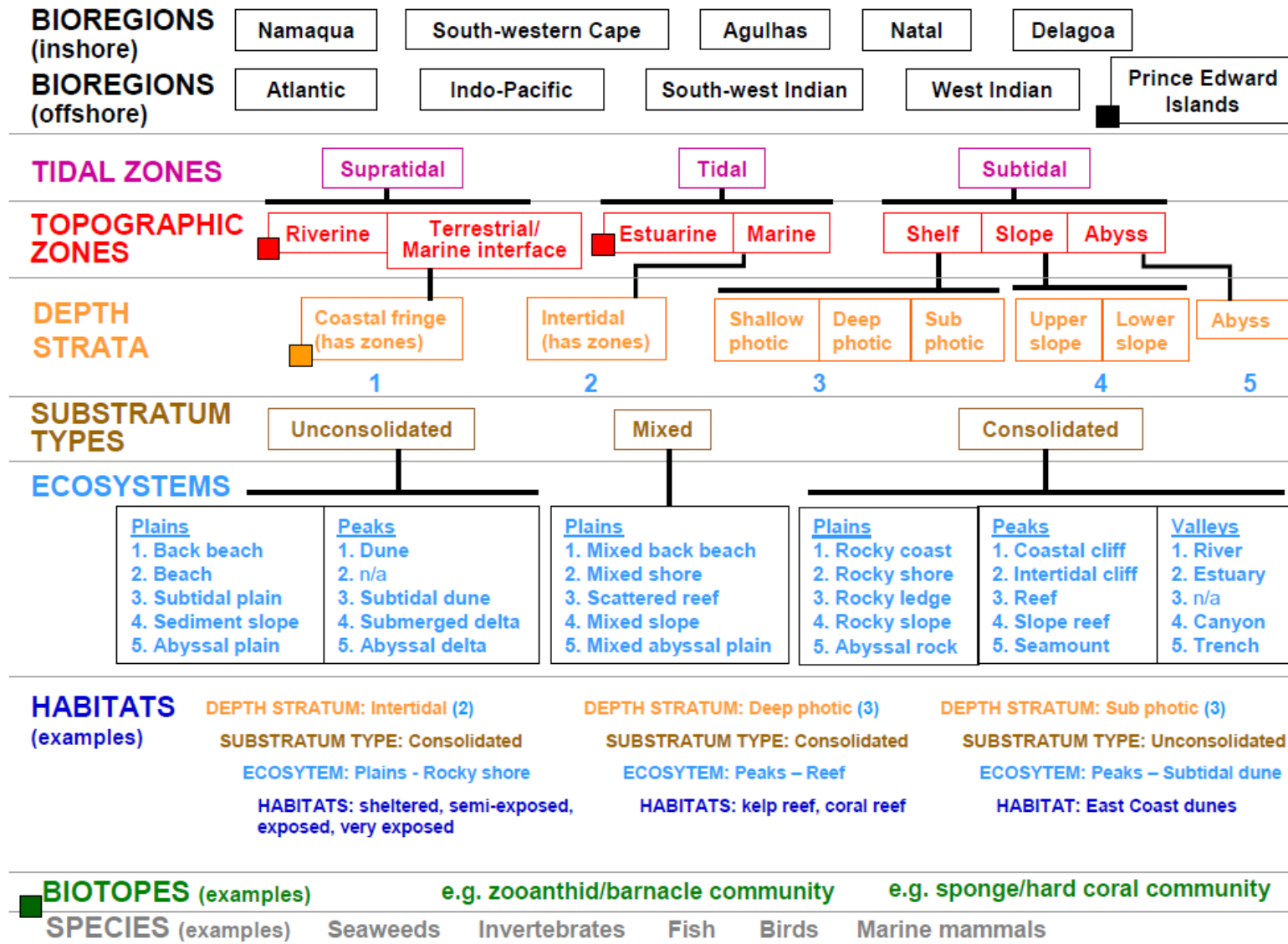


Figure 37: Image of a typical side-scan sonar fish (Penrose et al. 2005).

At the time of this study, no literature was available on the impacts of multibeam echo sounder and sub-bottom profile surveys on marine species.

All the methods mentioned above are useful in assessing the presence of mineral deposits under the seafloor as well as having the capability of providing information on different ecosystems and associated biodiversity that can assist in assessing the impact of activities (ECORYS 2014).

APPENDIX II: The first hierarchical marine habitat classification (Lombard et al. 2005)



APPENDIX III: Key characteristics of the 16 pelagic “habitats” recognised within the South African EEZ. Note that descriptions of key characteristics are within a South African and not a global context (Sink et al. 2012).

Pelagic “habitat”	Key characteristics
Aa1	Very high productivity, high chlorophyll and very cold water (SST mean = 15.2°C) over the shallow gradually sloping shelf of the upwelling centre of the Benguela current in the south Atlantic ocean.
Ab1	High productivity and high but highly variable chlorophyll and cold water (SST mean 16.6°C) due to upwelling over the deeper gradually sloping Benguela shelf area of the south Atlantic ocean. Very high occurrence of chlorophyll fronts.
Ab2	Medium - high productivity and very high variability in productivity, medium-high chlorophyll and very high variability in chlorophyll over the shallow gently sloping Agulhas bank. Moderate Indian Ocean temperatures that are highly variable (SST mean = 19.1 °C).
Ab3	Medium productivity, cold to moderate Atlantic temperatures (SST mean=18.3°C) moderate chlorophyll related to the eastern limit of the Benguela upwelling on the outer shelf. Relatively frequent chlorophyll fronts occur in this bioregion.
Bc1	Moderate temperature (SST mean = 21.8°C), low productivity, frequent sea surface temperature fronts in the Open Indian Ocean.
Bc2	Moderate temperature (SST mean = 20.5°C) with moderate variability in the Indian Ocean Abyss. Medium frequency of eddies. Agulhas retroflection and transition toward the Southern Ocean.
Bb1	Atlantic Ocean abyss, consistently low productivity and temperature (SST mean 18.7°C), low frequency of SSF fronts
Bb2	Consistently low productivity, chlorophyll and temperature (SST mean = 18.5°C) Atlantic open ocean transition toward the Benguela upwelling region.
Ba2	Cool (SST = 19.4°C) Indian and Atlantic ocean steep slope or abyss with high frequency of eddies, medium frequency of SST fronts, associated with the Subtropical convergence and Agulhas Return Current. This cluster exhibits occasional short –lived events of high productivity associated with the subtropical convergence (Llido et al. 2005).
Ba1	Cold (SST mean 17.8°C) Atlantic Ocean abyss with consistently low chlorophyll and medium frequency of eddies.
Ca1	Warm (SST mean = 24.1°C) Indian ocean abyss with very low chlorophyll, productivity and frequency of chlorophyll fronts.
Ca2	Consistently warm (SST mean 23.5°C) Indian ocean water with low variability in temperature and very low frequency of chlorophyll fronts.
Cb1	Very warm (SST mean = 24.9°C) stable subtropical Indian Ocean shelf ecosystem with low frequencies of eddies and SST fronts.
Cb2	Warm (SST mean = 23.5°C) core of the Agulhas current along the steep slope of the eastern continental shelf. High variability in primary productivity and chlorophyll with moderate to high chlorophyll values.
Cb3	Cool (SST mean = 21.2°C) Indian Ocean water with high productivity and high but variable chlorophyll, associated with very frequent SST and chlorophyll fronts. This habitat represents cool productive water that has been advected onto the shelf in this shear zone through Agulhas-current driven upwelling cells (Lutjeharms et al. 1989, 2000).
Cb4	Moderate (SST mean = 22.2°C) Indian Ocean water with frequent SST and chlorophyll fronts associated with the steep outer shelf.

APPENDIX IV: OMPA Focus Areas Rationale and Management Considerations

Focal Area Name	Rationale	Potential spatial management measures and other considerations
Childs Bank	<ul style="list-style-type: none"> • Offshore habitat representation • Benthic protection (submarine bank, shelf, shelf edge and cold water corals) • Bycatch management (offshore trawl) • Fisheries management (demersal trawl) 	Experimental closure for benthic fisheries along the shelf (linked to the SADSTIA proposed trawl closure committed as part of eco-certification conditions) is recommended. Full seabed protection is advised for the Child's Bank submarine feature and it is suggested that this is effected prior to implementation of the closure so as not to shift effort onto this potential vulnerable marine ecosystem. iBhubesi reef is also recommended as a seabed protection zone and further engagement with the petroleum sector is needed in this regard. The broader focus area is important for large pelagic fishing, seabed protection and support for the management of demersal resources. It may not be necessary to exclude pelagic fisheries from this area.
Cape Canyon	<ul style="list-style-type: none"> • Offshore habitat representation • Pelagic habitats and processes • Benthic protection (canyon) • Threatened species • Fisheries sustainability 	A zoned MPA including no-take areas, seabed protection zones and zones to minimise user conflict could help achieve multiple objectives in this area. The existing MPAs (Langebaan, Sixteen Mile Beach, Marcus Island, Malgas Island and, Jutten Island) in the area should be considered for consolidation, extension or re-zoning to resolve existing resource conflicts, protect threatened species in core areas and minimise stakeholder impacts. This area is important for small pelagic fisheries who are interested in negotiation to achieve increased protection of core seabird habitat in return for access to part of the Sixteen mile beach MPA.
Protea Seamount	<ul style="list-style-type: none"> • Offshore habitat representation • Benthic protection (seamount) 	Two seamounts in this area should be included within a zoned MPA that includes a no-take area and a benthic protection zone. Fishing could be excluded from the seamount where lowest effort has been exerted. A portion of the Ferro-manganese nodule habitat must be included in the MPA.
Browns Bank	<ul style="list-style-type: none"> • Offshore habitat representation • Benthic protection • Fisheries sustainability (demersal trawl and longlining) • Bycatch management (offshore trawl) 	Sector specific Fishery management Areas, seabed protection zones or MPAs can be considered in this area. The Browns Bank area is an important spawning area for hake and data suggests that large hake frequent this area. As such a small closed area, including the more vulnerable hard ground habitat, could support the sustainability of the hake fisheries. There are hard grounds in this focus area which should receive formal protection (effected in legislation) from fishing and mining. Activities that affect the seabed should be prevented from extending into deeper water along this shelf edge area.
Agulhas Bank	<ul style="list-style-type: none"> • Offshore habitat representation • Benthic protection (deep reefs) • Bycatch management (inshore trawl) • Fisheries sustainability (linefish, hake) • Threatened species (linefish) 	A zoned MPA is recommended in this area to represent poorly protected habitats (especially mud and gravel habitats), protect vulnerable marine ecosystems (deep reefs, hard grounds) and support fisheries sustainability. This could include or supplement independent spatial management aimed at supporting bycatch management for the inshore trawl sector. A network of linked (but not necessarily contiguous) spatial management measures across the bank may be most appropriate in this focus area. Key features for inclusion include the Alphen Banks, the 45 Mile Bank, unrepresented gravel and mud habitats and different fish communities that are caught by the inshore trawl sector.

Prideel Majiedt

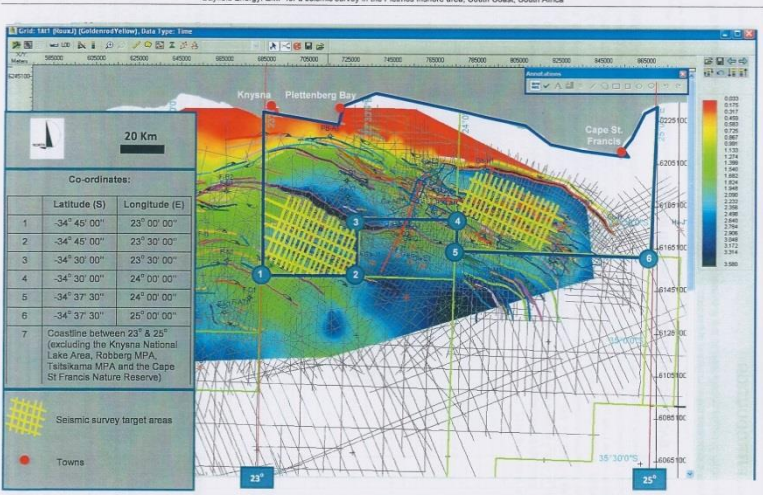
Stellenbosch University

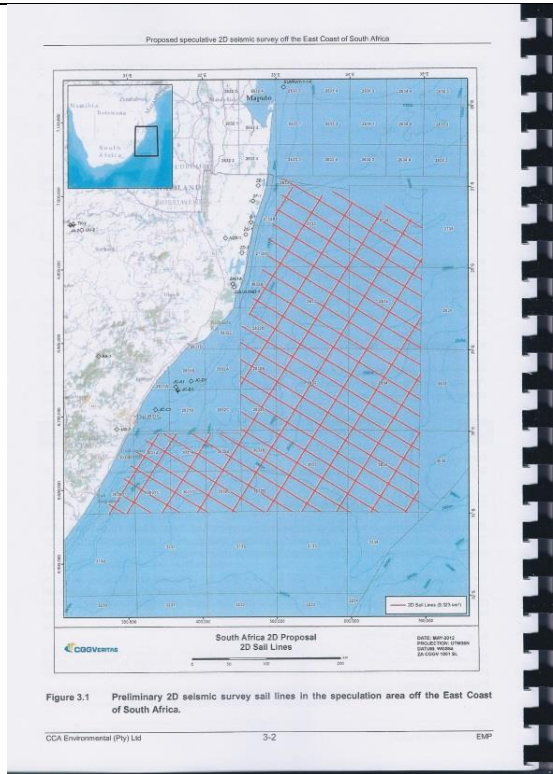
<p>Southwest Indian Seamounts</p>	<ul style="list-style-type: none"> • Offshore habitat representation • Benthic protection (seamount, shelf edge) • Fisheries sustainability (small pelagic species) • Bycatch reduction (large pelagic) 	<p>A fully protected or zoned MPA is suggested to achieve the multiple objectives for this area. Very rough ground and strong currents already offer some protection to this area which has lower cost than many other shelf edge areas. Unprotected habitats of very limited spatial extent should be considered for inclusion (e.g. shelf edge gravels). Two separate management areas or a large single zoned area could be considered.</p>
<p>Offshore Port Elizabeth</p>	<ul style="list-style-type: none"> • Offshore benthic habitat representation • Benthic protection (cold water corals, canyon, shelf edge, deep reefs) • Fisheries sustainability (kingklip, hake, linefish, squid) • Bycatch management (inshore and offshore trawl) • Threatened species (seabirds) 	<p>Seabed Protection zones, Fishery Management Areas and expansion of existing or proposed Marine Protected Areas should all be considered in this complex area. There are offshore features in this area that have few alternative options for conservation which is why this area is still selected despite relatively high cost values in this area. Existing planning for the proposed Addo MPA and the existing seasonal kingklip closure should also be considered in the development of offshore spatial management measures in this area and a suite of smaller appropriately zoned areas across this focus area could be appropriate.</p>
<p>Protea Bank</p>	<ul style="list-style-type: none"> • Offshore benthic habitat representation • Pelagic habitats and processes representation • Benthic protection (cold water corals, canyon, shelf edge, deep reefs) • Fisheries sustainability (linefish) • Threatened species (linefish) 	<p>A zoned Marine Protected Area should be considered in this area which also has potential to provide for non-consumptive resource use. This focus area was also identified by fine-scale planning conducted in KwaZulu-Natal through the SeaPlan project. The presence of 4 submarine canyons, deep reefs and 7 cold water coral records highlight the need for effective seabed protection in this area although there is evidence that this area is important for pelagic processes (high frequency of fronts) and sharks. This area could contribute to reef types that are currently underprotected in the bioregion and could help recovery of overexploited linefish. Conflict between divers and fishers needs to be addressed but there is currently some voluntary effort to stop fishing in some areas.</p>
<p>Tugela Banks</p>	<ul style="list-style-type: none"> • Offshore habitat representation • Benthic protection (cold water corals, canyon, shelf edge, deep reefs) • Bycatch management (crustacean trawl) • Threatened species (turtles, linefish) 	<p>A zoned Marine Protected Area and industry –specific fisheries or bycatch management areas should be considered for implementation in this area. Unprotected pelagic and seabed habitats (such as Natal shelf muds and gravels and submarine canyons) warrant protection in this area which has complex sedimentary patterns and complex oceanography. This area is highly productive and serves a nursery area for many species. This focus area was also identified by finescale planning conducted in KwaZulu-Natal through the SeaPlan project led by Ezemvelo KZN Wildlife.</p>
<p>iSimangaliso Offshore</p>	<ul style="list-style-type: none"> • Offshore benthic habitat representation • Pelagic habitats and processes representation • Benthic protection (canyons, corals) • Bycatch management (crustacean trawl) • Fisheries sustainability (linefish) • Threatened species (turtles, linefish) 	<p>Southern and offshore expansion of the existing Marine Protected Area and World Heritage Site with appropriate zonation is recommended in this area. Large pelagic fishing is not permitted within 20 nm of the coastline and costs are low within this zone of the focus area. This focus area was also identified by fine-scale planning conducted in KwaZulu-Natal (SeaPlan project). This area is important for threatened species, particularly turtles and linefish. Entire canyons and cold water coral records offshore of the current MPA must be included.</p>

APPENDIX V: Data captured from EMPs using content analysis.

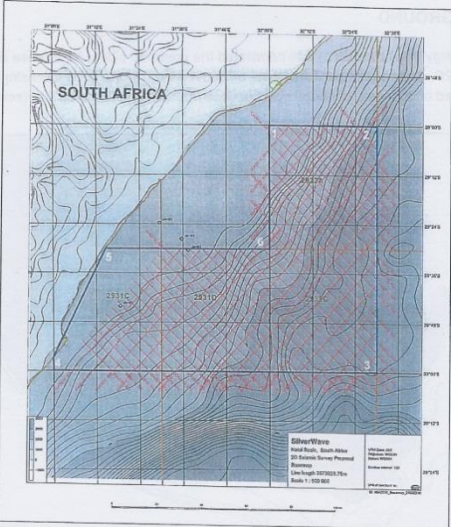
Document Number	P1
Name of document	South West Orange Basin Deepwater Exploration Area: Final Environmental Management Programme (EMPr)
Date	11 April 2014
Acquired from	PASA
Author/Lead consultant	Environmental Resources Management
Consultants/Specialist studies	Specialist Study on Impact on Fishing - CapFish; Marine Faunal Assessment - Pisces Environmental Services
Applicant	New Age Global Energy South Africa PTY LTD
Location	Off Cape Point to Saldana, 2800-4700m depth
Scan of map	
Proposed activities	2D seismic, 3D seismic, seabed surface heat flow measurements, seabed and water column sampling incl piston coring, multibeam echo sounder and sub-bottom profile survey
Ecosystem map	Bioregions map - Lombard et al. 2005, Coastal and Benthic ecosystem types - Sink et al. 2012
Ecosystem threat status	Sink et al. 2012 - offshore pelagic and benthic
Does it overlap with a threatened ecosystem type?	no
Have any mitigation measures been recommended?	no, impacts on invertebrates assessed as negligible.
Does it overlap with OMPA focus areas?	No – was cited.
Which focus area does it overlap with?	n/a
Have any mitigation measures been recommended?	n/a

Document number	P2
Name of document	Amended Environmental Management Programme for Seismic Surveys in the Algoa/Gamtoos Block
Date	03 October 2012
Acquired from	PASA
Author/Lead consultant	Environmental Resources Management
Consultants/Specialist studies	Fisheries - CapFish
Applicant	New African Global Energy South Africa (New AGE)
Location	Offshore between Jeffreys Bay and Kenton-On-Sea, shoreline to approximately 100km offshore at Van Stadens River Mouth.
Scan of map	<p>Figure 1.3 Locality map showing the delineation of the survey block with the Algoa Gamtoos Block</p> <p>Note: The proposed Addo Elephant MPA shown here (and therefore the buffer area) is based on data available as of September 2010</p>
Proposed activities	2D and 3D seismic surveys
Ecosystem map	no ecosystem map
Ecosystem threat status	no threat status
Does it overlap with a threatened ecosystem type?	not considered
Have any mitigation measures been recommended?	not considered
Does it overlap with OMPA focus areas?	not considered
Which focus area does it overlap with?	not considered
Have any mitigation measures been recommended?	not considered

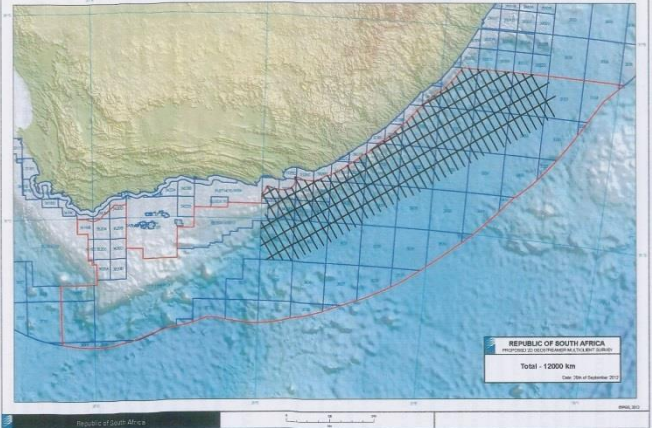
Document number	P3
Name of document	Environmental Management Programme for a proposed seismic survey in the Pletmos inshore area off the South Coast Of South Africa
Date	29 June 2010
Acquired from	PASA
Author/Lead consultant	CCA Environmental (Pty) Ltd
Consultants/Specialist studies	Specialist Study on Impact on Fishing - CapFish; Marine Faunal Assessment - Pisces Environmental Services
Applicant	Bayfield Energy Limited
Location	On the South Coast of SA, from Mossel Bay to Port Elizabeth over an approximate area of 11 346 km ²
Scan of map	 <p>Figure 1.2: Proposed 2D seismic survey target areas within the Pletmos Inshore area off the South Coast of South Africa.</p> <p>CCA Environmental (Pty) Ltd 1-2 June 2010</p>
Proposed activities	2D seismic surveys
Ecosystem map	not considered
Ecosystem threat status	not considered
Does it overlap with a threatened ecosystem type?	not considered
Have any mitigation measures been recommended?	not considered
Does it overlap with OMPA focus areas?	not considered
Which focus area does it overlap with?	not considered
Have any mitigation measures been recommended?	not considered

Document number	P4
Name of document	Environmental Management Programme for a proposed 2D speculative seismic survey off the East Coast of South Africa.
Date	21 June 2012
Acquired from	PASA
Author/Lead consultant	CCA Environmental (Pty) Ltd
Consultants/ Specialist studies	Specialist Study on Impact on Fishing - CapFish; Marine Faunal Assessment - Pisces Environmental Services; Description of the Offshore Environment of the East Coast - Centre for Marine Studies
Applicant	CGGVeritas Services
Location	along the coast from Port Shepstone to Mozambique
Scan of map	 <p>Figure 3.1 Preliminary 2D seismic survey sail lines in the speculation area off the East Coast of South Africa.</p> <p>CCA Environmental (Pty) Ltd 3-2 EMP</p>
Proposed activities	2d seismic survey
Ecosystem map	None
Ecosystem threat status	None
Does it overlap with a threatened ecosystem type?	not considered
Have any mitigation measures been recommended?	not considered
Does it overlap with OMPA focus areas?	not considered
Which focus area does it overlap with?	not considered
Have any mitigation measures been recommended?	not considered

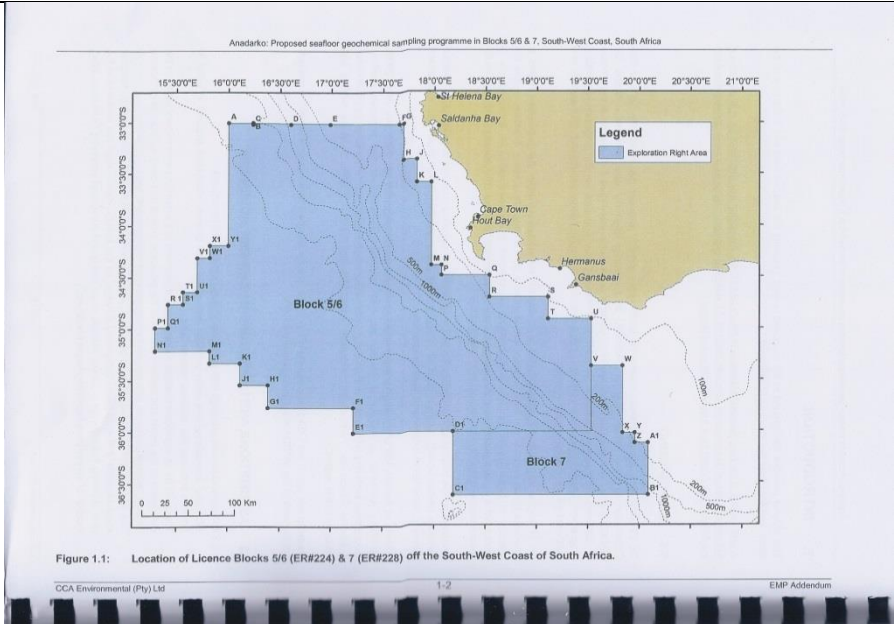
Document number	P5
Name of document	Environmental Management Programme for a proposed 2D speculative seismic survey in the Durban and Zululand Basins off the East Coast of South Africa
Date	14 December 2012
Acquired from	PASA
Author/Lead consultant	CCA Environmental (Pty) Ltd
Applicant	Sasol Petroleum International (Pty) Ltd
Consultants/ Specialist studies	Specialist Study on Impact on Fishing - CapFish; Marine Faunal Assessment - Pisces Environmental Services
Location	In the Durban and Zululand Basins between Port Edward and the Mozambique border
Scan of map	<p>Figure 1.2: Location of Sasol's 2D seismic survey programme in the Durban and Zululand basins off the East coast of South Africa. The position of the survey lines is only indicative at this stage.</p> <p>CCA Environmental (Pty) Ltd 1-3 EMP</p>
Proposed activities	2D seismic surveys
Ecosystem map	NSBA Bioregions - Lombard and Strauss 2004
Ecosystem threat status	Benthic and Pelagic threat status - Sink et al. 2012
Does it overlap with a threatened ecosystem type?	yes, benthic only
Have any mitigation measures been recommended?	no
Does it overlap with OMPA focus areas?	Yes
Which focus area does it overlap with?	Tugela Banks, iSimangaliso Offshore
Have any mitigation measures been recommended?	no

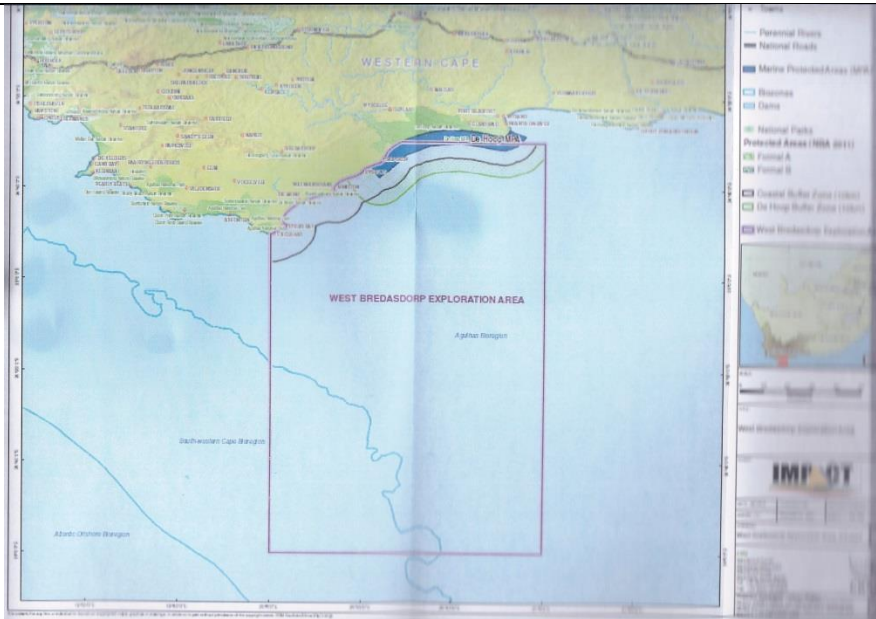
Document number	P6
Name of document	Environmental Management Programme for a seismic survey in Blocks 2931C, 2931D, 2932A and 2932C, East Coast, South Africa.
Date	27 May 2010
Acquired from	PASA
Author/Lead consultant	CCA Environmental (Pty) Ltd
Applicant	Silver Wave Energy (Pte) Ltd
Consultants/ Specialist studies	Specialist Study on Impact on Fishing - CapFish; Marine Faunal Assessment - Pisces Environmental Services; Description of the Offshore Environment of the East Coast - Centre for Marine Studies
Location	Blocks 2931C, 2931D, 2932A and 2932C fall within the offshore area of the East Coast between Durban and Richards Bay..
Scan of map	 <p>Figure 1.2: Proposed survey area within Blocks 2931C, 2931D, 2932A and 2932C.</p>
Proposed activities	2D seismic surveys
Ecosystem map	None
Ecosystem threat status	None
Does it overlap with a threatened ecosystem type?	not considered
Have any mitigation measures been recommended?	not considered
Does it overlap with OMPA focus areas?	not considered
Which focus area does it overlap with?	not considered
Have any mitigation measures been recommended?	not considered

Document number	P7
Name of document	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.
Date	26 October 2012
Acquired from	PASA
Author/Lead consultant	CCA Environmental (Pty) Ltd
Applicant	Total E and P South Africa (Pty) Ltd
Consultants/ Specialist studies	Specialist Study on Impact on Fishing - CapFish; Marine Faunal Assessment - Pisces Environmental Services
Location	The Outeniqua South Area is situated deep offshore roughly between Cape Agulhas and Cape St Francis
Scan of map	
Proposed activities	2D seismic surveys, drop core sampling, sonar bathymetry
Ecosystem map	NSBA Bioregions - Lombard et al. 2005
Ecosystem threat status	Ecosystem threat status - Sink et al. 2012 (benthic only)
Does it overlap with a threatened ecosystem type?	yes
Have any mitigation measures been recommended?	no
Does it overlap with OMPA focus areas?	Yes
Which focus area does it overlap with?	Southwest Indian Seamounts and Browns Bank
Have any mitigation measures been recommended?	no

Document number	P8
Name of document	Environmental Management Plan for a proposed 2D speculative seismic survey off the South and East Coasts of South Africa.
Date	01 October 2012
Acquired from	PASA
Author/Lead consultant	CCA Environmental (Pty) Ltd
Applicant	Petroleum Geo-Services
Consultants/ Specialist studies	Specialist Study on Impact on Fishing - CapFish; Marine Faunal Assessment - Pisces Environmental Services
Location	Most of the area located beyond 100m depth contour, with closest point to shore being approximately 30 km between Quoin Point and Cape Infanta and 30km between Cape St Francis and Port Edward. The entire area spans from Cape Agulhas to Port Edward.
Scan of map	 <p>Figure 1.1: Location of PGS's speculative 2D seismic survey off the South and East coasts of South Africa. The position of the survey lines is only indicative at this stage.</p>
Proposed activities	2D seismic survey
Ecosystem map	NSBA Bioregions - Lombard et al. 2005
Ecosystem threat status	Ecosystem threat status - Sink et al. 2012 (benthic only)
Does it overlap with a threatened ecosystem type?	Yes
Have any mitigation measures been recommended?	no
Does it overlap with OMPA focus areas?	Yes
Which focus area does it overlap with?	Port Elizabeth Offshore
Have any mitigation measures been recommended?	no

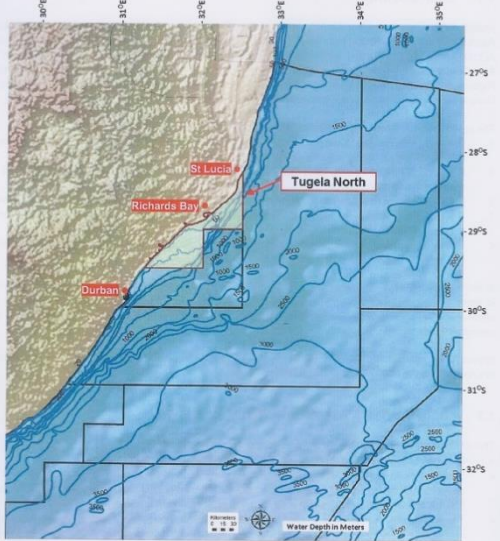
Document number	P9
Name of document	Transkei and Algoa Exploration Area: Environmental Management Programme
Date	26 June 2013
Acquired from	PASA
Author/Lead consultant	Environmental Resources Management
Applicant	Impact Africa
Consultants/ Specialist studies	Specialist Study on Impact on Fishing - CapFish; Marine Faunal Assessment - Pisces Environmental Services, Marine Archaeology - African Centre for Heritage Activities
Location	Port Elizabeth to Ramsgate, to maximum distance of 135km offshore
Scan of map	
Proposed activities	2D and 3D seismic surveys, Airborne geophysics, multibeam echosounder, seabed and water column sampling
Ecosystem map	NSBA 2004 Bioregions - Lombard et al. 2005
Ecosystem threat status	not considered
Does it overlap with a threatened ecosystem type?	not considered
Have any mitigation measures been recommended?	not considered
Does it overlap with OMPA focus areas?	Yes
Which focus area does it overlap with?	Port Elizabeth Offshore, Protea Banks
Have any mitigation measures been recommended?	no

Document numbers	P10
Name of document	Environmental Management Programme Addendum for a proposed seafloor geochemical sampling programme in Licence Blocks 5/6 (ER #224) and 7 (ER #228), South- West Coast, South Africa.
Date	23 July 2013
Acquired from	PASA
Author/Lead consultant	CCA Environmental (Pty) Ltd
Applicant	Anadarko South Africa (Pty) Lts
Consultants/ Specialist studies	Specialist Study on Impact on Fishing - CapFish; Marine Faunal Assessment - Pisces Environmental Services
Location	Off SW Coast, area extends from 100m depth contour to beyond the continental shelf
Scan of map	 <p>Figure 1.1: Location of Licence Blocks 5/6 (ER#224) & 7 (ER#228) off the South-West Coast of South Africa.</p> <p>CCA Environmental (Pty) Ltd 1-2 EMP Addendum</p>
Proposed activities	piston coring, seafloor heatflow measuring, multi-beam bathymetry survey
Ecosystem map	NSBA 2004 Bioregions - Lombard et al. 2005
Ecosystem threat status	NBA Benthic and Pelagic threat status - Sink et al. 2012
Does it overlap with a threatened ecosystem type?	yes
Have any mitigation measures been recommended?	no, impact considered INSIGNIFICANT .
Does it overlap with OMPA focus areas?	Yes
Which focus area does it overlap with?	Cape Canyon, Protea Seamount and Brown's Bank
Have any mitigation measures been recommended?	No

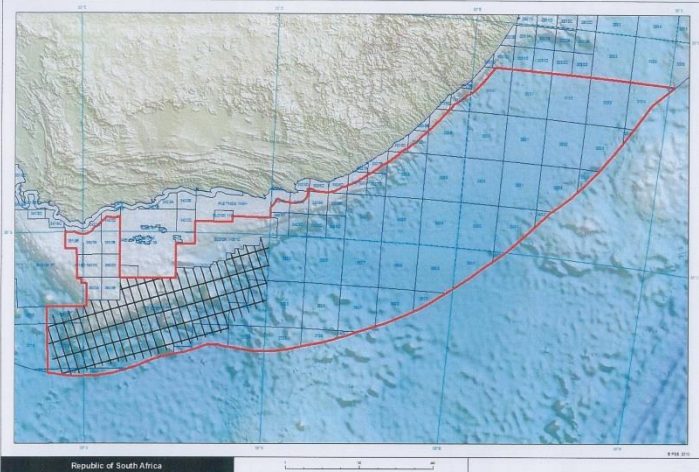
Document number	P11
Name of document	West Bredasdorp Exploration Area: Environmental Management Programme
Date	08 March 2013
Acquired from	PASA
Author/Lead consultant	Environmental Resources Management
Applicant	Impact Africa
Consultants/ Specialist studies	Specialist Study on Impact on Fishing - CapFish; Marine Faunal Assessment - Pisces Environmental Services
Location	Roughly located between Cape Agulhas and Algoa Bay, from coastline to approximately 200m depth contour
Scan of map	
Proposed activities	Piston coring, airborne geophysics acquisition, surface heatflow measuring, multi-beam seabed bathymetry, seismic survey
Ecosystem map	NSBA 2004 Bioregions - Lombard et al. 2005
Ecosystem threat status	not considered
Does it overlap with a threatened ecosystem type?	not considered
Have any mitigation measures been recommended?	not considered
Does it overlap with OMPA focus areas?	Only Benthic selection map used, not considered
Which focus area does it overlap with?	not considered
Have any mitigation measures been recommended?	not considered

Document number	P12
Name of document	Northwest Pletmos Exploration Area: Environmental Management Programme
Date	24 July 2013
Acquired from	PASA
Author/Lead consultant	Environmental Resources Management
Applicant	OK Energy Ltd
Consultants/ Specialist studies	Specialist Study on Impact on Fishing - CapFish; Marine Faunal Assessment - Pisces Environmental Services
Location	Located offshore of Mossel Bay on the South Coast, Western Cape - from shoreline to approximately 100km offshore
Scan of map	
Proposed activities	2D and 3D seismic surveys, multibeam seabed bathymetry, airborne/marine vessel geophysics acquisition, surface heat flow measurements, piston coring
Ecosystem map	NSBA 2004 Bioregions - Lombard et al. 2005
Ecosystem threat status	not considered
Does it overlap with a threatened ecosystem type?	not considered
Have any mitigation measures been recommended?	not considered
Does it overlap with OMPA focus areas?	No
Which focus area does it overlap with?	not considered
Have any mitigation measures been recommended?	not considered

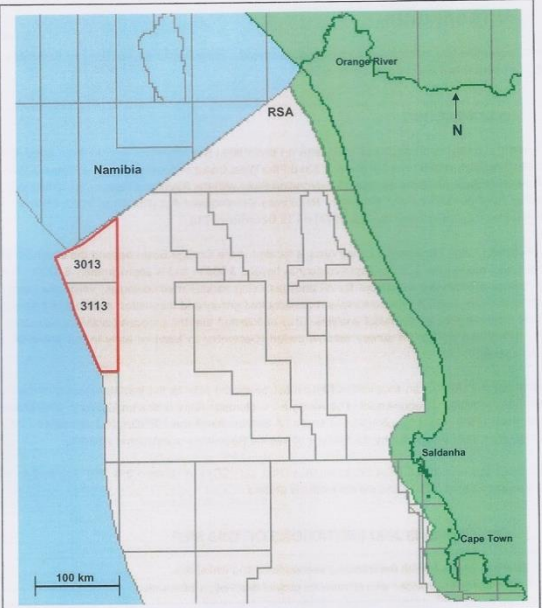
Document number	P13
Name of document	Environmental Management Programme for Proposed oil and gas exploration programme in licence block 2C, off the West Coast of South Africa.
Date	05 April 2013
Acquired from	PASA
Author/Lead consultant	CCA Environmental (Pty) Ltd
Applicant	Anadarko South Africa (Pty) Ltd
Consultants/ Specialist studies	Specialist Study on Impact on Fishing - CapFish; Marine Faunal Assessment - Pisces Environmental Services
Location	Situated off the West Coast in the Orange Basin roughly 200km offshore of the Northern Cape.
Scan of map	<p>Anadarko: Proposed oil and gas exploration programme in Block 2C, West Coast, South Africa</p> <ul style="list-style-type: none"> Specialists were provided with all relevant information required in order to produce accurate and unbiased assessments. <p>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.</p> <p>Figure 1.1: Location of the proposed Exploration Right area in Block 2C off the West Coast of South Africa.</p> <p>CCA Environmental (Pty) Ltd 1-2 EMP</p>
Proposed activities	2D and 3D seismic surveys, piston coring, seafloor heat flow measurements,
Ecosystem map	NSBA 2004 Bioregions - Lombard et al. 2005
Ecosystem threat status	NBA Benthic and Pelagic threat status - Sink et al. 2012
Does it overlap with a threatened ecosystem type?	yes
Have any mitigation measures been recommended?	no, impact deemed insignificant
Does it overlap with OMPA focus areas?	yes
Which focus area does it overlap with?	Childs Bank
Have any mitigation measures been recommended?	no, impact deemed insignificant

Document number	P14
Name of document	Environmental Management Programme for a proposed oil and gas exploration programme in the Tugela North area off the East Coast of SA
Date	08 March 2013
Acquired from	PASA
Author/Lead consultant	CCA Environmental (Pty) Ltd
Applicant	Impact Africa Limited
Consultants/ Specialist studies	Specialist Study on Impact on Fishing - CapFish; Marine Faunal Assessment - Pisces Environmental Services
Location	Tugela North is situated roughly between Salt Rock and St Lucia from the coast out to a maximum depth of ~1200m
Scan of map	 <p>Figure 1.1: Location of the proposed Exploration Right area (Tugela North) off the East Coast of South Africa.</p>
Proposed activities	Airborne geophysics acquisition, 2D and 3D seismic surveys, surface heat flow measurements, multibeam bathymetry acquisition, piston coring, box coring/grab samples
Ecosystem map	NSBA 2004 Bioregions - Lombard et al. 2005
Ecosystem threat status	NBA Benthic and Pelagic threat status - Sink et al. 2012
Does it overlap with a threatened ecosystem type?	yes
Have any mitigation measures been recommended?	no, impact deemed insignificant
Does it overlap with OMPA focus areas?	yes
Which focus area does it overlap with?	iSimangaliso Offshore, Tugela Banks
Have any mitigation measures been recommended?	no, impact deemed insignificant

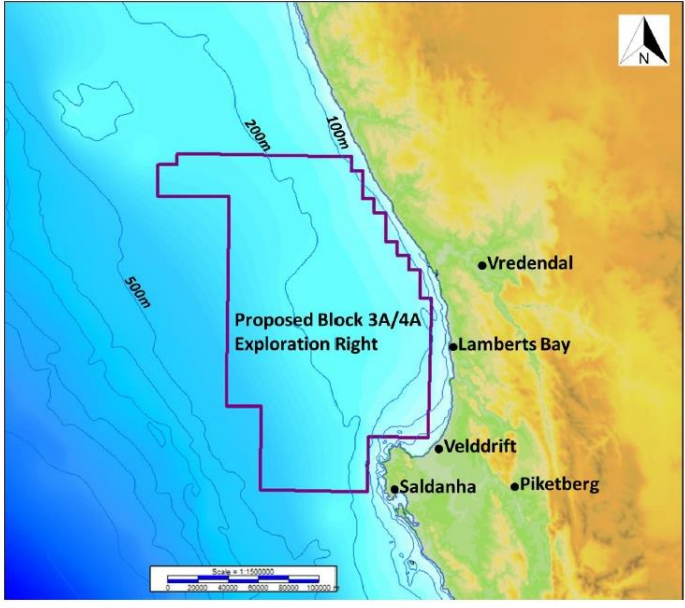
Document number	P15
Name of document	Environmental Management Plan for a reconnaissance permit to undertake a speculative 2D seismic survey in the Orange Basin off the West Coast of SA
Date	11 November 2013
Acquired from	PASA
Author/Lead consultant	CCA Environmental (Pty) Ltd
Applicant	Spectrum ASA
Consultants/Specialist studies	Specialist Study on Impact on Fishing - CapFish; Marine Faunal Assessment - Pisces Environmental Services
Location	Located along the SA border with Namibia, undertaken in water depth of between 50m and 3000m
Scan of map	
Proposed activities	2D seismic survey
Ecosystem map	NSBA 2004 Bioregions - Lombard et al. 2005
Ecosystem threat status	NBA Benthic and Pelagic threat status - Sink et al. 2012
Does it overlap with a threatened ecosystem type?	yes
Have any mitigation measures been recommended?	no, impacted deemed insignificant
Does it overlap with OMPA focus areas?	no
Which focus area does it overlap with?	n/a
Have any mitigation measures been recommended?	n/a

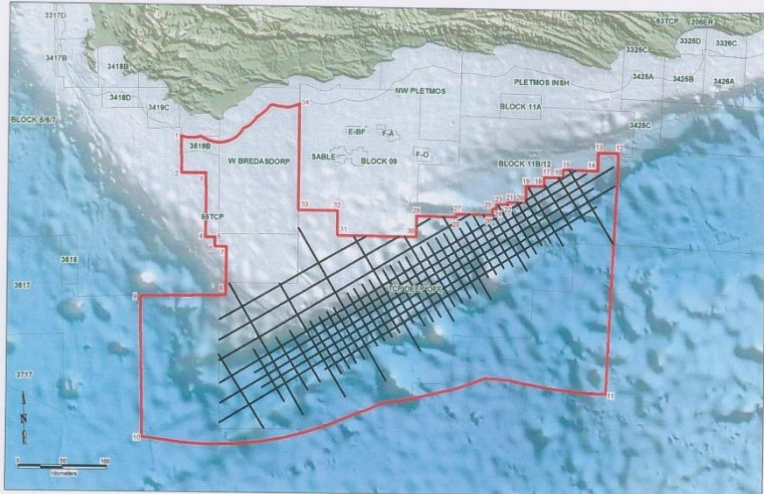
Document number	P16
Name of document	An Environmental Management Plan Addendum for a proposed 2D speculative seismic survey off the South Coast of South Africa.
Date	26 September 2013
Acquired from	PASA
Author/Lead consultant	CCA Environmental (Pty) Ltd
Applicant	Petroleum Geo-Services
Consultants/Specialist studies	Specialist Study on Impact on Fishing - CapFish; Marine Faunal Assessment - Pisces Environmental Services
Location	The proposed survey area is located a substantial distance offshore roughly between Cape Agulhas and Cape St. Francis in water depths ranging from 200m to over 4000m.
Scan of map	 <p>Figure 1.2: Location of the expanded speculative 2D seismic survey off the South Coast of South Africa.</p> <p>CCA Environmental (Pty) Ltd 1-4 EMP Addendum</p>
Proposed activities	2D seismic survey
Ecosystem map	NSBA 2004 Bioregions - Lombard et al. 2005
Ecosystem threat status	NBA Benthic and Pelagic threat status - Sink et al. 2012
Does it overlap with a threatened ecosystem type?	yes
Have any mitigation measures been recommended?	no
Does it overlap with OMPA focus areas?	Yes
Which focus area does it overlap with?	Southwest Indian Seamounts, Browns Bank
Have any mitigation measures been recommended?	no

Document number	P17
Name of document	Deepwater Durban Exploration Area: Environmental Management Programme
Date	14 March 2014
Acquired from	PASA
Author/Lead consultant	Environmental Resources Management
Applicant	Exxon Mobil Exploration and Production South Africa Limited
Consultants/ Specialist studies	Specialist Study on Impact on Fishing - CapFish; Marine Faunal Assessment - Pisces Environmental Services
Location	Offshore of Durban between Port St Johns and Richards Bay.
Scan of map	
Proposed activities	2D seismic, 3D seismic, Seabed surface heat flow measurements, seabed and water column sampling including piston coring, multibeam echo sounder and sub-bottom profile survey, autonomous underwater vehicle survey.
Ecosystem map	NBA Coastal and Benthic Ecosystem types - Sink et al. 2012, NSBA 2004 Bioregions - Lombard et al. 2005
Ecosystem threat status	none
Does it overlap with a threatened ecosystem type?	not considered
Have any mitigation measures been recommended?	not considered
Does it overlap with OMPA focus areas?	no - was cited
Which focus area does it overlap with?	n/a
Have any mitigation measures been recommended?	n/a

Document number	P18
Name of document	Environmental Management Programme for an Exploration Right in the Northern Cape Ultra-deep Licence Areas in the Orange Basin, West Coast of South Africa.
Date	04 April 2014
Acquired from	PASA
Author/Lead consultant	CCA Environmental (Pty) Ltd
Applicant	OK Energy Limited
Consultants/ Specialist studies	Specialist Study on Impact on Fishing - CapFish; Marine Faunal Assessment - Pisces Environmental Services
Location	Area is located off the continental shelf in the Orange Basin off the West Coast of SA
Scan of map	<p>OK Energy: Proposed exploration programme in the Northern Cape Ultra-deep Licence Area, West Coast of South Africa</p>  <p>Figure 1.1: Location of the Northern Cape Ultra-deep Licence Area in the Orange Basin off the West Coast of South Africa (red outline).</p>
Proposed activities	2D seismic survey, 3D seismic, boat acquired full tensor gravity magnetics, multi-beam bathymetry, seafloor sampling (piston coring)
Ecosystem map	NSBA 2004 Bioregions - Lombard et al. 2005
Ecosystem threat status	NBA Benthic and Pelagic threat status - Sink et al. 2012
Does it overlap with a threatened ecosystem type?	no
Have any mitigation measures been recommended?	n/a
Does it overlap with OMPA focus areas?	no
Which focus area does it overlap with?	n/a
Have any mitigation measures been recommended?	n/a

Document number	P19
Name of document	Environmental Management Programme: Exploration Right for oil and gas in Blocks 2734, 2735, 2834, 2835, 2934, 2935 and 3034 located off the KwaZulu-Natal coast.
Date	01 April 2014
Acquired from	PASA
Author/Lead consultant	Environmental Impact Management Services
Applicant	Silver Wave Energy PTE LTD
Consultants/ Specialist studies	Specialist Study on Impact on Fishing - CapFish; Marine Faunal Assessment - Pisces Environmental Services
Location	The proposed exploration right application area is located approximately 110km off the coast of KwaZulu-Natal.
Scan of map	<p>Figure 1: Location of exploration area</p>
Proposed activities	2D seismic survey
Ecosystem map	NBA 2011 Benthic ecosystem types - Sink et al. 2012, Bioregions - Lombard et al. 2005
Ecosystem threat status	NBA 2011 Benthic threat status - Sink et al. 2012
Does it overlap with a threatened ecosystem type?	no
Have any mitigation measures been recommended?	n/a
Does it overlap with OMPA focus areas?	not considered
Which focus area does it overlap with?	n/a
Have any mitigation measures been recommended?	n/a

Document number	P20
Name of document	Environmental Management Programme: Exploration and geophysical surveys in Licence Block 3A/4A, off the West Coast of South Africa
Date	14 August 2014
Acquired from	Jeffares & Green Engineering and Environmental Consultants (Pty) Ltd
Author/Lead consultant	Jeffares & Green Engineering and Environmental Consultants (Pty) Ltd
Applicant	The Petroleum Oil and Gas Corporation of South Africa (SOC) Ltd.
Consultants/ Specialist studies	Specialist Study on Impact on Fishing - CapFish; Marine Faunal Assessment - Pisces Environmental Services
Location	Block 3A/4A is a 25 332 km ² license block located off the West Coast of South Africa in water depths ranging from 20 m to about 480 m.
Scan of map	 <p>Figure 1.1: Position of Block 3A/4A off the West Coast of South Africa</p>
Proposed activities	2D and 3D Seismic Survey, Airborne gravity and magnetic survey, high resolution bathymetry survey, seabed sampling and heatflow measurements.
Ecosystem map	Bioregions - Lombard et al. 2005
Ecosystem threat status	NBA Benthic and Pelagic threat status - Sink et al. 2012
Does it overlap with a threatened ecosystem type?	marginal overlap, yes
Have any mitigation measures been recommended?	no
Does it overlap with OMPA focus areas?	not considered
Which focus area does it overlap with?	n/a
Have any mitigation measures been recommended?	n/a

Document number	P21
Name of document	Environmental Management Plan for a proposed 2D speculative seismic survey off the South Coast of South Africa
Date	29-Apr-14
Acquired from	PASA
Author/Lead consultant	CCA Environmental (Pty) Ltd
Applicant	Petroleum Geo-Services
Consultants/ Specialist studies	Specialist Study on Impact on Fishing - CapFish; Marine Faunal Assessment - Pisces Environmental Services
Location	Located offshore between Cape Agulhas and Cape St. Francis in water depths ranging from 200 m to over 4000 m.
Scan of map	 <p>Figure 1.1: Location of the Reconnaissance Permit area (red outline) and preliminary 2D seismic survey lines.</p>
Proposed activities	2D seismic survey
Ecosystem map	Bioregions - Lombard et al. 2005
Ecosystem threat status	NBA Benthic and Pelagic threat status - Sink et al. 2012
Does it overlap with a threatened ecosystem type?	Yes
Have any mitigation measures been recommended?	no
Does it overlap with OMPA focus areas?	Yes
Which focus area does it overlap with?	Southwest Indian Seamounts, Browns Bank
Have any mitigation measures been recommended?	no

APPENDIX VI: Spatial analysis results for EMPs overlap with NBA 2011 Benthic Ecosystem Threat Status Map.

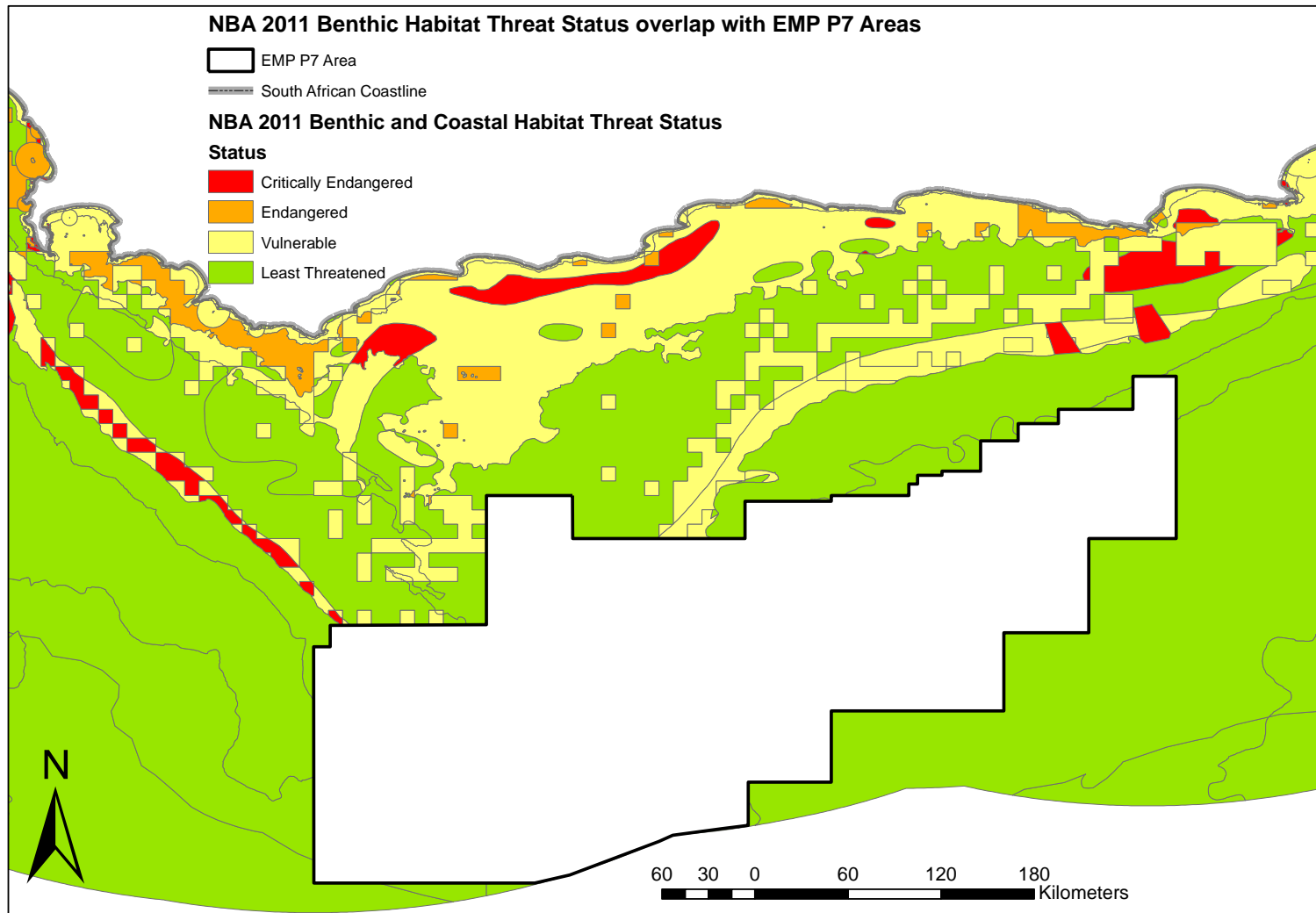


Figure 38: Map of EMP P7 Area overlap with NBA 2011 threatened benthic ecosystems.

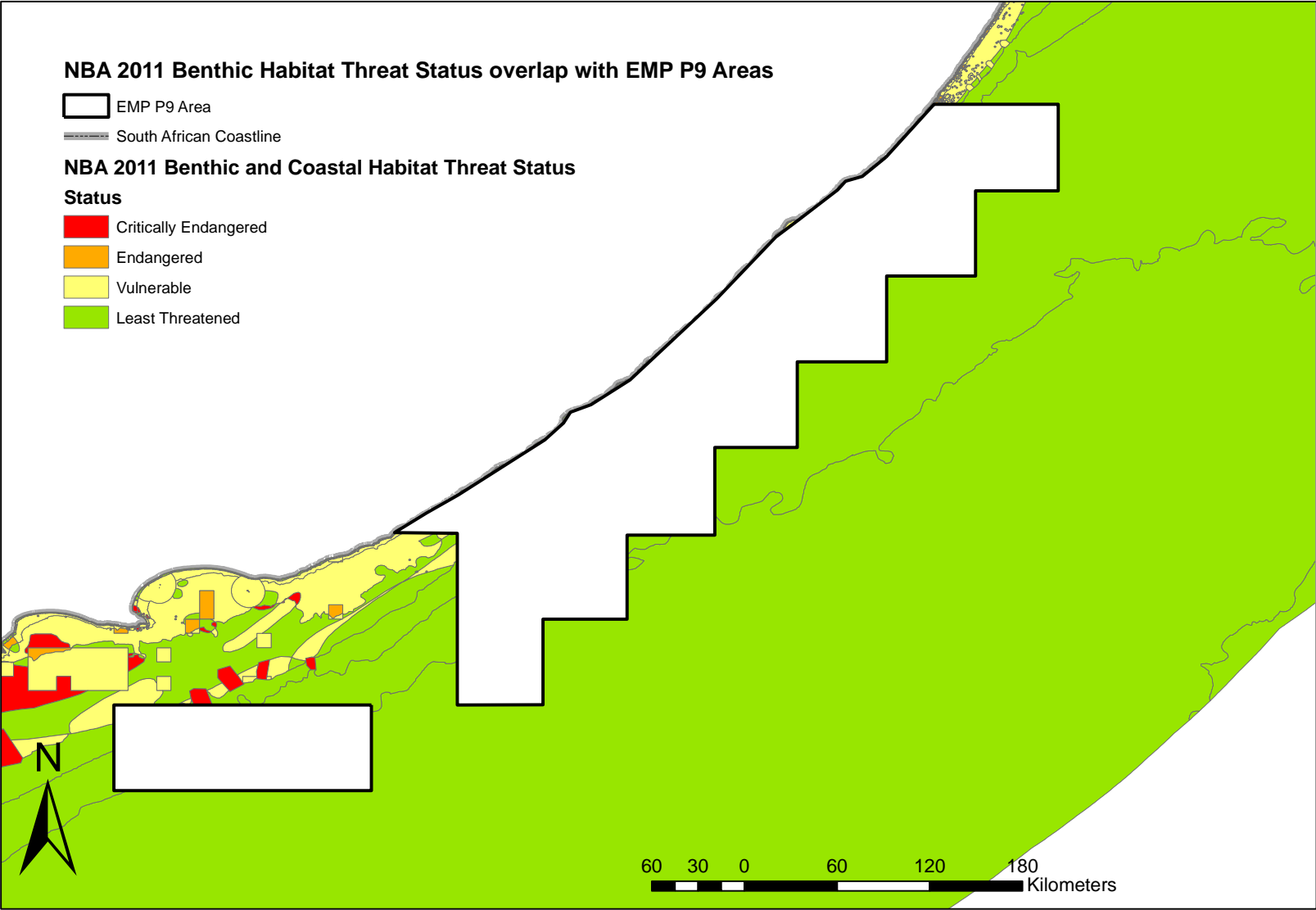


Figure 39: Map of EMP P9 Area overlap with NBA 2011 threatened benthic ecosystems.

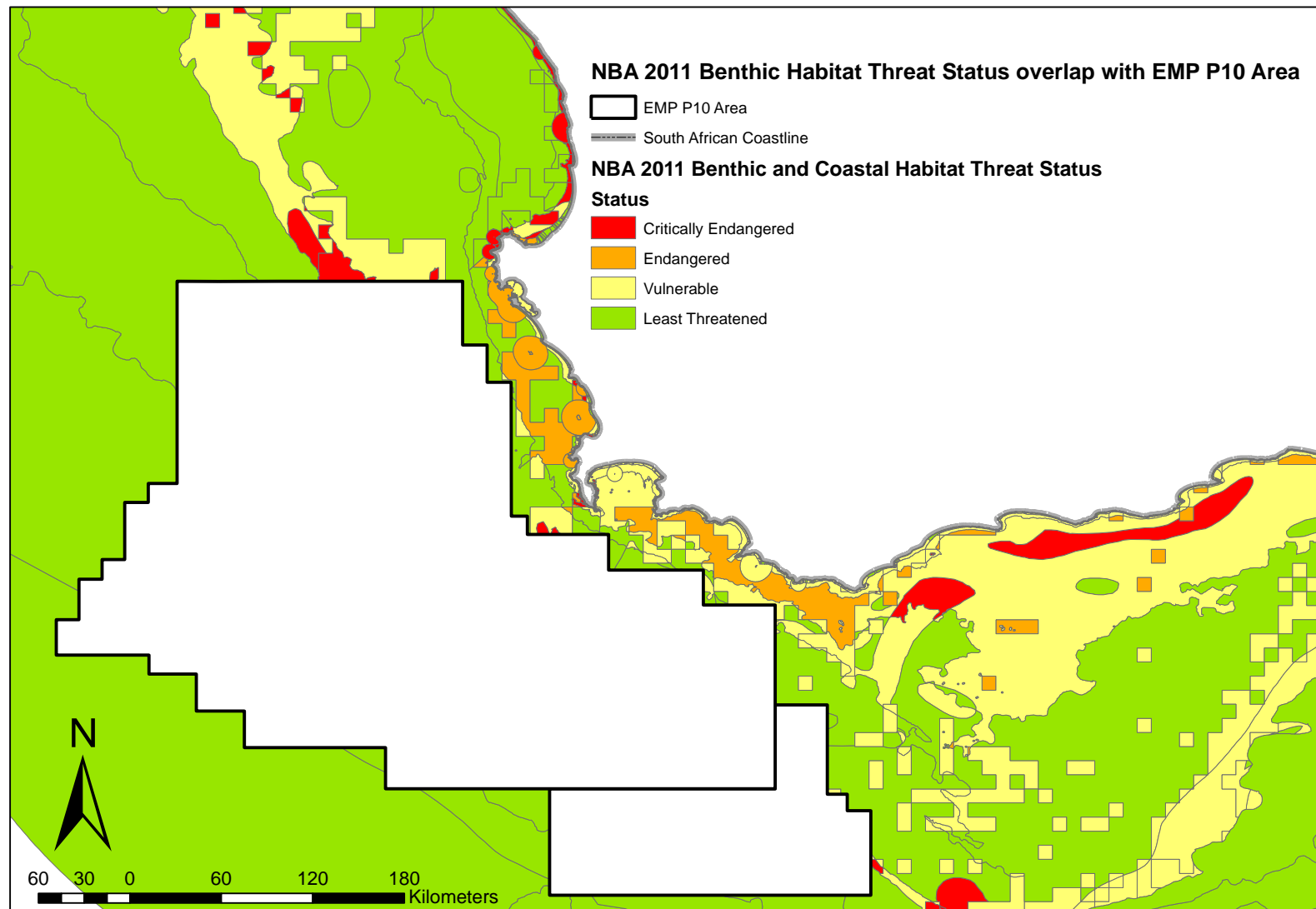


Figure 40: Map of EMP P10 Area overlap with NBA 2011 threatened benthic ecosystems.

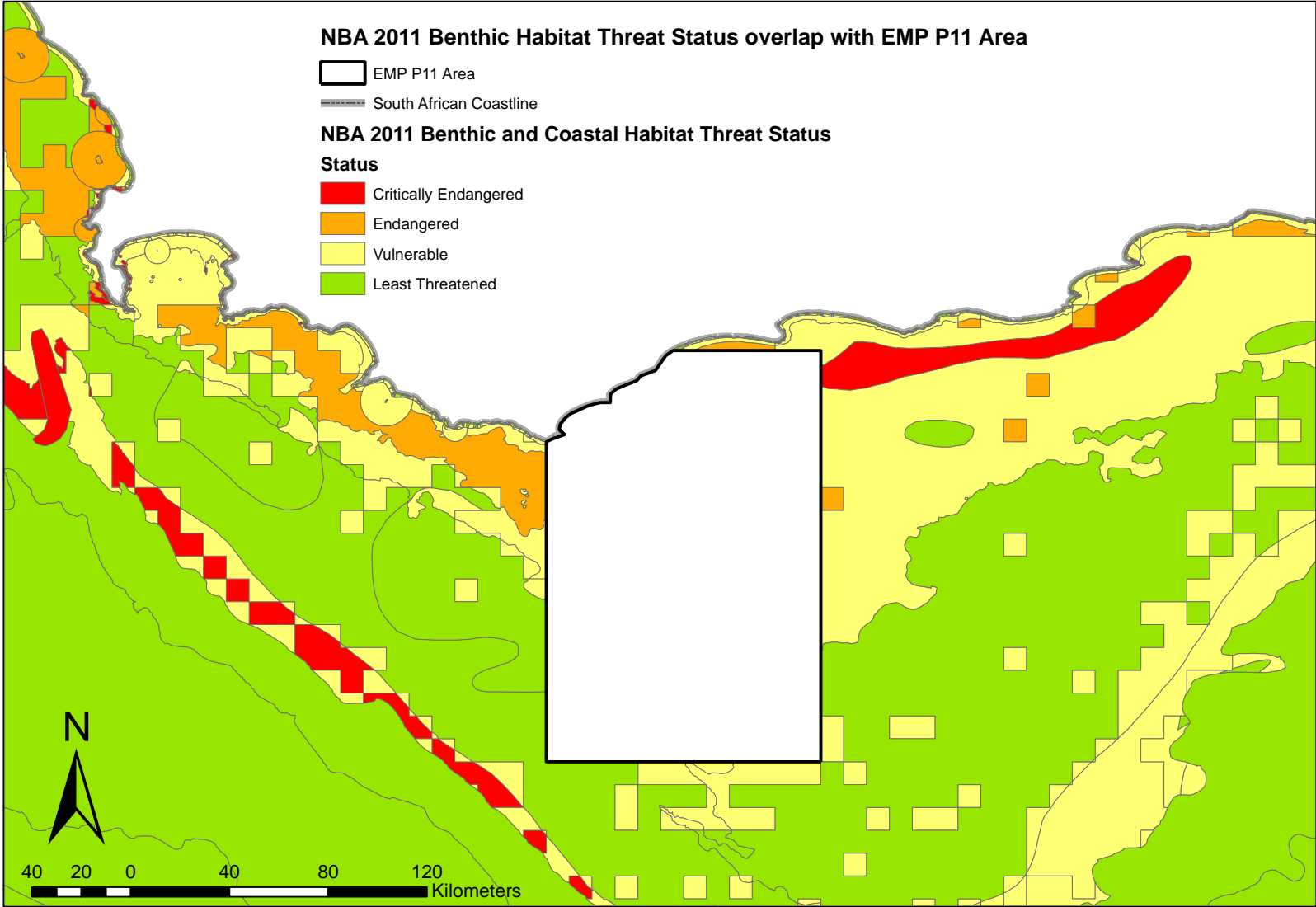


Figure 41: Map of EMP P11 Area overlap with NBA 2011 threatened benthic ecosystems.

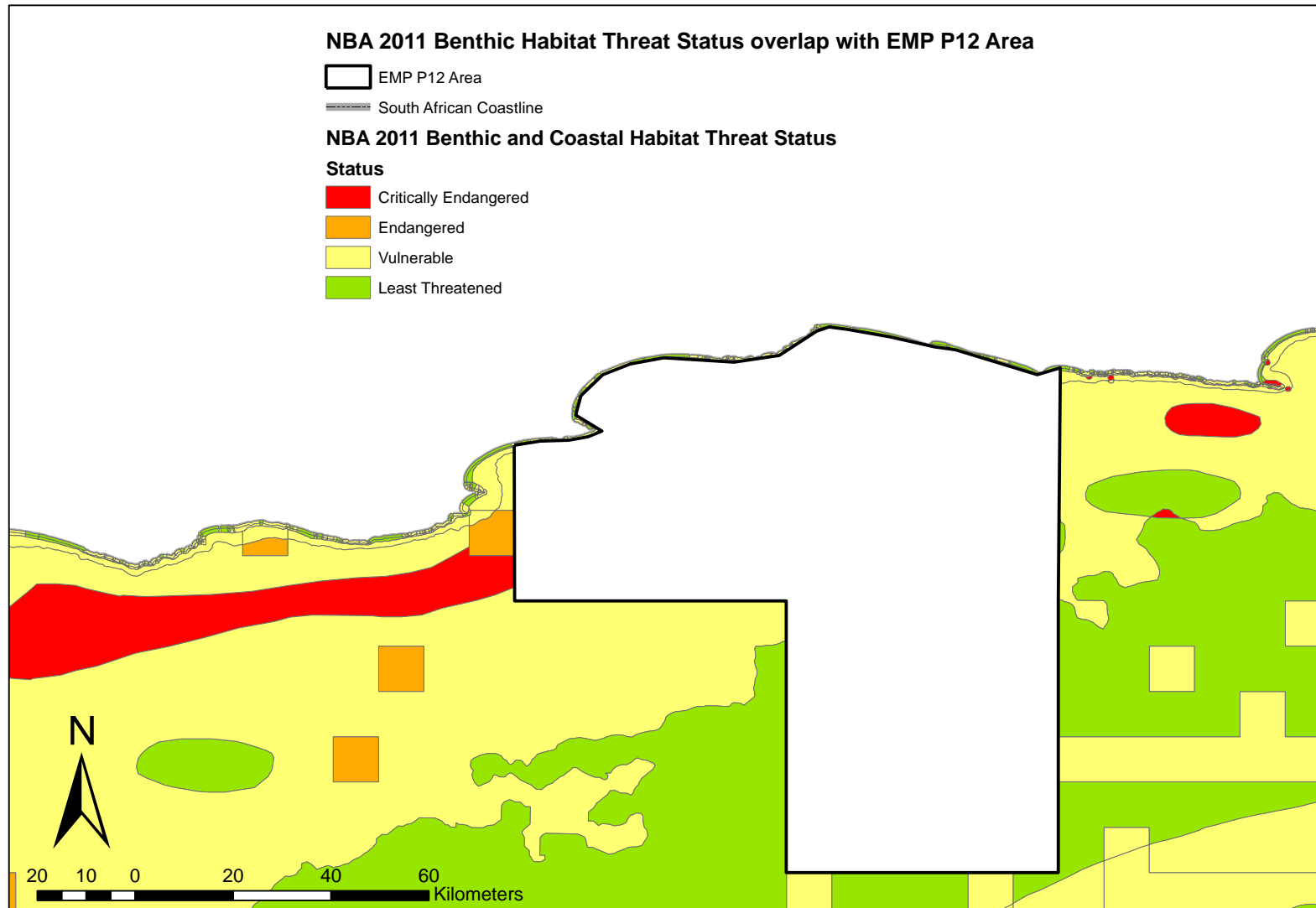


Figure 42: Map of EMP P12 Area overlap with NBA 2011 threatened benthic ecosystems.

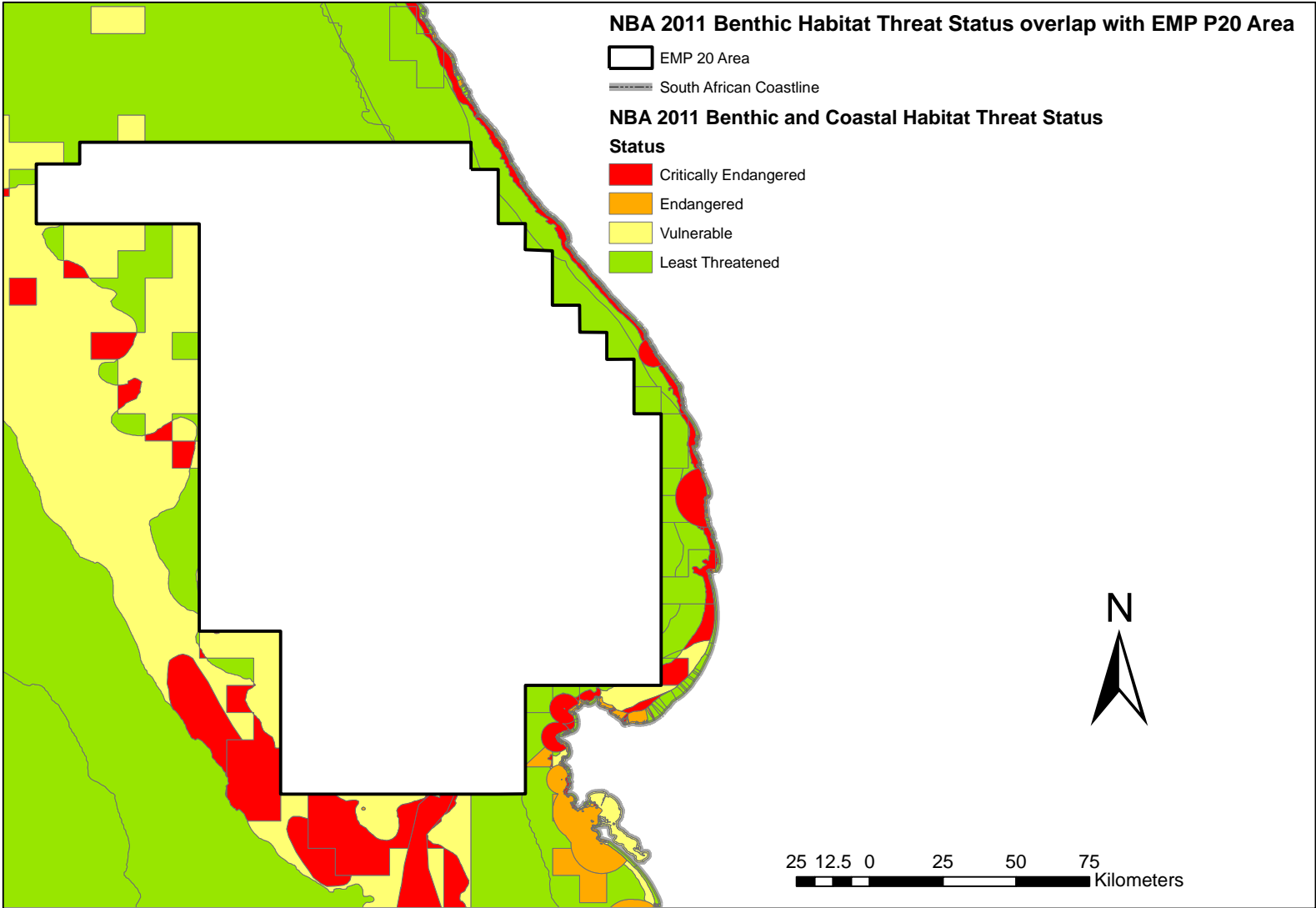


Figure 43: Map of EMP P20 Area overlap with NBA 2011 threatened benthic ecosystems.