Marine Ecosystem Asset Accounts: Developments from South Africa

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Abstract:

The new wave of interest in Ocean Economies worldwide has highlighted the many current benefits and potential opportunities that our global seas provide. However, consideration of these benefits and opportunities has historically not been adequately represented in terms of their contribution to the wealth of countries, with few tools available to measure the benefits. With the implementation of projects and programmes to expand on maritime economic activities to assist in economic growth, further attention is required to the natural systems that underpin current and future economic activities. Concurrently, the roll-out of Marine Spatial Planning around the world, and in South Africa, has also highlighted the need for spatially explicit tools to monitor and evaluate progress for environmentally sustainable development. Marine Ecosystem Accounting and Oceans Accounting more broadly provide policy support tools to account for these natural assets in space and time. This accounting includes the contribution made by nature to economies and human well-being, and the actions and related consequences that could improve or undermine these natural assets and their ability to continue delivering on these services and benefits.

Statistics South Africa has a long history of developing accounts for natural assets, with the latest development being the publication of the first *Land and Terrestrial Ecosystem Accounts, 1990 to 2014 (discussion document no: D0401.1)* in December 2020 launching Statistics South Africa's new *Natural Capital* series. In an effort to expand Natural Capital Accounting into other environmental realms, work is being undertaken by Statistics South Africa (Stats SA) and the South African National Biodiversity Institute (SANBI) to develop ecosystem asset accounts for the South African marine realm, beginning with ecosystem extent accounts. Although ecosystem mapping in South Africa for the marine realm is relatively young compared to terrestrial mapping, many advances have been made in the last decade to develop a comprehensive marine ecosystem map that uses thousands of data points related to oceanographic information, species distribution and ecology, bathymetry, and geological data to define 150 ecosystem types. This has provided a good platform from which to develop marine ecosystem accounts. Accounting at the ecosystem level allows for more accurate accounting for ecological infrastructure and the flow of services and benefits from marine ecosystems. It also allows for improved biodiversity assessment and accounting for condition.

This paper provides a brief, easily digestible breakdown of the marine ecosystem map and the development of the first set of marine ecosystem extent accounts for South Africa and will link these to policy interventions currently underway that marine ecosystem accounts can support.

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1 Introduction

Oceans have potentially played the greatest role in the development of the global community we see today. Ship travel not only provided the avenue for the connection of the “Old” and “New Worlds”, but it remains the primary vehicle to connect national economies today with more than 90% of goods transported by sea globally (George 2013). There is also archaeological evidence that suggests consumption of seafood may have led to the birth of culture, as coastal caves with rock art and evidence of jewellery crafted from seashells have been discovered (Marean 2010, 2014). The marine realm has once again come to the fore as a key aspect of ensuring prosperity in our collective futures with increasing global focus on expanding Ocean Economies.

The South African Ocean Economy is currently estimated to contribute US$6.3 billion to the South African Gross Domestic Product (GDP) (Operation Phakisa 2016), with over a quarter of South African goods and products exported and over a third of spending going to goods imported by sea (Potgieter 2018). The expansion and diversification of maritime activities in South Africa is expected to contribute an additional R177 billion by 2033 (Finke et al. 2020) to

the South African GDP through increased access to fishing rights, improved and new harbour facilities and maritime services, increased mining and oil and gas production activity, potential expansion of renewable energy, and improved market-share of the global nature-based tourism sector. Alongside these lofty economic goals, SA has recognised the need for improved compliance and monitoring, and greater cognisance of the role that the natural environment plays in our economy and its contributions to human wellbeing through implementation of high-level government initiatives accompanied by policy and legislative interventions.

A government initiative, Operation Phakisa ("phakisa" [pronounced *pah kee sah*] means "hurry up" in Sesotho), was initiated in 2014 to fast-track development of the ocean economy (Finke et al. 2020). This has led to several programmes of work (e.g., to improve compliance monitoring and enforcement, upgrade existing and installation of new small harbours, and upgrading and installation of container harbours for international import and export) along the coast and in the SA mainland marine territory. Most notably of these programmes is the implementation of Marine Spatial Planning (MSP). MSP aims to create an enabling environment for increased investment into maritime sectors through the alleviation of cumbersome and expensive bureaucratic processes, reduction of competition for space, and by identifying areas of priority for biodiversity management. This will allow for the identification of areas where certain activities will be prioritised, and thus face fewer "risks" to investment by eliminating conflict between sectors and ensuring that development is environmentally sustainable at the outset. Operation Phakisa was also responsible for fast-tracking the establishment of additional marine protected areas (MPAs) resulting in a network that covers ~5% of the SA mainland marine territory (Sink et al. 2019b). Further expansion of MPAs will likely be taken forward through the MSP implementation process, however there is still a need to provide appropriate management of areas outside of the MPA network to ensure that development is both economically and environmentally sustainable.

The advent of Natural Capital Accounting (NCA), and Oceans Accounting more broadly, provide an opportunity for the development of practical accounting tools to measure the environmental sustainability of decision-making in the MSP process, as well as provide metrics to account for the current benefits and services that we derive from our ocean space alongside the potential risks to our biodiversity assets. The lack of metrics to measure current stocks and flows of benefits derived from the natural marine environment is not a new challenge, as work is still underway to communicate the importance of areas that support/provide benefits that are not linked to economic activities, e.g., wave attenuation and protection from increased storm surges, carbon sequestration and fisheries support areas. The production of Marine Ecosystem Extent Accounts forms part of the SA National NCA Strategy (Statistics South Africa 2021) and aims to provide an additional lens and tool by which the natural marine assets of the country can be accounted for within the Operation Phakisa: MSP framework.

The SA Marine Ecosystem Extent Accounts will provide the basis for the development of further accounts and are underpinned by the Marine Map of Ecosystem Types published in the 2018 National Biodiversity Assessment, also referred to as the NBA2018 (Sink et al. 2019a). SA has a long history of classifying and mapping terrestrial ecosystem types, with marine work being more recent. However, mapping work in the marine realm has advanced quite dramatically since its inception in 2004 and provides a good basis for the development of the first set of Marine Accounts.

This paper aims to:

- Provide the background of the Marine Map of Ecosystem Types and its development
- Highlight the usefulness and preference of utilising ecosystem types for accounting
- Comment on the usefulness of Marine Accounts in MSP and development of the SA Oceans Economy

2 Background

This section provides a short discussion on the differences between the definitions of habitats and ecosystems, followed by a synopsis of the development of marine ecosystem mapping in SA.

2.1 Habitats vs Ecosystems

Hall et al. (1997) defined habitats as "*the resources and conditions present in an area to produce occupancy – including survival and reproduction – by a given organism*". Habitats are, therefore, species-specific and are described in terms of the relationship of that species to the physical and biological characteristics of an area. Wherever resources are available, and conditions are favourable for that species, that place becomes its habitat and is inclusive of migration corridors, breeding sites, etc, that may vary in space and time based on its life history. Habitat types have traditionally referred to vegetation types and geological characteristics of an area (e.g., The IUCN Habitats Classification Scheme Version 3.1), and therefore provide generic descriptions for similar areas or communities and not much information on the interactions within the community or the community structure beyond habitat-forming components. Hence, they provide limited insight into the biodiversity processes of an area, but nonetheless are extremely useful in understanding and measuring impacts of habitat loss and potential opportunity for species of concern.

Ecosystems on the other hand, are defined as assemblages of living organisms, their interactions with each other, and their environment (Cadman et al. 2010, Chapin III et al. 2012), and similarly defined in legal terms in SA in the National Environmental Management: Biodiversity Act. Ecosystem types can be defined at multiple scales and are characterised by their biotic and abiotic components, their structure, and the ecological processes that maintain their structure and composition to maintain them as functioning units (Cadman et al. 2010). Ecosystems can therefore encompass different habitat types and provide much more detail on the inter-relationships of communities within them and their response to changing physical variables.

2.2 History of the Development of Marine and Coastal Ecosystem Mapping in SA

The first map of marine habitats was developed through the National Spatial Biodiversity Assessment in 2004 (Lombard et al. 2005). The resulting map was very simplistic, utilising only two mapping features, these being bioregions, defined by limited biotic and abiotic information, and depth breaks to identify 35 marine biozones (Figure 1), and relied heavily on expert opinion from marine scientists whose work had mainly focused on coastal ecosystems. This assessment mapped 5 broad coastal habitat types (cobble, pebble and sandy beaches, and mixed and rocky shores), defined 5 inshore (Namaqua, South-Western, Agulhas, Natal and Delagoa)) and 4 offshore bioregions (Atlantic, Indo-Pacific, West Indian and South-west Indian), and digitised historical sediment data for offshore regions from the late 1980s. Species

data was limited at the time for individual species distribution, but also lacking in taxonomic and other ecological (i.e. the relationship between species, and the environment) information.

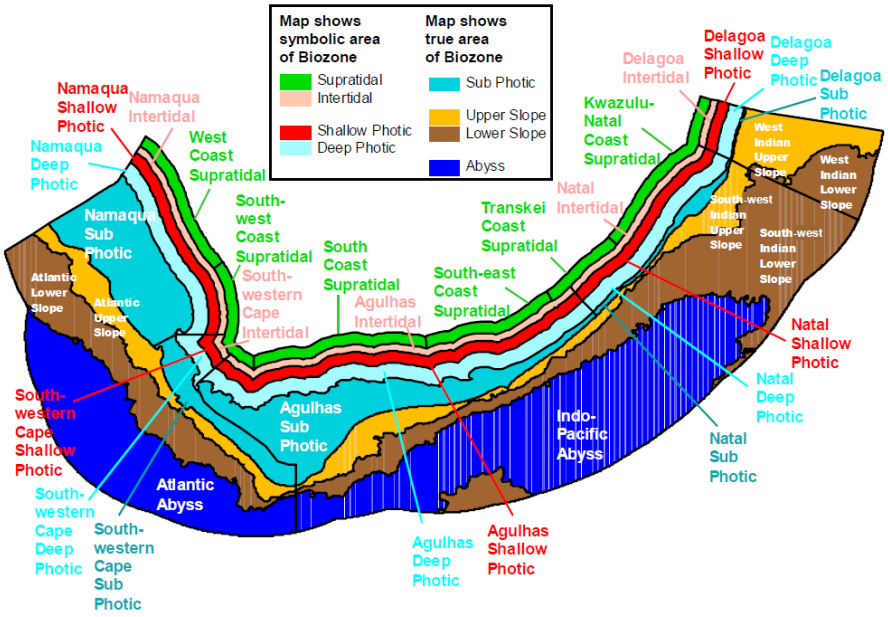

Figure 1: The map of marine biozones as identified in the NSBA2004 (Lombard et al. 2005).

Many improvements were achieved by 2012 when the National Biodiversity Assessment 2011: Marine and Coastal Component (NBA2011) was published (Sink et al. 2012). This saw the first publication of a Map of Marine and Coastal Habitat Types in SA. Although the name suggested that the map spatially represented habitat types, it is more accurate to describe it as the first map of marine ecosystem types as the revised classification system used in the NBA2011 included interacting assemblages of species, their physical habitat, and trophic structure as ecological communities, thus meeting the requirements of the definition for ecosystems. This revised classification also recognised the differences in biogeographic pattern, thus allowing for finer-scale differences in ecosystem morphology and species composition to inform the process. The NBA2011 also recognised the differences between the benthic and pelagic environments, and thus reported for benthic and pelagic habitat types separately. The resulting maps showcased 136 habitat types: 58 coastal and inshore habitat types (including harbours as artificial ecosystems) and 62 offshore benthic habitat types (Figure 2), and 16 offshore pelagic habitat types (Figure 3). The NBA2011 also introduced the concept of Broad Ecosystem Groups (BEGs) for the marine assessment which are groupings of similar habitat types based on physical features and function; however biogeographic differences account for significant differences in species composition and even ecology in many of these habitat types (Sink et al. 2012)

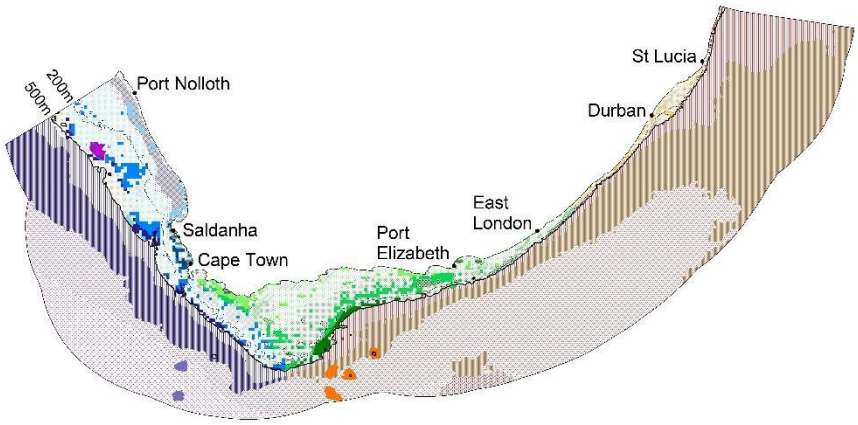

Figure 2: The Map of Benthic Habitat Types as published in the NBA2011 (Sink et al. 2012).

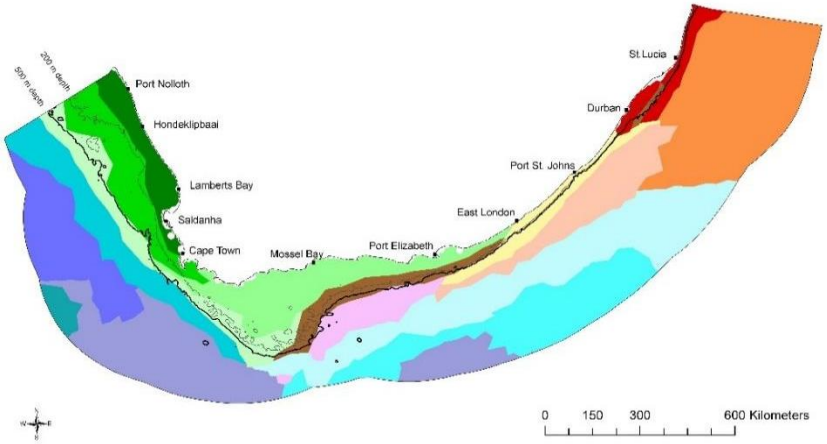

Figure 3: The Map of Pelagic Habitat Types as published in the NBA2011 (Sink et al. 2012).

The latest Map of Marine Ecosystems was published in 2019 once again forming part of the NBA2018 (Sink et al. 2019a). A key change in the assessment was the addition of the concept of a pre-industrial baseline. This baseline was set to 1750, a pre-colonial reference condition, corresponding approximately to the earliest onset of global industrial-scale exploitation of ecosystems (Bland et al. 2017). This led to changes in the classification, and the exclusion of artificial habitat types such as harbours, as the aim shifted to the mapping of the natural extent of ecosystem types. The revised classification system merged pelagic and benthic systems once again, although this was in response to requests from resources and environmental managers who found the differences in condition and threat status for overlapping biodiversity features too cumbersome to incorporate into management decisions, and requests from scientists who argued that in many instances it was difficult to decouple pelagic and benthic considerations in relation to impacts of human activities.

The 2018 Marine Ecosystem Classification and Map of Marine Ecosystems built on the 2011 ecosystem map, and key advances included the collation of substantial new datasets on bathymetry, sediment and seabed type, very fine-scale shore mapping with alignment and integration at the land-sea interface, the inclusion of kelp forests, bays and fluvial fans as distinct types and the introduction of finer depth strata across shelves and on the slope (Sink et al. 2019a). The inclusion of species data was strengthened by studies on benthic macrofauna (animals >2mm in size) and epifauna (animals that live on the seabed), data from

underwater visual surveys (e.g., from baited underwater camera, drop camera and sled monkey sampling), and the inclusion of museum and trawl species data including potential species linked to vulnerable marine ecosystems. The resulting map contains 150 marine ecosystem types, delineated by 3 marine Biogeographic Provinces and 6 Ecoregions with nested sub-regions.

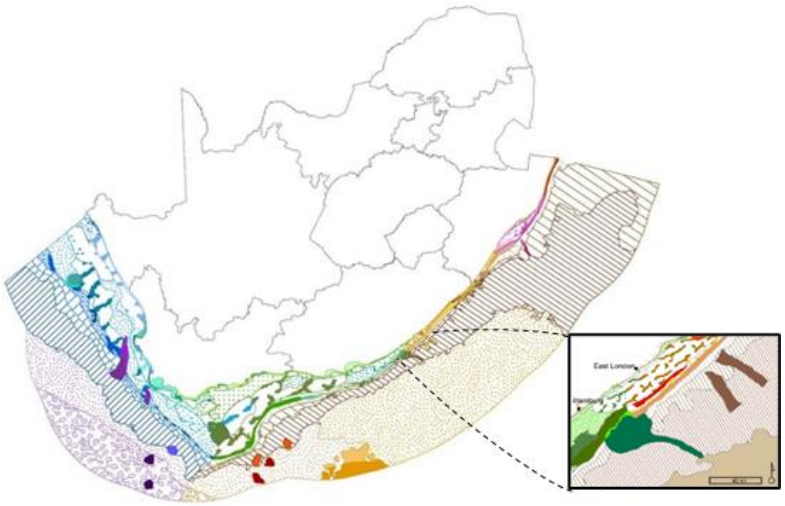

Figure 4: The Map of Marine Ecosystem Types as published in the NBA2018 (Sink et al. 2019).

The NBA 2018 Map of Marine Ecosystems will form the baseline data for the development of Marine Accounts.

3 Habitats vs Ecosystem Types as a unit of accounting

Examples of NCA accounts for marine and coastal habitats already exist (Schenau et al. 2019, Thornton et al. 2019) and clearly demonstrate that habitat accounts can be quite useful for developing basic accounts as an initial step, especially in instances where species and ecology data are not available. In settings where data on species and their ecology are available and there is potential for this to feed into ecosystem classification processes, the development of accounts based on ecosystems should be encouraged, as these would be cognisant of biotic and abiotic factors and would also provide additional incentives for nations to develop maps of ecosystem types.

Habitat accounts could potentially be very useful for local authorities, especially when conducting accounts in small accounting areas where environmental factors and species assemblages are similar across the different ecosystem assets for a specific habitat type. They could also potentially be useful when developing Natural Capital Accounts for Species; for example, one could account for remaining available habitat for a specific species in a spatially restricted accounting area, e.g., private game reserve or within an MPA. In the South African experience, habitat types have been found to be less useful at the national scale as there are great differences in abiotic factors (especially in oceanographic features) across the accounting area, which ultimately has shown (as would be expected) to result in changes in species assemblages and abundance between habitat types. This would therefore create a “false equivalence” between habitat types that may not be reflected in reality. Ecosystem types allow for more accurate accounting of ecosystem assets and can also be used to develop

habitat type accounts if need be. The reverse is not possible when developing ecosystem accounts using only maps of habitat types.

For example, SA uses 15 Broad Ecosystem Groups[1] for ease of assessment, and for greater ease of communication when sharing results and/or concerns with sea-users outside of the biodiversity sector. Of the broad ecosystem groups, kelp forests are recognised as key ecological infrastructure as they act as carbon sinks and provide wave attenuation during storms (Smale et al. 2016, Pfister et al. 2018, Wernberg and Filbee-Dexter 2018). The services derived from South African kelp forest ecosystems and associated reefs contribute about R5.8 billion per year, with direct services including recreational, commercial, and exploratory fisheries (Blamey and Bolton 2018). The broad ecosystem group for kelp forests is made up of three ecosystem types – the Agulhas Kelp Forest found on the south coast, the Cape Kelp Forest extending along the western portion of the south coast to the southern portion of the west coast, and the Namaqua Kelp Forest found at the northern parts of the west coast. Kelp forests are key habitats for rock lobster, and the West Coast Rock Lobster is the most valuable species harvested in South Africa per kg (Department of Agriculture, Forestry and Fisheries 2016). Kelp forests make up 0.18% of the total area allocated for commercial harvesting of WCRL and makes up 0.16% of the most heavily fished areas. However, not all kelp forests are equal as the Cape Kelp Forest makes up 90% of heavily commercially fished kelp forest areas, with the Agulhas Kelp Forest making up the remaining 10%. Using this information, we can infer that Cape Kelp Forest ecosystem types are the most productive in terms of fishing activity, and therefore potentially justify additional financial or human resources for improved management of this ecosystem type. This highlights the usefulness of using ecosystem types (rather than habitat types) in accounting processes in potential management decision making.

4 The road to Sea-use Classes? – Marine Spatial Planning in SA

Marine Spatial Planning (MSP) is like land-use planning in the terrestrial realm. Under Operation Phakisa, MSP is viewed as a key component to realising the goals of the National Development Plan (NDP2030) and aims to 1) unlock the potential of the oceans economy to increase its contribution to the GDP, 2) effectively communicate the value of the oceans to enable society to fully engage with their marine heritage, 3) ensure that development is environmentally sustainable to maintain biodiversity goods and services, and 4) to ensure good ocean governance through inter-governmental cooperation (The Republic of South Africa 2017). To achieve these aims, MSP will guide where and when certain human activities can take place. This is currently being developed through individual sector plans, where government departments in collaboration with their stakeholders are required to identify priority areas along with any future spatial areas of expansion envisioned for the next 20 years for their individual sector. Once priority areas have been identified, sectors are encouraged to develop conceptual zones along with a list of other sectors they feel would be compatible or not compatible with their activities, and therefore which sectors and/or activities could co-exist in the same area or zone, and which would jeopardise the purpose of the zone.

MSP is still at the early stages of development, although progress has been made on developing and passing legislation, i.e., the Marine Spatial Planning Act (The Republic of

[1] The Broad Ecosystem Groups used in the marine realm in South Africa are bays, canyons, deep rocky shelves, deep soft shelves, islands, kelp forests, plateaus, rocky shores, mixed shores, sandy shores, seamounts, shallow rocky shelves, shallow soft shelves, slopes and the abyss.

South Africa 2019), which has come into force in 2021. The MSP toolbox is therefore still under development, and NCA has been identified as one of the tools to monitor and report on sustainability targets for decisions. It is critical for development to truly be sustainable; baseline accounts also need to be developed in order to guide planning from the outset to avoid as many potentially negative decisions on biodiversity as possible. At the same time, potential environmental risks to economic investments can also be avoided or sufficiently mitigated. The development of marine accounts in SA therefore are being developed with this policy framework in mind.

5 Overview of the draft Marine Ecosystem Extent Accounts

5.1 Data used to develop the accounts

The baseline data used in the development of the first set of draft Marine Ecosystem Extent Accounts for South Africa are the Map of Marine and Coastal Ecosystem Types (which can be downloaded from bgis.sanbi.org). The spatial limits of the dataset are from the dune base to the 200nm extent of the EEZ, and the western and eastern boundaries were determined by the international boundaries with Namibia and Mozambique respectively. Although estuaries do not form part of the marine realm in South Africa, estuarine shores fall below the dune base and were therefore included in the marine data to avoid gaps in the raster dataset. This has added an additional 24 estuarine ecosystem types to the accounts, bringing the total of ecosystem types included in the marine extent accounts to 174 ecosystem types. Greater detail on the estuarine ecosystem types can be found in the 2018 National Biodiversity Assessment: Estuarine Report (van Niekerk et al. 2019).

5.2 Accounting Units

South Africa has chosen to use the geospatial concept of a basic spatial unit (BSU) to operationalise the use of spatial data for accounting (Statistics South Africa 2020). A BSU is a spatial measurement unit that is a geospatial construct to which a range of different spatial data and information can be attributed and can also be useful for many other ecosystem measurement-related purposes, not only for ecosystem accounting (Statistics South Africa 2019).

Ecosystem types, as identified in the NBA2018, were assigned as the assets, using the BSU of 1 hectare as the unit for reporting on extent.

5.2.1 Sub-accounting areas:

The first set of sub-accounting areas are the 6 Marine Ecoregions identified in the NBA2018 (Figure 5).

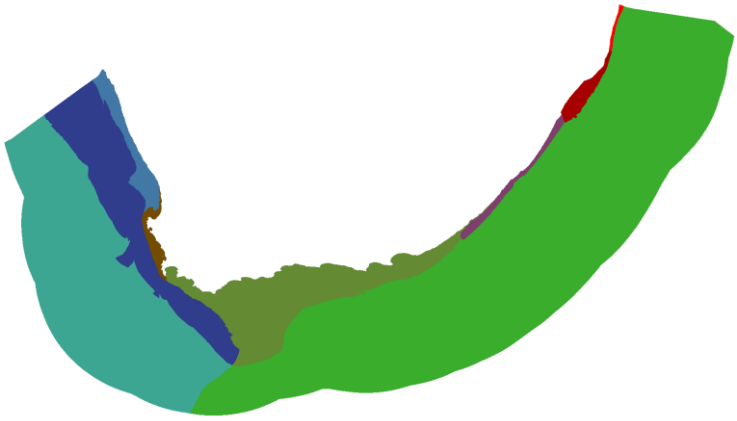

Figure 5: The Map of Marine Ecoregions as published in the NBA2011 (Sink et al. 2019)

The Inshore and Offshore subrealms were identified as potentially useful sub-accounting areas, so as to develop accounts that could also contribute to policy processes related to coastal and offshore management respectively. The Inshore subrealm is spatially defined by the dune base and the fair-weather wave base, and thus is too small to display on a national map.

The final set of subaccounting areas are the three Marine Planning Areas identified in the MSP process (Figure 6).

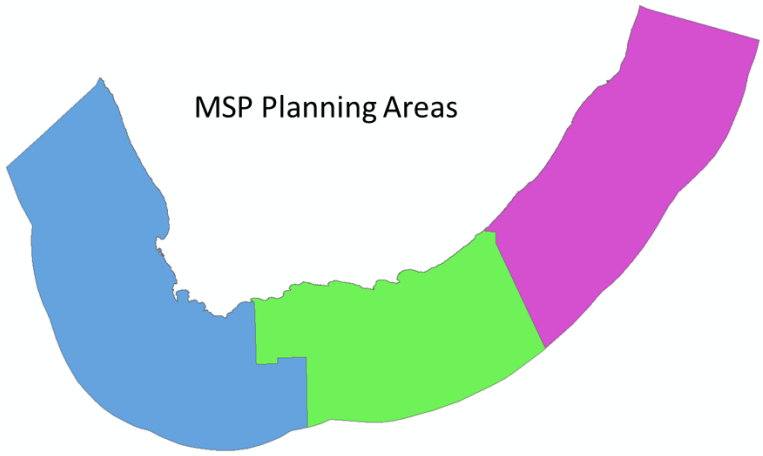

Figure 6: The Map of MSP Planning Areas (unpublished).

5.3 Draft Extent Account Tables

This section provides examples of the draft tables under development in preparation for publication by Stats SA. The planned publication of the Marine Ecosystem Extent Accounts will form part of Stats SA's Natural Capital series, which aims to produce Natural Capital Accounts for all realms (S.

5.3.1 National Accounts

As previously mentioned in Section 2.2, SA identified 150 ecosystem types for the marine realm and due to the spatial extent of the national marine accounting area it was necessary to include 24 estuarine shore ecosystem types. The accounts are therefore presented in

Appendix 1 as a portrait table to allow for ease of readability. The National Marine Extent Account using the BEGs is provided in Table 1.

Table 1: The draft National Marine Extent Account using Broad Ecosystem Groups.

		Broad Ecosystem Groups															
		Abyss	Bay	Canyon	Deep rocky shelf	Deep soft shelf	Estuarine shore	Island	Kelp forest	Plateau	Rocky and mixed shore	Sandy shore	Seamount	Shallow rocky shelf	Shallow soft shelf	Slope	Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
National Extent Account	Opening extent	40 250 064	536 741	851 698	10 561 077	10 513 417	9 113	939	2 933	1 408 615	61 326	37 204	615 051	401 675	656 672	41 368 501	107 275 026
	Additions to extent																
	Managed expansic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Natural expansion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Upward appraisal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reductions to extent																
	Managed regressic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Natural regression	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Downward apprais	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Closing extent	40 250 064	536 741	851 698	10 561 077	10 513 417	9 113	939	2 933	1 408 615	61 326	37 204	615 051	401 675	656 672	41 368 501	107 275 026

5.3.2 Regional/Sub-accounts

There are 6 Marine Ecoregions in the Map of Marine Ecosystem Types, and therefore 6 accounts have been generated for these sub-accounting areas. These accounts exclude estuarine ecosystem types. An example of one of the accounts is provided in Table 2 and represents the Agulhas Ecoregion.

Table 2: The draft Ecosystem Extent Account for the Agulhas Ecoregion Subaccounting Area using Broad Ecosystem Groups.

		Broad Ecosystem Groups										
		Bay	Canyon	Deep rocky shelf	Deep soft shelf	Island	Kelp forest	Rocky and mixed shore	Sandy shore	Shallow rocky shelf	Shallow soft shelf	Grand Total
		1	2	3	4	5	6	7	8	9	10	
Agulhas	Opening extent	413 217	10 194	5 386 040	3 030 211	647	1 209	30 718	15 664	192 109	451 210	9 531 219
	Additions to extent											
	Managed expansion	-	-	-	-	-	-	-	-	-	-	-
	Natural expansion	-	-	-	-	-	-	-	-	-	-	-
	Upward appraisal	-	-	-	-	-	-	-	-	-	-	-
	Reductions to extent											
	Managed regression	-	-	-	-	-	-	-	-	-	-	-
	Natural regression	-	-	-	-	-	-	-	-	-	-	-
	Downward appraisal	-	-	-	-	-	-	-	-	-	-	-
	Closing extent	413 217	10 194	5 386 040	3 030 211	647	1 209	30 718	15 664	192 109	451 210	9 531 219

As mentioned previously in Section 5.1, the Inshore Subrealm accounts include estuarine shores (Table 3), and the Offshore Subrealm accounts are from the fair-weather wave base to the 200nm extent of the EEZ (Table 4)

Table 3: The draft Extent Account for the Marine Inshore Subaccounting Area using Broad Ecosystem Groups.

		Broad Ecosystem Groups				
		Estuarine shore	Kelp forest	Rocky and mixed shore	Sandy shore	Grand Total
		1	2	3	4	
Marine Inshore	**Opening extent**	**9 113**	**2 263**	**61 326**	**37 204**	**109 906**
	Additions to extent					
	Managed expansion	-	-	-	-	-
	Natural expansion	-	-	-	-	-
	Upward appraisal	-	-	-	-	-
	Reductions to extent					
	Managed regression	-	-	-	-	-
	Natural regression	-	-	-	-	-
	Downward appraisal	-	-	-	-	-
	Closing extent	9 113	2 263	61 326	37 204	109 906

Table 4: The draft Extent Account for the Marine Offshore Subaccounting Area using Broad Ecosystem Groups.

		Broad Ecosystem Groups												
		Abyss	Bay	Canyon	Deep rocky shelf	Deep soft shelf	Island	Kelp forest	Plateau	Seamount	Shallow rocky shelf	Shallow soft shelf	Slope	Grand Total
		1	2	3	4	5	6	7	8	9	10	11	12	
Marine Offshore	**Opening extent**	**40 250 064**	**536 741**	**851 698**	**10 561 077**	**10 513 417**	**939**	**670**	**1 408 615**	**615 051**	**401 675**	**656 672**	**41 368 501**	**107 165 120**
	Additions to extent													
	Managed expansion	-	-	-	-	-	-	-	-	-	-	-	-	-
	Natural expansion	-	-	-	-	-	-	-	-	-	-	-	-	-
	Upward appraisal	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reductions to extent													
	Managed regression	-	-	-	-	-	-	-	-	-	-	-	-	-
	Natural regression	-	-	-	-	-	-	-	-	-	-	-	-	-
	Downward appraisal	-	-	-	-	-	-	-	-	-	-	-	-	-
	Closing extent	**40 250 064**	**536 741**	**851 698**	**10 561 077**	**10 513 417**	**939**	**670**	**1 408 615**	**615 051**	**401 675**	**656 672**	**41 368 501**	**107 165 120**

The MSP process will develop marine area plans for 3 MSP Planning Areas. The first to be developed will be for the Southern Marine Planning Area, and the draft ecosystem extent account for this sub-accounting area is provided in Table 5.

Table 5: The draft Extent Account for the Southern Marine Planning Area under MSP, using the Broad Ecosystem Groups.

		Broad Ecosystem Groups															
		Abyss	Bay	Canyon	Deep rocky shelf	Deep soft shelf	Estuarine shore	Island	Kelp forest	Plateau	Rocky and mixed shore	Sandy shore	Seamount	Shallow rocky shelf	Shallow soft shelf	Slope	Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Southern Marine Planning Area	**Opening extent**	15 198 931	242 242	169 503	3 466 906	2 553 894	2 395	303	10	1 404 334	15 518	8 964	155 552	96 074	441 421	4 654 735	28 410 782
	Additions to extent																
	Managed expansion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Natural expansion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Upward appraisal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Reductions to extent																
	Managed regression	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Natural regression	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Downward appraisal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Closing extent	15 198 931	242 242	169 503	3 466 906	2 553 894	2 395	303	10	1 404 334	15 518	8 964	155 552	96 074	441 421	4 654 735	28 410 782

6 Conclusion

The changing global economic seascape has provided an opportunity for the development of different metrics to ensure that development in the last truly wild part of the world is environmentally sustainable. By encouraging the development of accounts using ecosystem types, the usefulness of the resulting accounts would be increased tremendously. It is recognised that ecosystem mapping in the marine realm needs to be prioritised to ensure that this is possible, and this prioritisation would be greatly supported/fast-tracked if supported by the SEEA-EA Framework.

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Appendix 1: Draft of the South African National Marine Extent Account. This draft is under embargo pending publication. (Estuarine shore ecosystem types are highlighted in grey)

		National Extent Account							
			Additions to extent			*Reductions to extent*			
	Ecosystem Types	Opening extent	Managed expansion	Natural expansion	Upward appraisal	Managed regression	Natural regression	Downward appraisal	Closing extent
1	Agulhas Basin Abyss	5 701 010	-	-	-	-	-	-	5 701 010
2	Agulhas Basin Complex Abyss	377 719	-	-	-	-	-	-	377 719
3	Agulhas Blues	837 985	-	-	-	-	-	-	837 985
4	Agulhas Boulder Shore	167	-	-	-	-	-	-	167
5	Agulhas Coarse Sediment Shelf Edge	399 042	-	-	-	-	-	-	399 042
6	Agulhas Dissipative Intermediate Sandy Shore	11 648	-	-	-	-	-	-	11 648
7	Agulhas Dissipative Sandy Shore	2 479	-	-	-	-	-	-	2 479
8	Agulhas Exposed Rocky Shore	8 904	-	-	-	-	-	-	8 904
9	Agulhas Exposed Stromatolite Rocky Shore	829	-	-	-	-	-	-	829
10	Agulhas Inner Shelf Mosaic	185 418	-	-	-	-	-	-	185 418
11	Agulhas Inner Shelf Reef	1 780	-	-	-	-	-	-	1 780
12	Agulhas Intermediate Sandy Shore	1 444	-	-	-	-	-	-	1 444
13	Agulhas Island	647	-	-	-	-	-	-	647
14	Agulhas Kelp Forest	1 209	-	-	-	-	-	-	1 209
15	Agulhas Lower Canyon	115 246	-	-	-	-	-	-	115 246
16	Agulhas Mid Shelf Mosaic	363 244	-	-	-	-	-	-	363 244
17	Agulhas Mid Shelf Reef	5 201	-	-	-	-	-	-	5 201
18	Agulhas Mixed Shore	18 809	-	-	-	-	-	-	18 809
19	Agulhas Muddy Mid Shelf	173 257	-	-	-	-	-	-	173 257
20	Agulhas Muddy Outer Shelf	127 775	-	-	-	-	-	-	127 775
21	Agulhas Plateau	546 893	-	-	-	-	-	-	546 893
22	Agulhas Reflective Sandy Shore	93	-	-	-	-	-	-	93
23	Agulhas Rocky Outer Shelf	421 449	-	-	-	-	-	-	421 449
24	Agulhas Rocky Plateau	861 722	-	-	-	-	-	-	861 722
25	Agulhas Rocky Shelf Edge	523 249	-	-	-	-	-	-	523 249
26	Agulhas Sandy Inner Shelf	52 168	-	-	-	-	-	-	52 168
27	Agulhas Sandy Mid Shelf	2 023 252	-	-	-	-	-	-	2 023 252
28	Agulhas Sandy Outer Shelf	705 927	-	-	-	-	-	-	705 927
29	Agulhas Sheltered Rocky Shore	133	-	-	-	-	-	-	133
30	Agulhas Stromatolite Mixed Shore	836	-	-	-	-	-	-	836
31	Agulhas Upper Canyon	10 194	-	-	-	-	-	-	10 194
32	Agulhas Very Exposed Rocky Shore	913	-	-	-	-	-	-	913
33	Agulhas Very Exposed Stromatolite Rocky Shore	127	-	-	-	-	-	-	127
34	Aliwal Shoal Reef Complex	511	-	-	-	-	-	-	511
35	Alphard Bank	3 183	-	-	-	-	-	-	3 183
36	Amathole Hard Shelf Edge	46 861	-	-	-	-	-	-	46 861
37	Amathole Lace Corals	13 169	-	-	-	-	-	-	13 169
38	Browns Bank Rocky Shelf Edge	216 400	-	-	-	-	-	-	216 400
39	Cape Basin Abyss	5 787 290	-	-	-	-	-	-	5 787 290
40	Cape Basin Complex Abyss	7 307 122	-	-	-	-	-	-	7 307 122
41	Cape Bay	25 434	-	-	-	-	-	-	25 434
42	Cape Boulder Shore	259	-	-	-	-	-	-	259

		National Extent Account							
			Additions to extent			*Reductions to extent*			
	Ecosystem Types	Opening extent	Managed expansion	Natural expansion	Upward appraisal	Managed regression	Natural regression	Downward appraisal	Closing extent
43	Cape Exposed Rocky Shore	2 899	-	-	-	-	-	-	2 899
44	Cape Island	292	-	-	-	-	-	-	292
45	Cape Kelp Forest	977	-	-	-	-	-	-	977
46	Cape Lower Canyon	283 784	-	-	-	-	-	-	283 784
47	Cape Mixed Shore	3 356	-	-	-	-	-	-	3 356
48	Cape Rocky Inner Shelf	47 366	-	-	-	-	-	-	47 366
49	Cape Rocky Mid Shelf Mosaic	390 472	-	-	-	-	-	-	390 472
50	Cape Sandy Inner Shelf	52 657	-	-	-	-	-	-	52 657
51	Cape Sheltered Rocky Shore	141	-	-	-	-	-	-	141
52	Cape Upper Canyon	239 482	-	-	-	-	-	-	239 482
53	Cape Very Exposed Rocky Shore	49	-	-	-	-	-	-	49
54	Central Agulhas Outer Shelf Mosaic	245 317	-	-	-	-	-	-	245 317
55	Childs Bank Coral	50 563	-	-	-	-	-	-	50 563
56	Childs Bank Plateau	162 017	-	-	-	-	-	-	162 017
57	Cool Temperate Arid Predominantly Closed	117	-	-	-	-	-	-	117
58	Cool Temperate Estuarine Lake	517	-	-	-	-	-	-	517
59	Cool Temperate Large Fluvially Dominated	266	-	-	-	-	-	-	266
60	Cool Temperate Large Temporarily Closed	483	-	-	-	-	-	-	483
61	Cool Temperate Micro-estuary	100	-	-	-	-	-	-	100
62	Cool Temperate Predominantly Open	167	-	-	-	-	-	-	167
63	Cool Temperate Small Fluvially Dominated	2	-	-	-	-	-	-	2
64	Cool Temperate Small Temporarily Closed	210	-	-	-	-	-	-	210
65	Delagoa Deep Shelf Edge	60 674	-	-	-	-	-	-	60 674
66	Delagoa Lower Canyon	3 355	-	-	-	-	-	-	3 355
67	Delagoa Mixed Shore	2 865	-	-	-	-	-	-	2 865
68	Delagoa Rocky Mid Shelf	2 284	-	-	-	-	-	-	2 284
69	Delagoa Sandy Inner Shelf	17 312	-	-	-	-	-	-	17 312
70	Delagoa Sandy Mid Shelf	27 564	-	-	-	-	-	-	27 564
71	Delagoa Shelf Edge	19 100	-	-	-	-	-	-	19 100
72	Delagoa Upper Canyon	1 367	-	-	-	-	-	-	1 367
73	Delagoa Very Exposed Rocky Shore	25	-	-	-	-	-	-	25
74	Durnford Inner Shelf Reef Complex	46 026	-	-	-	-	-	-	46 026
75	Durnford Mid Shelf Reef Complex	43 180	-	-	-	-	-	-	43 180
76	Eastern Agulhas Bay	163 146	-	-	-	-	-	-	163 146
77	Eastern Agulhas Outer Shelf Mosaic	2 596 618	-	-	-	-	-	-	2 596 618
78	False and Walker Bay	168 143	-	-	-	-	-	-	168 143
79	Kei Fluvial Fan	4 911	-	-	-	-	-	-	4 911
80	Kei Reef Mosaic	9 369	-	-	-	-	-	-	9 369
81	Kingklip Koppies	64 281	-	-	-	-	-	-	64 281
82	Kingklip Ridge	10 365	-	-	-	-	-	-	10 365
83	Kosi Coral Community	796	-	-	-	-	-	-	796
84	KZN Bight Deep Shelf Edge	176 151	-	-	-	-	-	-	176 151
85	KZN Bight Mid Shelf Mosaic	53 478	-	-	-	-	-	-	53 478
86	KZN Bight Mid Shelf Reef Complex	2 285	-	-	-	-	-	-	2 285
87	KZN Bight Muddy Inner Shelf	32 882	-	-	-	-	-	-	32 882
88	KZN Bight Muddy Shelf Edge	51 563	-	-	-	-	-	-	51 563
89	KZN Bight Outer Shelf Mosaic	65 572	-	-	-	-	-	-	65 572

		National Extent Account							
			Additions to extent			*Reductions to extent*			
	Ecosystem Types	Opening extent	Managed expansion	Natural expansion	Upward appraisal	Managed regression	Natural regression	Downward appraisal	Closing extent
90	KZN Bight Sandy Inner Shelf	14 589	-	-	-	-	-	-	14 589
91	Leadsman Coral Community	1 253	-	-	-	-	-	-	1 253
92	Namaqua Exposed Rocky Shore	4 192	-	-	-	-	-	-	4 192
93	Namaqua Kelp Forest	747	-	-	-	-	-	-	747
94	Namaqua Mid Shelf Fossils	2 012	-	-	-	-	-	-	2 012
95	Namaqua Mixed Shore	6 144	-	-	-	-	-	-	6 144
96	Namaqua Muddy Mid Shelf Mosaic	1 176 216	-	-	-	-	-	-	1 176 216
97	Namaqua Muddy Sands	1 217 467	-	-	-	-	-	-	1 217 467
98	Namaqua Sandy Inner Shelf	76 026	-	-	-	-	-	-	76 026
99	Namaqua Sandy Mid Shelf	285 475	-	-	-	-	-	-	285 475
100	Namaqua Sheltered Rocky Shore	117	-	-	-	-	-	-	117
101	Namaqua Very Exposed Rocky Shore	310	-	-	-	-	-	-	310
102	Natal Boulder Shore	26	-	-	-	-	-	-	26
103	Natal Deep Shelf Edge	137 727	-	-	-	-	-	-	137 727
104	Natal Delagoa Dissipative Intermediate Sandy Shore	3 300	-	-	-	-	-	-	3 300
105	Natal Delagoa Dissipative Sandy Shore	74	-	-	-	-	-	-	74
106	Natal Delagoa Intermediate Sandy Shore	5 177	-	-	-	-	-	-	5 177
107	Natal Delagoa Reflective Sandy Shore	937	-	-	-	-	-	-	937
108	Natal Exposed Rocky Shore	3 133	-	-	-	-	-	-	3 133
109	Natal Lower Canyon	148 182	-	-	-	-	-	-	148 182
110	Natal Mixed Shore	6 993	-	-	-	-	-	-	6 993
111	Natal Upper Canyon	8 303	-	-	-	-	-	-	8 303
112	Natal Very Exposed Rocky Shore	99	-	-	-	-	-	-	99
113	Orange Cone Inner Shelf Mud Reef Mosaic	51 152	-	-	-	-	-	-	51 152
114	Orange Cone Muddy Mid Shelf	192 123	-	-	-	-	-	-	192 123
115	Port St Johns Inner Shelf Mosaic	4 861	-	-	-	-	-	-	4 861
116	Port St Johns Muddy Mid Shelf	12 482	-	-	-	-	-	-	12 482
117	Port St Johns Muddy Shelf Edge	12 938	-	-	-	-	-	-	12 938
118	Protea Mid Shelf Reef Complex	1 556	-	-	-	-	-	-	1 556
119	Sodwana Coral Community	596	-	-	-	-	-	-	596
120	Southeast Atlantic Lower Slope	8 629 959	-	-	-	-	-	-	8 629 959
121	Southeast Atlantic Mid Slope	1 813 293	-	-	-	-	-	-	1 813 293
122	Southeast Atlantic Seamount	157 607	-	-	-	-	-	-	157 607
123	Southeast Atlantic Slope Seamount	88 783	-	-	-	-	-	-	88 783
124	Southeast Atlantic Upper Slope	1 525 126	-	-	-	-	-	-	1 525 126
125	Southern Benguela Dissipative Intermediate Sandy Shore	5 148	-	-	-	-	-	-	5 148
126	Southern Benguela Dissipative Sandy Shore	2 603	-	-	-	-	-	-	2 603

		National Extent Account							
			Additions to extent			*Reductions to extent*			
	Ecosystem Types	Opening extent	Managed expansion	Natural expansion	Upward appraisal	Managed regression	Natural regression	Downward appraisal	Closing extent
127	Southern Benguela Intermediate Sandy Shore	3 240	-	-	-	-	-	-	3 240
128	Southern Benguela Muddy Outer Shelf Mosaic	557 441	-	-	-	-	-	-	557 441
129	Southern Benguela Muddy Shelf Edge	81 395	-	-	-	-	-	-	81 395
130	Southern Benguela Outer Shelf Mosaic	1 950 897	-	-	-	-	-	-	1 950 897
131	Southern Benguela Reflective Sandy Shore	1 061	-	-	-	-	-	-	1 061
132	Southern Benguela Rocky Shelf Edge	238 038	-	-	-	-	-	-	238 038
133	Southern Benguela Sandy Outer Shelf	3 608 871	-	-	-	-	-	-	3 608 871
134	Southern Benguela Sandy Shelf Edge	741 323	-	-	-	-	-	-	741 323
135	Southern Benguela Shelf Edge Mosaic	218 187	-	-	-	-	-	-	218 187
136	Southern KZN Inner Shelf Mosaic	25 854	-	-	-	-	-	-	25 854
137	Southern KZN Mid Shelf Mosaic	98 999	-	-	-	-	-	-	98 999
138	Southwest Indian Lower Slope	19 806 751	-	-	-	-	-	-	19 806 751
139	Southwest Indian Mid Slope	7 830 771	-	-	-	-	-	-	7 830 771
140	Southwest Indian Seamount	207 237	-	-	-	-	-	-	207 237
141	Southwest Indian Slope Seamount	161 424	-	-	-	-	-	-	161 424
142	Southwest Indian Upper Slope	1 752 236	-	-	-	-	-	-	1 752 236
143	St Helena Bay	98 090	-	-	-	-	-	-	98 090
144	St Lucia Mid Shelf Mosaic	478	-	-	-	-	-	-	478
145	St Lucia Sandy Inner Shelf	11 996	-	-	-	-	-	-	11 996
146	St Lucia Sandy Mid Shelf	64 704	-	-	-	-	-	-	64 704
147	Subtropical Estuarine Bay	7	-	-	-	-	-	-	7
148	Subtropical Estuarine Lake	216	-	-	-	-	-	-	216
149	Subtropical Large Fluvially Dominated	325	-	-	-	-	-	-	325
150	Subtropical Large Temporarily Closed	977	-	-	-	-	-	-	977
151	Subtropical Micro-estuary	171	-	-	-	-	-	-	171
152	Subtropical Predominantly Open	692	-	-	-	-	-	-	692
153	Subtropical Small Temporarily Closed	833	-	-	-	-	-	-	833
154	Trafalgar Reef Complex	5 860	-	-	-	-	-	-	5 860
155	Transkei Basin Abyss	21 076 923	-	-	-	-	-	-	21 076 923
156	Tropical Estuarine Lake	44	-	-	-	-	-	-	44
157	uThukela Canyon	41 785	-	-	-	-	-	-	41 785
158	uThukela Mid Shelf Mosaic	78 944	-	-	-	-	-	-	78 944
159	uThukela Mid Shelf Mud Coarse Sediment Mosaic	134 865	-	-	-	-	-	-	134 865
160	uThukela Outer Shelf Muddy Reef Mosaic	53 173	-	-	-	-	-	-	53 173
161	Warm Temperate Estuarine Bay	25	-	-	-	-	-	-	25
162	Warm Temperate Estuarine Lake	144	-	-	-	-	-	-	144
163	Warm Temperate Large Fluvially Dominated	70	-	-	-	-	-	-	70
164	Warm Temperate Large Temporarily Closed	1 337	-	-	-	-	-	-	1 337

		National Extent Account							
			Additions to extent			*Reductions to extent*			
	Ecosystem Types	**Opening extent**	Managed expansion	Natural expansion	Upward appraisal	Managed regression	Natural regression	Downward appraisal	**Closing extent**
165	**Warm Temperate Micro-estuary**	**215**	-	-	-	-	-	-	**215**
166	**Warm Temperate Predominantly Open**	**1 241**	-	-	-	-	-	-	**1 241**
167	**Warm Temperate Small Fluvially Dominated**	**69**	-	-	-	-	-	-	**69**
168	**Warm Temperate Small Temporarily Closed**	**885**	-	-	-	-	-	-	**885**
169	**Western Agulhas Bay**	**81 928**	-	-	-	-	-	-	**81 928**
170	**Western Agulhas Outer Shelf Mosaic**	**278 652**	-	-	-	-	-	-	**278 652**
171	**Wild Coast Inner Shelf Mosaic**	**25 291**	-	-	-	-	-	-	**25 291**
172	**Wild Coast Mid Shelf Mosaic**	**238 562**	-	-	-	-	-	-	**238 562**
173	**Wild Coast Shelf Edge Mosaic**	**143 551**	-	-	-	-	-	-	**143 551**
174	**Southern KZN Shelf Edge Mosaic**	**66 978**	-	-	-	-	-	-	**66 978**
	Total	**107 275 026**	-	-	-	-	-	-	**107 275 026**