Agulhas and Somali Current Large Marine Ecosystems Project

Report on the National Causal Chain Analysis Meetings (14th July to 15th August 2011)

Final Draft

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1 EXECUTIVE SUMMARY

The Agulhas and Somali Currents Large Marine Ecosystems (ASCLMEs) Project is one of three parallel projects within the broader multi-agency ASCLMEs Programme, which aims to institutionalize cooperative and adaptive management of the ASCLMEs. The three component projects include the ASCLMEs Project (this project, implemented by UNDP), the Western Indian Ocean-Land Based Sources (WIO-LaB) Project that addresses land-based sources of pollution (implemented by UNEP); and South-Western Indian Ocean Fisheries Project (SWIOFP) that aims to build knowledge for managing industrial offshore fisheries (implemented by the World Bank). These three projects are all supported by the Global Environment Facility (GEF) and coordinated by the UNDP ASCLMEs Programme Coordination Unit (PCU).

The ASCLMEs Project (this project) adopted a phased approach that aimed to progressively build: (i) the knowledge base, (ii) the technical and management capabilities to address transboundary environmental concerns within the LMEs, at the regional scale and; (iii) the political will to undertake threat abatement activities and (iv) to leverage finances proportionate to management needs. ASCLMEs Project activities were targeted at filling the significant coastal and offshore data gaps by capturing information relating to the dynamic ocean-atmosphere interface and other interactions that define the LMEs, along with data on artisanal fisheries, larval transport and nursery areas along the coast. This involved an intensive data capture phase which resulted in the delivery of national Marine Ecosystem Diagnostic Analyses (MEDAs). The contents of the MEDA were thus to form the basis for a regional Transboundary Diagnostic Analysis (TDA) and a Strategic Action Programme (SAP).

The addition of this intensive data capture phase to the ASCLMEs Project, and the production of the national MEDAs, is a variation on the standard approach to the TDA to SAP process that is unique to the ASCLMEs Project (Figure 1 and Figure 2). The parallel UNEP and World Bank Projects were designed to be complementary to the ASCLMEs Project, with the intention that they would also supply information that would feed into this process. Together the three projects would thereby collectively provide the basis to help identify policy, legal and institutional reforms and investments to address transboundary priorities within the region.

The purpose and overall objective of this assignment was to assist the ASCLMEs PCU to develop national Causal Chain Analyses (CCA) in support of the regional TDA. This report outlines (i) the findings from the initial review and issue scoping exercise from the draft MEDAs, (ii) the method used to prepare the 'Draft Issues Framework', which was then taken forward and discussed at the national CCA meetings, (iii) the standard methodology used during the National CCA meetings to help the countries to prioritise the issues at the national level and to develop impact and causal chains for the top priority issues, (iv) the results of the prioritisation exercises and causal chain analyses from each of the national meetings and (v) a comparision of the national outputs at the regional level.

An intitial review of the MEDA documents was used to scope the issue of concern (Table 1). The issues discussed in the text of each MEDA, and those the countries had highlighted at the end of each subsection of the MEDA (Table 2), were captured, the aim being to scope out the full range issues impacting upon the ASCLMEs at the national level.

The issues of concern identified from the MEDA were then consolidated and categorised, and this resulted in the creation of a list of 50 issue categories, subdivided into four broad Main Areas of Concern (MAC), as follows:

- MAC01: Water quality degradation (8 issue categories)
- MAC02: Habitat and community modification (15 issue categories)
- MAC03: Declines in living marine resources (20 issue categories)
- MAC04: Unpredictable Environmental Variability and Extreme Events (7 issue categories)

The issues that had been extracted and captured from the national MEDA documents were then classified according to one of the 50 issue categories. If an issue or area of concern expressed in the MEDA was relevant to more than one issue category, this was recorded under both of the relevant issue categories.

The issue scoping, categorisation and classification process enabled the preparation of an initial 'Draft Issues Framework' (Table 3). The 'Draft Issues Framework' is a basic matrix showing list of issue categories and whether or not the country had identified the issue as a concern within the MEDA. This 'Draft Issues Framework' provided one of the first points for discussion and validation by the country participants at the National CCA meetings.

National CCA meetings were held in each of the nine countries in the ASCLMEs between 14th July 2011 and 15th August 2011 (Annex 1 and 2). The National CCA meetings followed the same outline agenda (Annex 3). Each meeting started with a series of presentations (Annex 4 and 5) to update participants on project progress, and to introduce the 'Draft Issues Framework' and to explain the CCA process.

Meeting participants were then split into three working groups, one for each of the first three Main Areas of Concern (MAC01, MAC02, and MAC03). The groups were then tasked with a series of exercises which occupied the groups for the rest of the day. The first two working groups sessions (Group Work Sessions 1 and 2) aimed to help the countries to identify which of the issues of in the 'Draft Issues Framework' were of relevance at the national level, and then the importance of these issues at the national level within each MAC by completing two prioritisation exercises. The second two working group sessions (Group Work Sessions 3 and 4), aimed to help the countries to construct impact and causal chains for these top priority issues within each MAC.

The countries were provided with the draft outputs from the workshops (the results of the Level 1 and Level 2 prioritisation exercises and the impact and causal chains) and given the opportunity to review and submit comments. The final set of outputs from the National CCA meetings are provided in Annex 6.

The results of the Level 1 Prioritization exercise from the national CCA workshops revealed that all the issues identified in the 'Draft Issues Framework' were 'Relevant' to one or more of the countries in the ASCLMEs. Differences were found between the issues which the countries considered to be 'Relevant' now, 'Future relevant' or 'Not relevant'.

In **MAC01**, all 8 issues were considered to be **'Relevant'** by one or more of the countries. Two of the issues were considered to be 'Future relevant' by one of the countries these included: nutrient enrichment (1.3.2, Mauritius) and degradation of ground and surface water quality (1.2, Comoros). None of the issues were considered to be 'Not relevant'.

In **MAC02**, all 15 issues were considered to be **'Relevant'** by one or more of the countries. There were 4 issues that were identified as being 'Future Relevant' by one or more of the countries: wetland habitats (2.2.4); deep water habitats (2.3.5); pelagic habitats (2.4,); introduction of exotic non-native species, invasives and nuisance species (2.6). There were 10 issues that were identified as 'Not relevant' by one or more of the countries, 4 of which were identified as being 'Not relevant' by more than one country but only deep water habitats (2.3.5) was considered to be 'Not relevant' by more than half of the countries.

In **MAC03**, all 20 of the issues were considered **'Relevant'** by one or more of the countries. There were 12 issues that were considered to be 'Future relevant', 4 of which were considered 'Future relevant' by more than one country, these included: small pelagics (3.2.3,); molluscs (3.3.1); sea urchins (3.3.5) and; expansion of mariculture industry (3.5). A further 15 issues were considered 'Not relevant' by one or more of the countries: cetaceans (3.1.2); small pelagics (3.2.3); deep water demersals (3.2.4); molluscs (3.3.1); abalone (3.3.2); sea urchins

(3.3.5); lobsters (3.3.7) and; crayfish / deep water lobster (3.3.8). The issues that were considered 'Not relevant' by more than half the countries (abalone 3.3.2, sea urchins 3.3.5, and crayfish 3.3.8) could either be removed (e.g. sea urchins) or consolidated with other issues e.g. abalone and crayfish. The term 'crayfish' was used to refer to deepwater lobster in one of the MEDAs, so this issue could be combined with lobster.

The ranking of the issues in terms of their **'Importance'** provided an indication of the relative prioritisation of each issue at the national level, within and between the Main Areas of Concerns, as well as providing a 'first glimpse' a the prioritisation at the regional level. Although all of the MAC01 issues were identified as 'Relevant', none of the issues in MAC01 were ranked as being of 'High' importance by all of the countries, and only 4 of the 8 issues (50 %) were ranked as being of 'High' importance by more than half of the countries. By comparison, 8 of the 15 issues (53.3 %) in MAC02, and 13 of the 20 issues (65.2 %) in MAC03 were ranked as being of 'High' importance by over half of the countries. This suggested that countries of the ASCLMEs considered MAC02 and MAC03 issues to be higher priority. Furthermore, there was one issue in both MAC02 and MAC03, that was ranked as being of 'High' importance by all countries: coastal habitats (2.2.3) and reef and demersal fish (3.2.5).

The number of issues identified as being of 'High' importance by each country ranged from a minimum of 16 'High' priority issues identified by the Seychelles to 32 'High' priority issues identified by Madagascar. Two issue were ranked as 'High' by all countries, which were: declines in reef and demersal fish (3.2.5) and coastal habitats (2.2.3). There were 4 issues that were ranked as 'High' by 8 of the 9 countries in MAC02 and MAC03, these included: coral reefs (2.3.1), sharks and rays (3.2.1), sea cucumbers (3.3.4) and bycatch (3.4). There were 4 issues ranked as 'High' by 7 of the 9 countries: upland habitats (2.2.1), turtles (3.1.4), large pelagics (3.2.2), cephalopods (3.3.3). A further 10 issues were ranked as 'High' importance by 6 of the 9 countries, split between MAC01 (4 issues), MAC02 (3 issues) and MAC03 (3 issues), which included: alteration of natural river flows (1.1), ground and surface water quality (1.2), solid waste (1.3.5), and oil spills (1.3.6), shoreline change (2.1), mangroves (2.2.6), and pelagic habitats (2.4), prawn and shrimp (3.3.6), lobster (3.3.7) and mariculture (3.5). Finally, in MAC02 and MAC03 there were 7 issues ranked as being of 'High' importance by 5 of the 9 countries: coastal forest (2.2.2), wetlands (2.2.4), estuaries (2.2.5), seagrass (2.3.2), marine mammals (3.1.1), cetaceans (3.1.2), small pelagics (3.2.3). All other issues were ranked as 'High' by 4 or less of the countries.

Consideration of the **transboundary** nature of each of the issues in the Draft Issues Framework, in terms of whether the issues were 'Transboundary', 'Future transboundary' or 'Not transboundary' revealed that the majority of countries considered the majority (but not all) issues to be either 'Transboundary' in the present day or 'Future transboundary' within 10 years. The issues that were considered to be 'Transboundary' by all countries were: chemical contamination (1.3.3), oil spills (1.3.6), coral reefs (2.3.1), turtles (3.1.4), large pelagics (3.2.2) and bycatch (3.4). This exercise demonstrated that those issues that had been listed as 'Not transboundary' at the national perspective, were in fact mostly common between the countries, and hence a shared transboundary issue.

The Group work Session on **'Baseline Data'** revealed that while there is some data available for the all of the issues (43 of 43 issues, or 100 %) in the Draft Issues Framework, there are gaps and concerns with regards the availability or quality of these data. Common concerns that were raised by workshop participants in relation to the baseline datasets included: the data being of limited or patchy geographic extent, poor data quality or out of date data, or data accessibility issues due to the data being disparately held between different governmental departments and or by local or international non-governmental organisations. There were 37 of the 43 issues for which there was baseline data, or at least a partial baseline dataset in more than half of the countries. The 6 issues for which baseline or partial baseline data is limited included: soft

sediment habitats (2.3.4), deep water habitats (2.3.5), exotic, invasive and nuisance species (2.6), abalone (3.3.2), sea urchins (3.3.5) and crayfish (3.3.8). In addition there were 15 of the 43 issues (41.9 %) for which there is either no routine monitoring or only limited monitoring in more than half the countries as follows: nutrients (1.3.2), suspended solids (1.3.4), coastal habitats (2.2.3), estuarine habitats (2.2.5), macroalgal habitats (2.3.3), soft sediment habitats (2.3.4), deep water habitats (2.3.5), pelagic habitats (2.4), invasive species (2.6), marine mammals (3.1.1), cetaceans (3.1.2), molluscs (3.3.1), abalone (3.3.2), cephalopods (3.3.3), and crabs (3.3.9).

The **'Monitoring'** exercise revealed similar trends as was found for the 'Baseline' data. There is some type of monitoring for 74 % (36 of 43) issues within the ASCLMEs region. The 7 issues for which there is no routine monitoring, or only limited (site specific or periodic) monitoring including: microbiological contamination (1.3.1), suspended solids (1.3.4), macroalgae (2.3.3), coastal habitats (2.2.3), macroalgae (2.3.3), deep water habitats (2.3.5), abalone (3.3.2), sea urchins (3.3.5) and crayfish (3.3.8). These issues are generally those that were identified as being of a lower priority, with the exception of microbiological contamination. In addition there were 18 of the 43 issues (41.9 %) for which there is either no routine monitoring or only limited monitoring in more than half the countries as follows: ground and surface water (1.2), nutrients (1.3.2), chemical contamination (1.3.3), solid wastes (1.3.5), oils spills (1.3.6), shoreline change (2.1), wetlands (2.2.4), seagrass (2.3.2), soft sediment habitats (2.3.4), pelagic habitats (2.4), marine mammals (3.1.1), sharks and rays (3.2.1), molluscs (3.3.1), cephalopods (3.3.3), sea cucumbers (3.3.4), sea urchins (3.3.5), crabs (3.3.9), bycatch (3.4). These issues include some of the priority transboundary issues identified at the national and regional level. These findings suggest that there are still some significant gaps in monitoring needs that will need to be addressed within the ASCLMEs region in the future.

The results of the **Level 2 prioritisation exercise** revealed the importance of these issues in terms of their severity and scope at both the national and regional level. The priority issues at the national level, with the highest three 'Overall ranking' scores within each MAC, are listed below for each country:

- Comoros, had 13 issues with an above average 'Overall ranking'. The highest ranked issues were those related to living marine resources (MAC03) and included turtles (24), large pelagics (23), and sharks and rays (22), followed by habitat related issues (MAC02) concerning coral reef habitats (20), shoreline change (17), upland watersheds (17), and coastal habitats (17), followed by water quality issues (MAC01), relating to microbilogical contamination (16), river flows (15), solid wastes (15) and oil spills (15).
- Kenya, had 20 issues with an above average 'Overall ranking'. The highest ranked issues were those related to habitats (MAC02) and included upland / wateshed habitats (24), mangroves (22), coral reefs (22), and wetlands (21), followed by declines in living marine resources (MAC03), including reef and demersal fish (21), prawn and shrimp (20), cephalopods (19), sea cucumbers (19), excessive bycatch (19), mariculture (19), followed by water quality concerns, including solid wastes (18), river flows (17), and nutrients (15).
- Madagascar, had 12 issues with an above average 'Overall ranking'. The highest ranking issues varied between the MAC's, while the lowest ranking issues were all related to declines in living marine resources (MAC03). The highest ranking issue was microbiological contamination (24), followed by mangrove habitats (24), coastal forests (21), oil spills (20), coral reef (19), seagrass (19), pelagic (19) and turtles (19), chemicals (18), prawn and shrimp (17) and cetaceans (16).
- Mauritius, had 20 issues with an above average 'Overall ranking'. The highest ranking issues were those related to living marine resources (MAC03) and included deep water demersals (24), reef and demersal fish (24), large pelagics (23) and mariculture (22),

followed by habitat related issues (MAC02) including shoreline change (22), coral reefs (21), mangroves (20), and then water quality issues (MAC03) including microbiological contamination (14), solid wastes (14), river flows (13) and ground and surface water (13).

- Mozambique, had 24 issues with an above average 'Overall ranking'. The highest ranking issues were those related to living marine resources or habitats and included prawn and shrimp (24), mariculture (23), coastal habitats (23), mangroves (23), shoreline change (22), turtles (22), upland watersheds (21), followed by water quality issues including river flows (19), solid wastes (17), ground and surface water (15) and microbiological contamination (15).
- Seychelles, had 16 issues with an above average 'Overall ranking'. The highest ranking issues were mixed between the different MAC's, starting with shoreline change (24), coral reefs (24), oil spills (22), sharks and rays (21), large pelagics (21), solid wastes (19), bycatch (19), river flows (18) and pelagic habitats (18).
- Somalia, had 22 issues with an above average 'Overall ranking'. The highest ranking issues were related mainly to living marine resources (MAC03) and included sharks and rays (22), large pelagics (22), bycatch (21), and reef and demersal fish (20), followed by coral reef habitats (19), oil spills (17), chemical contamination (17), upland watershed habitats (17), microbiological contamination (16), solid wastes (16), coastal forests (16), mangroves (16), pelagic habitats (16) and nutrient enrichment (15).
- South Africa, had 19 issues with an above average 'Overall ranking'. The highest ranking concerns were those related to water quality (MAC01) including river flows (19) and ground and surface water (19), followed by habitat related issues (MAC02) including coastal habitats (19), wetlands (19), estuarine (19), soft sediments (19), upland watersheds (18), coastal forest (18), mangrove (17), followed by concerns related to living marine resources (MAC03) including, sharks and rays (16), large pelagics (15), reef and demersal fish (15), molluscs (14), small pelagics (14) and deep water demersals (14).
- Tanzania, had 19 issues with an above average 'Overall ranking'. The highest ranking issues were related to habitats (MAC02), including mangroves (24), coastal habitats (23), coral reef habitats (23), shoreline change (22), followed by river flows (20), cephalopods (19), prawn and shrimp (19), small pelagics (18), reef and demersals (18), ground and surface water (18), solid wastes (18), suspended solids (17), sea cucumbers (16)and bycatch (16).

Comparing the Level 2 Prioritisation results for all countries revealed a 'second glimpse' at the ranking of these issues at the regional level. This process identified 20 potential top priority transboundary issues, divided between MAC01 (4 issues), MAC02 (7 issues) and MAC03 (8 issues) as follows:

- 2.2.6. Disturbance, damage and loss of mangrove habitats (8 countries)
- 2.3.1. Disturbance, damage and loss of coral reef habitats (8 countries)
- river flows (1.1) (7 countries)
- 1.3.5 Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources (7 countries)
- 2.1. Shoreline change, due to modification, land reclamation and coastal erosion (7 countries)
- 2.2.3. Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation) (7 countries)
- 2.4. Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth) (7 countries)
- 3.2.1. Decline in populations of sharks and rays (7 countries)
- 3.2.5. Decline in populations of reef and demersal fish (7 countries)

- 3.4. Excessive bycatch and discards (7 countries)
- 2.2.1. Disturbance, damage and loss of upland / watershed habitats (>10 m elevation) (6 countries)
- 2.2.2. Disturbance, damage and loss of coastal forest habitats (6 countries)
- 3.1.4. Decline in populations of turtles (6 countries)
- 3.2.2. Decline in populations of large pelagics (6 countries)
- 1.2 Degradation of ground and surface water quality (5 countries)
- 1.3.1 Microbiological contamination from land-based (domestic, industrial, agriculture) (5 countries)
- 3.2.3 Decline in populations of small pelagics (5 countries)
- 3.3.6 Decline in populations of prawns and shrimp (5 countries)
- 3.3.6 Decline in populations of sea cucumbers (4 countries)
- 3.5. Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality) (4 countries)

Comparison of the Level 1 and Level 2 prioritisation revealed that the results were broadly consistent, but there were some discrepancies:

- In **MAC01**, the Level 1 and Level 2 prioritisation exercises both identified 4 issues, 3 of which were identical: alteration of natural river flows (1.1), ground and surface water quality (1.2), and solid waste (1.3.5). The fourth issue identified by the Level 1 prioritisation exercise was oil spills (1.3.6), which was ranked as being of 'High' importance by all 9 countries in Level 1, but only ranked above average by 4 countries in Level 2. The fourth issue identified by the Level 2 priorisation exercise was microbiological contamination (1.3.1), which had an above average 'Overall ranking' by 5 countries in Level 2, but was only ranked as being of 'High' importance by 2 countries and of 'Medium' importance by 5 countries in Level 1.
- In **MAC02**, the Level 1 and Level 2 prioritisation exercises identified 10 and 7 top priority issues respectively. There were 7 top priority issues in common between Level 1 and 2, including: shoreline change (2.1), upland / watershed habitats (2.2.1), coastal forests (2.2.2), coastal habitats (2.2.3), mangrove (2.2.6), coral reefs (2.3.1) and pelagic habitats (2.4). The additional issues identified by Level 1 were all ranked as being of 'High' importance by 5 countries and included: wetlands (2.2.4), estuarine (2.2.5) and seagrass (2.3.2). In Level 2, these issues had above average 'Overall ranking' scores by < 3 countries: wetlands (2.2.4) (3 countries), estuarine (2.2.5) (1 country) and seagrass (2.3.2) (3 countries).
- In **MAC03**, the Level 1 and Level 2 prioritisation exercises identified 13 and 9 issues respectively. There were 9 top priority issues in common between Level 1 and 2, including: turtles (3.1.4), sharks and rays (3.2.1), large pelagics (3.2.2), small pelagics (3.2.3), reef and demersal fish (3.2.5), sea cucumbers (3.3.4), prawn and shrimp (3.3.5), bycatch (3.4) and mariculture (3.5). The 4 additional issues identified by the Level 1 exercise included: marine mammals (3.1.1) (5 countries), cetaceans (3.1.2) (5 countries), cephalopods (3.3.3) (7 countries), spiny lobster (3.3.7) (6 countries). The issues did not have above average 'Overall rankings in Level 2: marine mammals (3.1.1) (2 countries), cetaceans (3.1.2) (3 countries), cephalopods (3.3.3) (2 countries), spiny lobster (3.3.7) (3 countries).

Impact and causal chain analyses were completed by the countries for their top priority issues within each of the three MACs. Collectively the countries completed 72 chains (either impact, causal or both chains) covering 29 of the 43 issues (67 % issues). These included chains for all 20 of the top ranked issues identified through Level 2 prioritisation exercise. The number of chains prepared for each issue by the countries varied between 0-6 chains. The maximum number of chains (6) was prepared was coral reef (2.3.1). The 14 issues for which no chains

were prepared were typically issues that had not been identified as a high priority issue in either of the Level 1 or Level 2. There were however some issues that were ranked as being of 'High' importance by more than half of the countries at Level 1, for which no chains were prepared e.g. seagrass (2.3.2) and cephalopods (3.3.3). There are also chains prepared for priority issues at the national level that were not then identified as top priority issues at the regional level e.g. nutrient enrichment (1.3.2), chemical contamination (1.3.3), soft sediment habitats (2.3.4), and introduction of exotics (2.6).

The countries which prepared the most chains were Madagascar, Seychelles, Mauritius (12 issues), followed by Mozambique (10 chains), Kenya (9 chains), Tanzania (7 chains), South Africa (7 chains), Comoros (3 chains) and Somalia (1 chain). The number of chains each country prepared reflected a combination of factors such as the number of workshop participants (e.g. Somalia had a very small number of participants and the chain was prepared in plenary), their experience in causal chain analysis, familiarity of the participants with the wide range of issues (e.g. not all countries had technical specialists for all fields present at the workshops) and language challenges (e.g. Comoros and Mozambique, where it was necessary to have additional translators to facilitate the process).

The outputs from the national CCA meetings, and the results of the impact and causal chain analyses were consolidated into tabular form to enable cross comparison of the impacts and causes. These outputs and all the associated tables provided the basis for the development of regional impact and causal chains for use in the TDA to SAP development process.

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2 ACRONYMS

ASCLMEs	Agulhas and Somali Currents Large Marine Ecosystems
CCA	Causal Chain Analysis
GEF	Global Environment Facility
IW	International Waters
LME	Large Marine Ecosystem
PCU	Project Coordination Unit
MAC	Main Area of Concern
MEDA	Marine Ecosystem Diagnostic Analyses
TDA	Transboundary Diagnostic Analysis
SAP	Strategic Action Programme
SWIOFP	South-Western Indian Ocean Fisheries Project
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WIO-Lab	Western Indian Ocean Land Based Sources Project

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5 INTRODUCTION

The Agulhas and Somali Currents Large Marine Ecosystems (ASCLMEs) Project is one of three parallel projects within the multi-agency ASCLMEs Programme, which aims to institutionalize cooperative and adaptive management of the Agulhas and Somali Currents LMEs. The ASCLMEs Programme component projects include the:

- Agulhas and Somali Currents Large Marine Ecosystems (ASCLMEs) Project (implemented by UNDP),
- Western Indian Ocean-Land Based Sources (WIO-LaB) Project that addresses land-based sources of pollution (implemented by UNEP); and
- South-Western Indian Ocean Fisheries Project (SWIOFP) that aims to build knowledge for managing industrial offshore fisheries (implemented by the World Bank).

These three projects are all supported by the Global Environment Facility (GEF) and coordinated by the UNDP ASCLMEs Project.

The ASCLMEs Project (this project) has adopted a phased approach that aims to progressively build the knowledge base and strengthen the technical and management capabilities at the regional scale to address transboundary environmental concerns within the LMEs, build political will to undertake threat abatement activities and leverages finances proportionate to management needs. ASCLMEs Project activities focus on filling the significant coastal and offshore data gaps by capturing information relating to the dynamic ocean-atmosphere interface and other interactions that define the LMEs, along with data on artisanal fisheries, larval transport and nursery areas along the coast.

The objective of the intensive data capture phase is to deliver national Marine Ecosystem Diagnostic Analyses (MEDAs) that will form the basis for a regional Transboundary Diagnostic Analysis (TDA) and a Strategic Action Programme (SAP). The addition of this data capture phase to produce the MEDA at the national level is a new addition to the standard TDA to SAP process that is unique to the ASCLMEs (Figure 1 and Figure 2). The parallel UNEP and World Bank Projects will also supply information that will feed into the process. Together the three projects will provide the basis to help identify policy, legal and institutional reforms and investments to address transboundary priorities.

All nine of the countries participating in the ASCLMEs project were tasked with preparing a MEDA. The documents were drafted by national technical experts following a standard format. In preparing the MEDAs the technical experts were also asked to identify particular issues or areas of concern at the national level. The issues or areas of concern were consolidated into an annex to the MEDAs, and it is these annexes and the draft MEDA that provided the basis for this work.

The purpose of this work is to commence the process of consolidating the information captured at the national level in the MEDA in preparation for the development of the regional TDA and SAP. The standard TDA to SAP process applied by GEF International Waters, requires the identification and prioritisation of transboundary issues, an analysis of nature and extent of the 'problems' or issues in terms of their environmental and socio-economic consequences, followed by Causal Chain Analysis (CCA), which is used to identify direct (immediate), underlying and ultimately root causes. The identification of root causes is important because root causes tend to be more systemic and fundamental contributors to environmental degradation. Interventions and actions directed at the root causes tend to be more sustainable and effective than interventions directed at immediate or underlying causes. However, because the linkages between root causes and solutions are often not clear to policymakers, interventions are commonly erroneously directed at immediate or underlying causes.

Traditionally, GEF-IW LME projects have applied this process of identifying priority transboundary issues, and analysing the impacts and causes, and root causes at the regional level. The addition of the national level MEDAs within the ASCLMEs Project, serves two purposes: First it provides the countries with the opportunity to undertake a more detailed analysis of the issues of concern at the country level and to explore and identify their specific national level root causes for their priority issues, before these issues are discussed at the regional level. Second, it creates an opportunity for a higher level of participation in the early stages of TDA development, which should in theory create a greater understanding and hence results in a greater sense of ownership of the TDA to SAP process at the national level.

As part of this process, the ASCLMEs PCU organised series of national Causal Chain Analysis meetings to discuss and identify priority issues at the national level, and to analyse the cause-effect relationships from immediate to root causes, and to identify those causes that most significantly contribute to the problem at the national level. Prioritizing the causes will be a crucial component of the next stage in the process, taking contextual, financial and political issues into consideration, to select the causes amenable to remediation at the regional level.

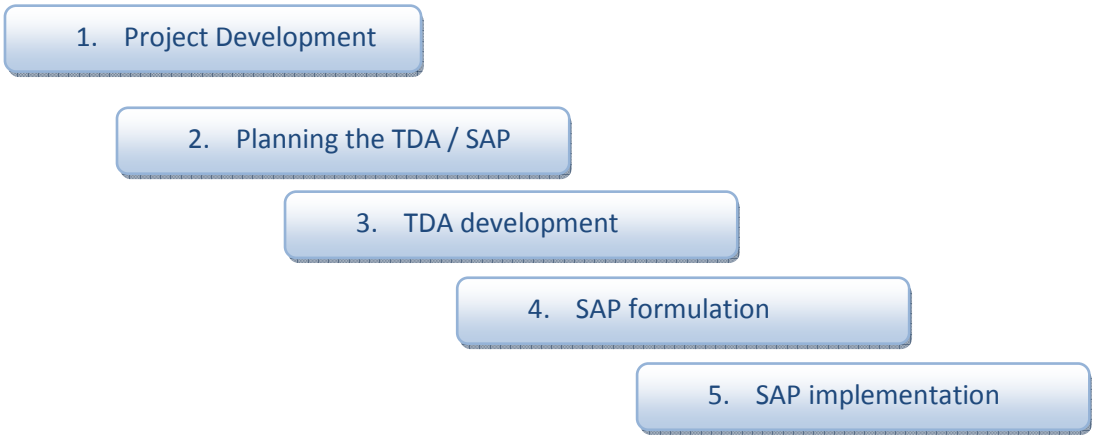

Figure 1: The standard GEF IW LME TDA to SAP process, which involved 5 steps from the initial project development to implementation of the SAP

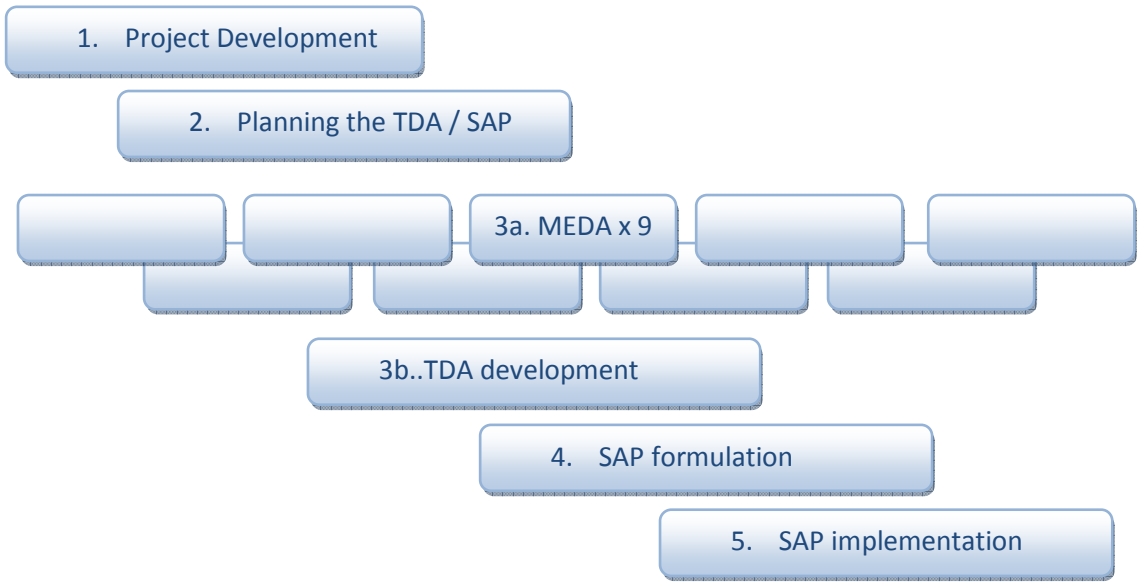

Figure 2: The ASCLMEs TDA to SAP process, with the 5 steps from the initial project development to implementation of the SAP, with the additional MEDA step, which allows for a more detailed analysis of the issues and causal relationships at the national, before TDA development.

6 PURPOSE AND SCOPE

The purpose and overall objective of this assignment was to assist the ASCLMEs Project Coordination Unit (PCU) to develop national Causal Chain Analyses in support of the regional TDA. The specific responsibilities outlined in the terms of reference were:

- Reading and reviewing ASCLMEs MEDA documents and key literature
- Causal Chain Analysis meeting preparation
- Facilitation of National Causal Chain Analysis workshops (in each country)
- Causal Chain Analysis reporting and follow-up

This report outlines (i) the findings from the initial review and issue scoping from the draft MEDA, (ii) the process used to prepare the 'Draft issues framework' for discussion at the Causal Chain Analysis meetings (iii) the standard methodology used during all the National Causal Chain Analysis workshops to assist the countries to develop causal chains for the top priority issues and, (iv) the initial results from each of the national meetings.

7 METHOD

7.1 REVIEW OF AVAILABLE DOCUMENTATION

The documents provided for the purposes of the review in advance of the National CCA meetings are listed in Table 1. These documents included the draft MEDA for eight out of the nine countries (with the exception of Comoros), and a draft version of Annex XIII for all nine countries, which summarised the Areas of Concern identified from the MEDA.

Table 1: List of the documents provided for the review in advance of the CCA meetings.

Country	Source	Document Date
Comoros	Comoros Annex XIII Areas of Concern.doc	
Kenya	Kenya MEDA v5b for review.doc – excluding annexes	01/06/2011
	Kenya Annex XIII Areas of Concern.doc	01/06/2011
Madagascar	Madagascar MEDA v5 for review.doc – excluding annexes	01/06/2011
	Madagascar Annex XIII Areas of Concern.doc	01/06/2011
Mauritius	Mauritius MEDA for review v3c.doc – excluding annexes	07/06/2011
	Mauritius Annex XIII Areas of Concern.doc	07/06/2011
Mozambique	Mozambique MEDA for review v2a.doc – excluding annexes	12/06/2011
	Mozambique Annex XIII Areas of Concern.doc	12/06/2011
Seychelles	Seychelles MEDA for review.doc – excluding annexes	12/06/2011
	Seychelles Annex XIII Areas of Concern.doc	12/06/2011
Somalia	Somalia MEDA v4.doc – excluding annexes	01/06/2011
	Somalia Annex XIII Areas of Concern.doc	01/06/2011
South Africa	South Africa MEDA for review.doc – excluding annexes	01/06/2011
	South Africa Annex XIII Areas of Concern.doc	01/06/2011
Tanzania	Tanzania MEDA for review.doc – excluding annexes	01/06/2011
	Tanzania Annex XIII Areas of Concern.doc	01/06/2011

The MEDA documents were all prepared following a standard format (the outline table of contents is provided below in Table 2). After each subsection, the local technical experts had been asked to identify and bullet the 'Areas of Concern' as discussed in the preceding section. These lists had then been consolidated by the PCU and used to prepare the draft Annex XIII.

In this context, the purpose of the review of the MEDAs was to identify and extract the issues or concerns at the national level for the purposes of the national CCA meetings. The MEDA's were meanwhile also undergoing a more comprehensive peer review process by national and regional experts[1].

The review revealed that, in general, the quality of the content of the text in the main body of the MEDA was high. However, the identification and analysis of these issues or 'Areas of

[1]The MEDA documents were concurrently being review by (i) national experts in each of the countries and, (ii) by two regional experts, who were assigned the task of reviewing the MEDAs from all the mainland countries (Somalia, Kenya, Tanzania, Mozambique and South Africa) and from the island nations (Seychelles, Mauritius, Madagascar, Comoros).

Concerns', and hence Annex XIII, was generally poorly developed. The majority of the MEDA documents were also still missing information from some key sections and annexes. Various background documents that were to be included in the MEDAs, either in the main body of the text, or as annexes were either still under preparation or were not made available in advance of the national CCA meetings (e.g. Coastal Livelihood Assessments, Cost-Benefit Analyses and Policy and Governance Analyses).

A more in depth comparison of the issues listed as 'Areas of Concern' in Annex XIII with those discussed in the MEDA documents, revealed that not all the issues were captured in the Annex. Conversely, not all of the issues listed in the 'Areas of Concern' were discussed in the MEDA. In some instances, example issues that had been supplied with the MEDA document template, were left in as bullet points in the 'Areas of Concern'. While these may have been pertinent issues to the country, they were not discussed in the main body of the text of the MEDA. The Annex XIII documents were therefore disregarded from this point forward, and the review efforts focussed on extracting issues from the MEDAs themselves.

In most of the MEDAs, the section of the document that was consistently nearest completion between all countries (with the exception of Comoros), and for which most 'Areas of Concern' had been identified if not analysed, was section 2 on the 'Biophysical Environment'. Typically, the first step in causal chain analysis is the identification and prioritisation of the environmental issues of greatest concern. It was thus agreed with the PCU that the discussions during the national CCA meetings would focus on these biophysical environmental issues. Other parts of the MEDA, which could provide the detail to help explain the underlying higher level relationships that contribute towards environmental degradation, could then be drawn upon at a later date.

Table 2: Table of contents for the Marine Environmental Diagnostic Analysis (MEDA) documents.

7.2 DEVELOPMENT OF DRAFT ISSUES FRAMEWORK

The following section describes the process used to develop the 'Draft Issues Framework'.

7.2.1 Issue Identification and Capture

Each MEDA document was reviewed and the issues that were discussed in the body of the text, and those highlighted in the bulleted lists at the end of each subsection, were extracted and copied into an Excel spreadsheet. This process aimed to capture the full range (scope) of different issues that are impacting upon different parts of the marine ecosystems within these LMEs and those that the countries of the ASCLMEs are particularly concerned about.

7.2.2 Issue Categorization

The issues extracted from the MEDAs and the phraseology used to describe the issues was highly variable (which was to be expected as the MEDA documents had been written by different national technical experts). There were however common identifiable themes and suites of issues that were shared or common between countries. A mechanism was therefore needed to categorise and catalogue the issues into a consistent framework to allow comparability between countries. Given the broad spectrum of issues highlighted in the MEDA, it was apparent that the framework to be developed would need to be holistic. The issues identified from the MEDA were thus used to develop a comprehensive draft list of Issue Categories, and this process resulted in the identification of 50 issue categories.

7.2.3 Identification of Main Areas of Concern

The 50 issues categories highlighted in the MEDA were allocated to one of the four Main Areas of Concern (MAC), as follows:

- MAC01: Water quality degradation (8 issue categories)
- MAC02: Habitat and community modification (15 issue categories)
- MAC03: Declines in living marine resources (20 issue categories)
- MAC04: Unpredictable Environmental Variability and Extreme Events (7 issue categories)

7.2.4 Classification of Issues and Construction of 'Draft Issues Framework'

Each of the issues extracted from the individual MEDA documents were classified according to one or more of the 50 Issue Categories. For example, an issue highlighted in the Kenya MEDA which related to mangroves, "*Mangroves in Kenya have been heavily impacted by human activities particularly through the removal of wood products, conversion pressure, and pollution. Recent estimates indicate a 20% decline in mangrove area over the last two decades*", was assigned to the issue category *3.2.6. Disturbance, damage and loss of mangrove habitats*.

Some of the issues expressed in the MEDA were relevant to more than one issue category. In this instance they were recorded under both issue categories. For example, an issue related to the degradation of seagrass beds, which was also reportedly to be affecting the status of dugong populations, was captured as an issue under both relevant issue categories.

This process enabled the production of an initial 'Draft Issues Framework' (Table 3), which was a matrix that listed the issues relevant to each countries, and allowed for comparison across all countries. The 'Draft Issues Framework' provided one of the first points for discussion and validation at the National CCA meetings.

Table 3 Draft Issues Framework for discussion at Causal Chain Analysis Workshops (July-August 2011)

Major Area of Concern	Issue No.	Issues	Comoros	Kenya	Madagascar	Mauritius	Mozambique	South Africa	Seychelles	Somalia	Tanzania	TOTAL
1. Water quality degradation	1.1.	Alteration of natural river flow and changes in freshwater input and sediment load		✓	✓	✓	✓	✓	✓	✓	✓	8
	1.2.	Degradation of ground and surface water quality		✓	✓	✓		✓	✓	✓	✓	7
	1.3.	Degradation of coastal and marine water quality		✓	✓	✓	✓	✓	✓	✓	✓	8
	1.3.1	Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources		✓	✓	✓	✓		✓	✓		6
	1.3.2	Nutrient enrichment from land-based (domestic, industrial, agriculture, livestock) and marine (mariculture) sources		✓	✓	✓	✓		✓	✓	✓	7
	1.3.3	Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources			✓	✓	✓	✓	✓	✓	✓	7
	1.3.4	Suspended solids in coastal waters due to human activities on land and in the coastal zone		✓	✓	✓	✓	✓	✓	✓		7
	1.3.5	Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources		✓	✓	✓			✓	✓	✓	6
	1.3.6	Oil spills (drilling, exploitation, transport, processing, storage, shipping).		✓	✓	✓	✓	✓	✓	✓	✓	8
2: Habitat and community modification	2.1.	Shoreline change, due to modification, land reclamation and coastal erosion		✓	✓	✓	✓	✓	✓	✓	✓	8
	2.2.	Disturbance, damage and loss of coastal, watershed and upland habitats		✓	✓	✓	✓	✓	✓	✓	✓	8
	2.2.1.	Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)			✓	✓		✓	✓	✓		5
	2.2.2.	Disturbance, damage and loss of coastal forest habitats		✓	✓			✓			✓	4
	2.2.3.	Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)		✓	✓	✓	✓	✓	✓	✓	✓	8
	2.2.4.	Disturbance, damage and loss of wetland habitats		✓	✓	✓						3
	2.2.5.	Disturbance, damage and loss of estuarine habitats		✓				✓		✓		3
	2.2.6.	Disturbance, damage and loss of mangrove habitats		✓	✓	✓	✓	✓		✓	✓	7
	2.3.	Disturbance, damage and loss of subtidal benthic habitats		✓	✓	✓	✓	✓	✓		✓	7
	2.3.1.	Disturbance, damage and loss of coral reef habitats		✓	✓	✓	✓	✓	✓	✓	✓	8
	2.3.2.	Disturbance, damage and loss of seagrass habitats		✓	✓	✓	✓		✓	✓	✓	7
	2.3.3.	Disturbance, damage and loss of macroalgal habitats						✓				1

Major Area of Concern	Issue No.	Issues	Comoros	Kenya	Madagascar	Mauritius	Mozambique	South Africa	Seychelles	Somalia	Tanzania	TOTAL
	2.3.4.	Disturbance, damage and loss of soft sediment habitats		✓	✓	✓	✓	✓	✓	✓	✓	8
	2.3.5.	Disturbance, damage and loss of deep water habitats (including sea mounts)			✓			✓				2
	2.4.	Disturbance, damage and degradation of pelagic habitats (nearshore<30 m, neritic 30-200m and oceanic >200m depth)		✓	✓	✓		✓	✓	✓		6
	2.5.	Increase in the occurrence of harmful or toxic algal blooms (HABs)		✓	✓	✓			✓	✓	✓	6
	2.6.	Introduction of exotic non-native species, invasives and nuisance species		✓	✓	✓	✓	✓	✓	✓	✓	8
3: Declines in living marine resources	3.1.	Declines in populations of focal species		✓	✓	✓	✓	✓	✓	✓	✓	8
	3.1.1.	Declines in populations of marine mammals		✓	✓	✓	✓	✓	✓	✓	✓	8
	3.1.2.	Declines in populations of cetaceans			✓		✓		✓	✓		4
	3.1.3.	Declines in populations of seabirds		✓	✓	✓	✓	✓	✓	✓		7
	3.1.4.	Declines in populations of turtles		✓	✓	✓	✓	✓	✓	✓	✓	8
	3.2.	Declines in populations of commercial fish stocks		✓	✓	✓	✓	✓	✓	✓	✓	8
	3.2.1.	Declines in populations of sharks and rays			✓	✓	✓	✓	✓	✓		6
	3.2.2.	Declines in populations of large pelagic			✓	✓		✓	✓	✓		5
	3.2.3.	Declines in populations of small pelagic			✓			✓		✓	✓	4
	3.2.4.	Declines in populations of deep water demersals						✓			✓	2
	3.2.5.	Declines in populations of reef and demersal fish		✓	✓	✓	✓	✓	✓	✓	✓	8
	3.3.	Declines in populations of commercial invertebrates		✓	✓	✓	✓	✓	✓	✓	✓	8
	3.3.1.	Declines in populations of molluscs (bivalves, gastropods)			✓			✓		✓	✓	4
	3.3.2.	Declines in populations of abalone						✓				1
	3.3.3.	Declines in populations of cephalopods			✓	✓					✓	3
	3.3.4.	Declines in populations of sea cucumbers		✓	✓	✓			✓	✓	✓	6
	3.3.5.	Declines in populations of sea urchins			✓							1
	3.3.6.	Declines in populations of prawns and shrimp			✓	✓	✓			✓	✓	5
	3.3.7.	Declines in populations of lobsters			✓					✓	✓	3

Major Area of Concern	Issue No.	Issues	Comoros	Kenya	Madagascar	Mauritius	Mozambique	South Africa	Seychelles	Somalia	Tanzania	TOTAL
	3.3.8.	Declines in populations of crayfish			✓					✓		2
	3.3.9.	Declines in populations of crabs		✓	✓					✓		3
	3.4.	Excessive bycatch and discards		✓	✓	✓	✓	✓		✓	✓	7
	3.5.	Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)		✓	✓	✓	✓	✓	✓			6
4: Risks, unpredictable environmental variability and extreme events	4.1.	Climate hazards and extreme weather events (cyclones, storms, rainfall, coastal flooding)		✓	✓	✓	✓	✓	✓	✓	✓	8
	4.2.	Sea level change		✓	✓	✓	✓	✓	✓	✓	✓	8
	4.3.	Ocean acidification		✓	✓	✓		✓	✓	✓	✓	7
	4.4.	Changes in seawater temperatures		✓	✓	✓	✓	✓	✓	✓	✓	8
	4.5.	Changes to hydrodynamics and ocean circulation			✓		✓	✓		✓		4
	4.6.	Changes in productivity (shifts in primary and secondary production)		✓	✓	✓		✓	✓	✓		6
	4.7.	Geohazards (tsunamis, volcanic eruptions, earthquakes)		✓		✓	✓	✓		✓	✓	6

7.3 NATIONAL CAUSAL CHAIN ANALYSIS MEETINGS

7.3.1 National CCA Meeting Schedule

National CCA meetings were organised for each of the nine countries in the ASCLMEs between 14th July 2011 and 15th August 2011. Meeting attendees were identified and invited by the local ASCLMEs focal point and they included national experts in a wide range of topics from different government authorities and partner organisations. The meetings were typically facilitated by a team of three or sometimes four people, which included:

- Dr Rebecca Klaus (International Consultant - CCA)
- Ms Lucy Scott (Data Manager - ASCLMEs)
- Dr Ranjeet Bhagooli (Regional Consultant – ASCLMEs island nations)
- Dr Johnson Kitheka (Regional Consultant – ASCLMEs mainland nations)
- Mr Rondolph Payet (Chief Technical Advisor – SWIOFP project)

In Madagascar and Mozambique, national counterparts assisted in leading the facilitation of the working group sessions in order to address the language challenge.

The meeting schedule and associated travel work plan (which includes the list of facilitators at each meeting) are included in Annex 1 and Annex 2 respectively.

7.3.2 National CCA Meeting Agenda

Each of the National CCA meetings followed the same outline agenda (a copy of which is included in Annex 3). During the first session, after the Registration and Welcome, attendees were introduced to the proposed list of activities through a series of presentations given by the Data Manager (Ms Lucy Scott) and the consultant (Dr Rebecca Klaus). Copies of these presentations are included in Annex 4 and Annex 5.

The first presentation provided attendees with an update on progress on the ASCLMEs Project. The second presentation introduced the process of Causal Chain Analysis and the third presentation provided an overview of the National Issues of Concern that had been identified from the MEDAs for that country and included in the Draft Issues Framework.

The attendees were then divided into three roughly equal sized groups, one group for each of the first three Main Areas of Concern (MAC01, MAC02 and MAC03). A separate group was not created for the fourth Main Area of Concern (Risks, unpredictable environmental variability and extreme events) as the issues included in this MAC should arise through the CCA.

For the remainder of the day the groups worked through a series of different exercises:

- Group Work Session 1: the participants were asked to review the issues included in the Draft Issues Framework and to conduct a first level prioritisation. The aim of the first level prioritisation was to identify the issues of relevance at the national level, to validate the Draft Issues Framework, and to rank them in terms of their national importance.
- Group Work Session 2: the participants conducted a second prioritisation exercise, which considered the severity of the issue at the national level and the scope of each of the issues at the regional level. The result of this exercise was used to identify the top priority issues for inclusion in the Impact Analysis and CCA.
- Group Work Sessions 3 and 4: the participants commenced the Impact Analysis and CCA for a subset of high priority issues. Each group was advised to try to complete chains for between 3 to 5 of the top priority issues. Attendees then constructed two spider diagrams per issue, one to illustrate the impact analysis and the other to

illustrate causal relationships between the direct (immediate), underlying and root causes.

7.3.3 Group Work Session 1: Prioritisation Level 1

The Draft Issues Framework was validated at the national CCA meetings during the first Level 1 Prioritisation exercise. Attendees were asked whether or not the issue was relevant at the national level, or would be relevant in 10 years time if no action was taken. If the issue was not relevant now or likely to be relevant in the future, the issue was not discussed further. During this exercise, the facilitator for each group asked a series of 6 questions:

Question 1 National relevance?

The facilitator asked the group to identify if the issue was relevant in their country. The responses were classified as follows:

- ***Relevant*** (R): Relevant issue at the national level now and will continue unless acted upon.
- ***Future Relevant*** (FR): Not relevant now but likely to be relevant in 10 years time.
- ***Not relevant*** (NR): Not relevant now and unlikely to become an issue in 10 years time.

If the issue was relevant now or likely to be relevant in the future, the facilitator continued with questions 2 to 8.

If the issue was not relevant, and thought unlikely to become relevant, it was disregarded from this point forward.

Question 2 National Importance?

The groups were asked to rank the issues according to whether or not it was considered to be of high, medium or low priority at the national level and in the present day.

Question 3 Transboundary?

The group was then asked if they thought the issue was transboundary and responses were classified as follows:

- ***Transboundary*** (T): Relevant transboundary issue now in the present day and likely to continue unless acted upon.
- ***Future Transboundary*** (FT): Not a transboundary issues now but likely to be a transboundary issue in 10 years.
- ***Not transboundary*** (NT): Not a serious transboundary issue and unlikely to become a transboundary issue in 10 years time.

Question 4 Baseline?

The facilitator asked the group whether there was baseline data available related to the issue. If the answer was ‘yes’, the facilitator asked who collected the data originally, what the data consisted of and who currently held responsibility for the data.

Question 5 Monitoring?

The facilitator asked the group if there was an ongoing monitoring programme related to the issue. If the answer was ‘yes’, the facilitator asked who was responsible for collecting the monitoring data, what the data consisted of, and who held responsibility for the data.

Question 6 Any missing issues?

Once the group had finished answering the above questions, the facilitator asked if there are were other issues that were not captured in the Draft Issues Framework.

7.3.4 Group Work Session 2: Prioritisation Level 2

During the second Group Work Session, a second level prioritisation was then carried out to assess the severity and scope of the issues, and to determine an overall ranking of the issues at the national level. The facilitators asked the attendees the following questions for each issue:

Question 7 Severity of the issue at the national level?

The facilitator asked the group to rank the issues again, now and how they imagine it could be in 10 years time, in terms of the:

- Environmental impact
- Socio-economic impact
- Macro-economic impact

The severity of each different impact type was ranked using the following categories:

- ***Very High (VH or 4)***: Already a serious issue at the national level, likely to destroy or eliminate part of the ecosystem, or have severe socio- or macro-economic impacts, and will be even more widespread in 10 years time.
- ***High (H or 3)***: The issue is becoming more of a problem, likely to seriously degrade part of the ecosystem, or have serious socio- or macro-economic impacts, and will become a more widespread problem in 10 years time.
- ***Medium (M or 2)***: The issue is localized now, only likely to moderately degrade part of the ecosystem, or have moderate socio- or macro-economic impacts, and will still only affect a moderate part of these systems in 10 years.
- ***Limited (L or 1)***: The issue is not a serious issue now, will likely only slightly impair part of the ecosystem, or have mild socio- or macro-economic impacts, and will remain localized in 10 years.

Question 8: Scope of the issue at the regional level?

The facilitator then explained to the group that they wanted them to think about the geographic scope and impact of the issue at the regional level.

Transboundary scope

The facilitator asked the group to consider whether they consider the transboundary nature of the issue. The group was asked to rank the issue as follows:

- ***Very High (VH or 4)***: Already a widespread issue in its scope and will continue to have a widespread affects on the ecosystem throughout the ASCLMEs region in 10 years.
- ***High (H or 3)***: The issue is becoming more widespread and will affect the ecosystem in many parts of the ASCLMEs region in 10 years.
- ***Medium (M or 2)***: The issue is moderately localized in its scope now, but will spread and affect the ecosystem in some parts of the of the ASCLMEs region in 10 years.
- ***Limited (L or 1)***: The issues is localized in scope and will continue to only affect a limited part of the ecosystem in the ASCLMEs region in 10 years.

Scale of benefits of resolving the issue

The facilitator asked the group to consider whether they thought that it would be beneficial to try to resolve the issue. The group was asked to rank the issue as follows:

- ***Very High (VH or 4)***: Very likely to bring widespread benefits throughout the ASCLMEs region in 10 years.
- ***High (H or 3)***: Likely to bring some benefits throughout the ASCLMEs region in 10 years.
- ***Medium (M or 2)***: The issue is localized and will benefit only some parts of the ASCLMEs region in 10 years.

- ***Limited (L or 1)***: Likely to only bring very localized benefits within the ASCLMEs region in 10 years.

Feasibility of finding solutions to the issue

The facilitator asked the group to consider whether they thought it was feasible to find a solution to the problem. The group was asked to rank the issue as follows:

- ***Very High (VH or 4)***: Very likely to be able find a solution to this issue for the whole ASCLMEs region in 10 years.
- ***High (H or 3)***: Likely to be able find a solution to this issue for the whole ASCLMEs region in 10 years.
- ***Medium (M or 2)***: Likely to only be able to find localized solutions for some parts of ASCLMEs region in 10 years.
- ***Limited (L or 1)***: Likely to only be able to find very localized solutions in limited parts ASCLMEs region in 10 years.

The results of the Level 2 Prioritisation were consolidated. Results from the 'Overall severity' score and 'Overall scope' score were added and used to generate the 'Overall Ranking', which was used to identify the top priority issues at the national level. Attendees were asked to compare the results of the Level 2 Prioritisation, with the Level 1 Prioritisation, and to determine if they still agreed with those that had been identified as high priority through the Level 2 prioritisation exercise.

7.3.5 Group Work Session 3: Impact Analysis

An Impact Analysis was carried out for the top three to five ranked issues identified through the Prioritisation exercises, depending on how quickly the participants managed to complete the analysis.

A schematic diagram illustrating the standard impact and CCA analysis is shown in Figure 3. For comparison, the standard DPSIR (Driver-Pressure-State-Impact-Response) framework, which is another method that can be used to identify management responses to actual or predicted impacts is illustrated in Figure 4. The steps used in these meetings is illustrated in Figure 5.

Facilitators first asked attendees to develop impact chains by considering the environmental impacts of the issue, the ecosystem services most likely to be affected, the socio-economic impacts and the stakeholder groups most affected.

The facilitator led the groups through the process of creating spider diagrams to illustrate the impact chains for each issue as follows:

Step 1: Environmental Impacts and Ecosystem Services

The facilitator started by writing the issue at the top of a sheet of flip-chart paper. They then asked the group to identify the environmental impacts, and using a spider diagram format, to record each impact. Once the group has identified the impacts, the facilitator asked the group to identify which ecosystem services would also be affected by that impact. Participants were given a list of ecosystem services as shown in Table 4.

Step 2: Socio-economic Impacts and Stakeholders

The facilitator then asked the group to consider the socio-economic consequences for each impact, in terms of the economic impacts (welfare), social impacts (wellbeing) and ecological impacts (sustainability) aspects. The group were also asked to identify which of the stakeholder groups they thought would be impacted. . Participants were given a list of ecosystem services as shown in Table 4.

An example of one of the impact chains created by the workshop participants during one of these national workshops is shown in Figure 6. After the workshops, these diagrams were transferred into Microsoft Publisher, as shown in Figure 8.

7.3.6 Group Work Session 4: Causal Chain Analysis

The final two Sessions in the meeting were used to construct causal chain analyses on the prioritised issues; to determine the direct causes and the sectors involved, the underlying resource use practices, legal, social, economic and political causes and then the root causes.

Constructing a causal chain is a relatively straight forward process which involves several different levels: direct causes and sectors, underlying causes (resource use practices as well as social, economic, legal and political factors), and root causes. Diagrams illustrating the steps in the CCA process are shown in Figure 3 and Figure 5.

Each link in the chain is forged by asking the question 'Why?' Each time the question 'Why?' is asked, the response can be used to add another link in the chain. By repeatedly asking this same question, this should eventually lead to the root cause. The facilitators led the groups through the process of constructing causal chains, by using the following steps to help the groups to construct the causal chain:

Step 1: Identify direct causes of the issue

Groups were first asked to identify the 'direct' causes of the issue. There may be multiple direct causes of any one issue, and the facilitators encouraged the attendees to identify as many of these as possible.

Step 2: Identify the sectors

The facilitator asked the group to identify the sectors that contribute to the direct causes in parallel with Step 1. For example, if a direct cause of an issue was 'Sedimentation' the sectors that contributed towards 'Sedimentation' were identified (e.g. Agriculture and Forestry, Mining etc.).

Step 3: Link the sectors to the direct causes

The facilitator explained that some sectors may contribute to only one direct cause of any one particular issue, whereas as other sectors may contribute towards more than one of the direct causes of the issue. The facilitator asked the group to interlink the causes with the sectors.

Step 4: Identify the resource uses and practices that are the underlying causes

For each sector, the facilitator asked the attendees to identify the resource use practices within each sector that contributed towards each direct cause.

Step 5: Identify social, economic, legal and political factors that are the underlying causes

For each sector, the facilitator asked the attendees to identify the social, economic, legal and political causes of the resource use practices that contributed towards the direct cause.

Step 6: Link the resource uses and practices, and social, economic and legal causes

The facilitator asked the attendees to link the resource use practices with the social, economic, legal and political causes of the direct cause.

Step 7: Determine the root causes

The facilitator continued to ask the attendees 'Why' the resource use practices or social, economic and legal causes behind the issue persisted in an effort to reveal the root cause.

An example of one of the causal chains created by the workshop participants during one of these national workshops is shown in Figure 7. After the workshops, these diagrams were transferred into Microsoft Publisher, as shown in

Figure 9.

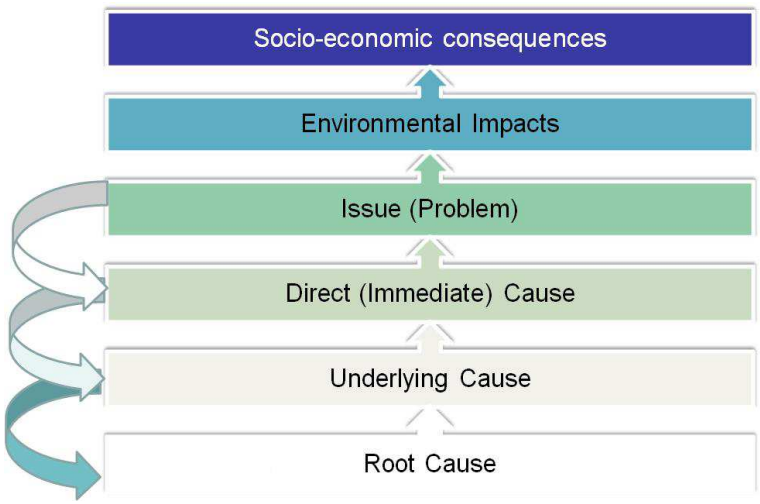

Figure 3: Flow diagram illustrating the Causal Chain Analysis process used GEF-IW projects.

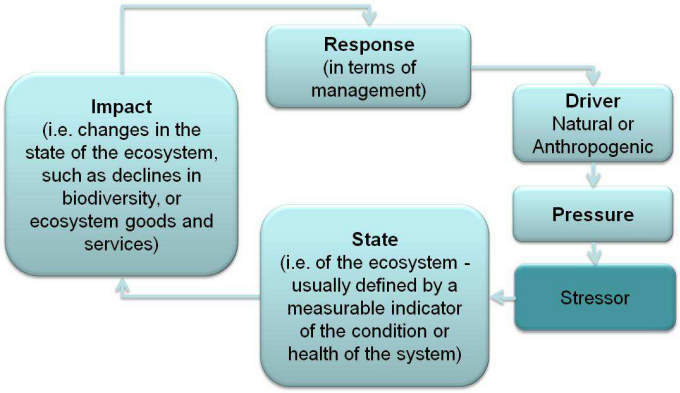

Figure 4: Diagram illustrating the DPSIR (Driver-Pressure-State-Impact-Response)

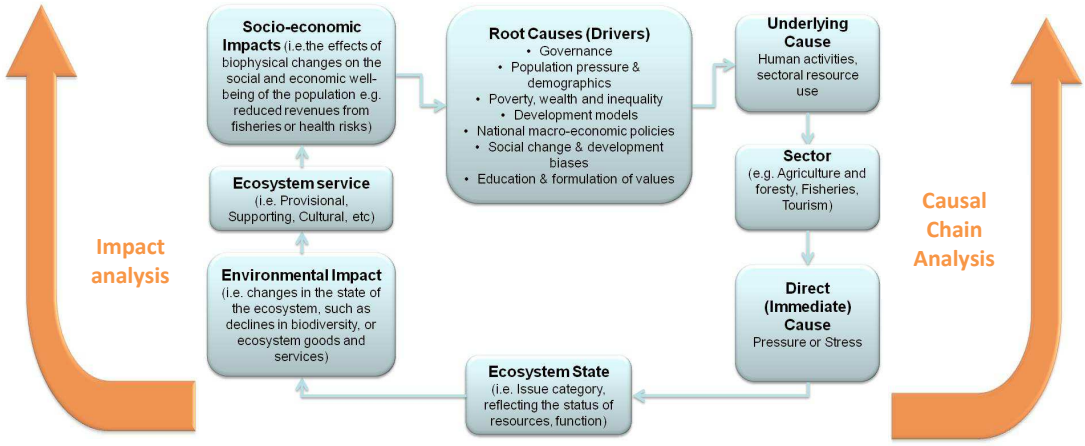

Figure 5: Diagram illustrating the process used to develop (i) impact and (ii) causal chains in the National CCA meetings

Table 4: List of Ecosystem Services used during the National CCA Meetings. Based on TEEB (2011) and Raymond et al., (2009)*, derived from Costanza et al. (1997), De Groot et al. (2002), MA (2005a), Daily, Ehrlich, Mooney, et al. (2008)

PROVISIONING SERVICES

Pro1 Food (e.g. fish, game fruit)
Pro2 Freshwater (e.g. for drinking, irrigation, cooling)
Pro3 Raw materials (e.g. fibre, timber, fuelwood, fodder, fertilizer)
Pro4 Genetic resources (e.g. for crop improvements and medicinal purposes)
Pro5 Biochemical medicines and pharmaceuticals (e.g. biochemical products, and test organisms)
Pro6 Ornamental resources (e.g. artisan work, decorative plants, pet animals, fashion)
Pro7 Geological resources*
Pro8 Energy*

REGULATING SERVICES

Reg1 Air quality regulation (e.g. Capturing dust, chemicals, etc)
Reg2 Climate regulation (e.g. Carbon sequestration, influence of vegetation on rainfall etc.)
Reg3 Natural hazard regulation (e.g. Storm protection and flood prevention)
Reg4 Regulation of water flows (e.g. Natural drainage, irrigation and drought prevention)
Reg5 Waste treatment (especially water purification)
Reg6 Erosion regulation / prevention
Reg7 Nutrient cycling and maintenance of fertility (incl. soil formation)*
Reg8 Pollination
Reg9 Biological control (e.g. Seed dispersal, pest and disease control)

SUPPORTING / HABITAT SERVICES

Sup1 Maintenance of life cycles (incl. nursery, spawning, breeding, feeding)
Sup2 Maintenance of genetic diversity (gene pool protection)
Sup3 Photosynthesis & Primary production*
Sup4 Secondary production*

CULTURAL & AMENITY SERVICES

Cul1 Aesthetics information
Cul2 Opportunities for recreation, tourism and lifestyle
Cul3 Inspiration for culture, art and design (Cultural heritage values)
Cul4 Spiritual experience
Cul5 Bequest, intrinsic and existence*
Cul6 Information for cognitive development Knowledge systems and education values
Cul7 Social relations*
Cul8 Sense of place*

Table 5: List of Sectors & Stakeholders (from WIO-Lab TDA 2009)

Sector	Stakeholders
Fisheries and Aquaculture	Traditional / Artisanal fishers Commercial fishers (local) Commercial fishers (foreign) Recreational fishers (local) Sports fishers (tourism) Seaweed farmers Industrial prawn farmers Fish & shellfish farmers
Agriculture and Forestry	Charcoal makers Small-scale loggers Industrial loggers Small-scale farmers Large-scale farmers Forest users/herbalists Pastoralists Ranchers Poultry farmers Dairy farmers Beekeepers
Tourism	Tourists Hotel owners & operators Small-scale traders Tour, boat & SCUBA operators
Mining	Coral/lime miners Sand miners Small-scale salt producers Industrial salt works Small-scale miners Industrial mining companies Fuel suppliers and stations Oil & gas producers
Industry	Heavy manufacturing industry Light manufacturing industry Agro-processing industries Oil refining
Transportation	Ports Dredging companies Clearing and forwarding Railway Roads (incl. traffic) Airports Airlines Shipping
Energy Production	Hydro-dam operators Power station operators Renewable energy producers
Urbanisation	Solid waste operators Sewage managers Property developers Property owners Town planners Coastal community
Defence	Military Coastguard Police

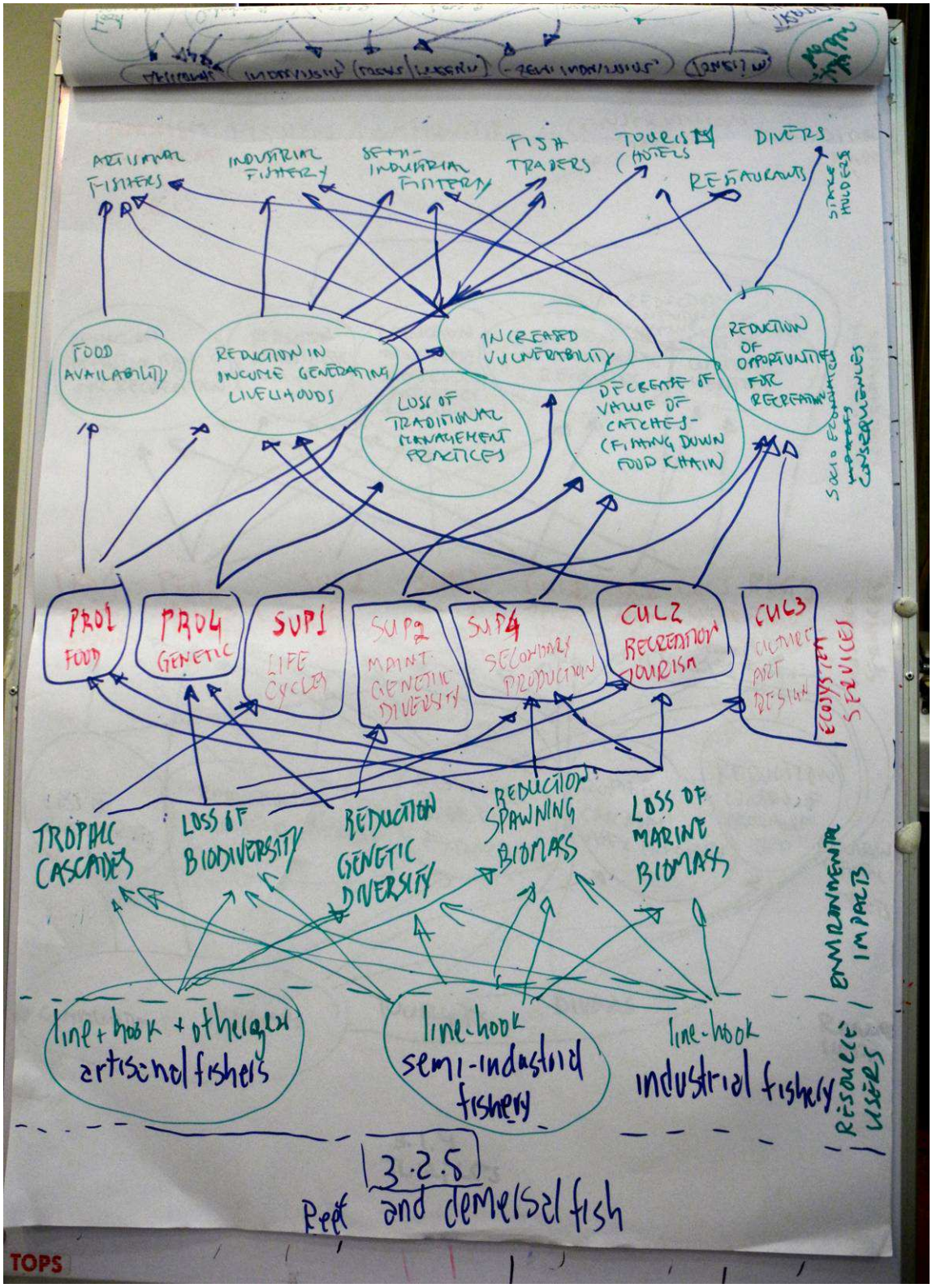

Figure 6: Example of the Impact Analysis for the issue 3.2.5 Declines in populations of reef and demersal fishes from the National Causal Chain Analysis meeting in Mozambique.

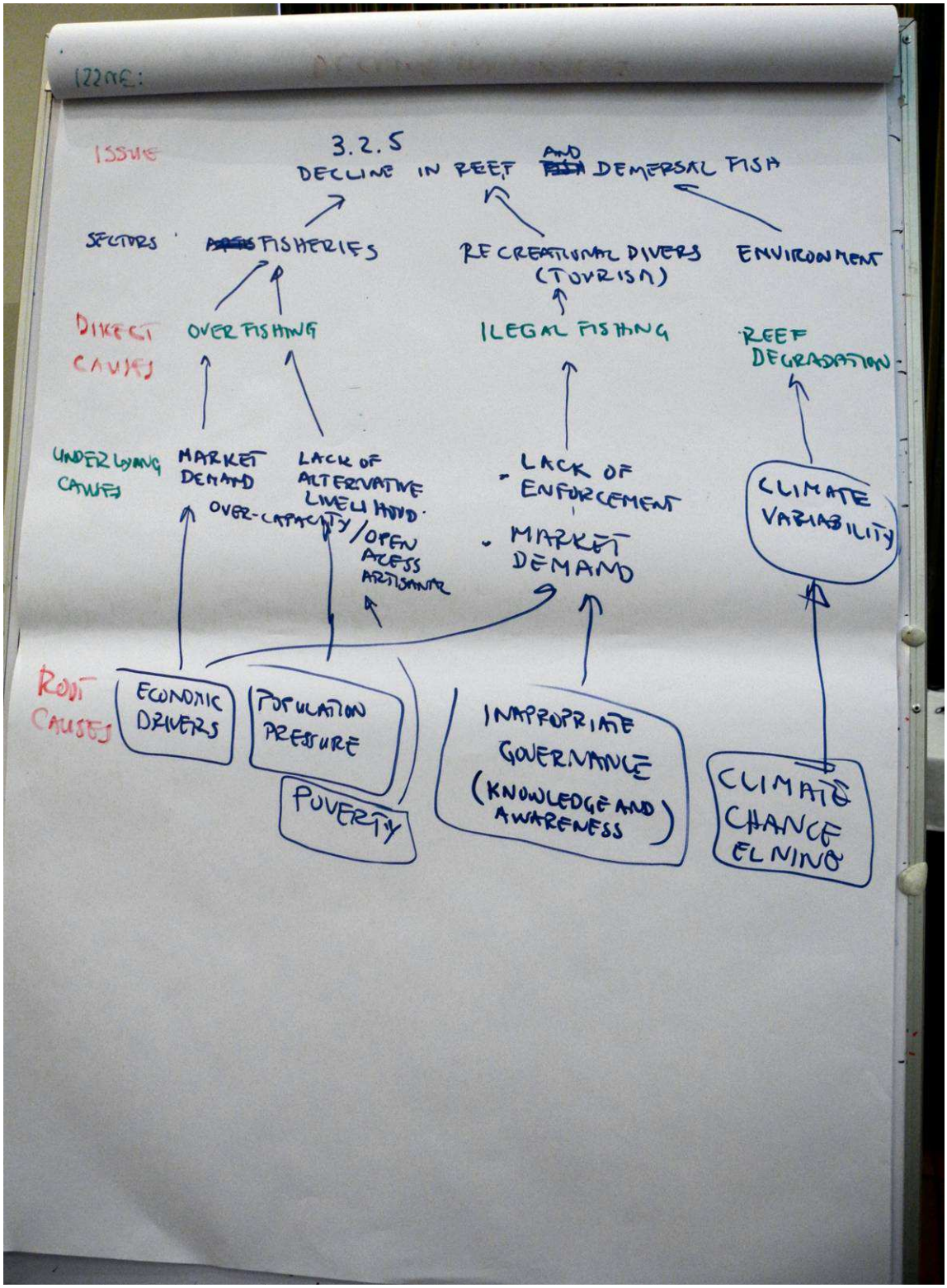

Figure 7: Example of the Causal Chain Analysis for the issue 3.2.5 Declines in populations of reef and demersal fishes from the National Causal Chain Analysis meeting in Mozambique.

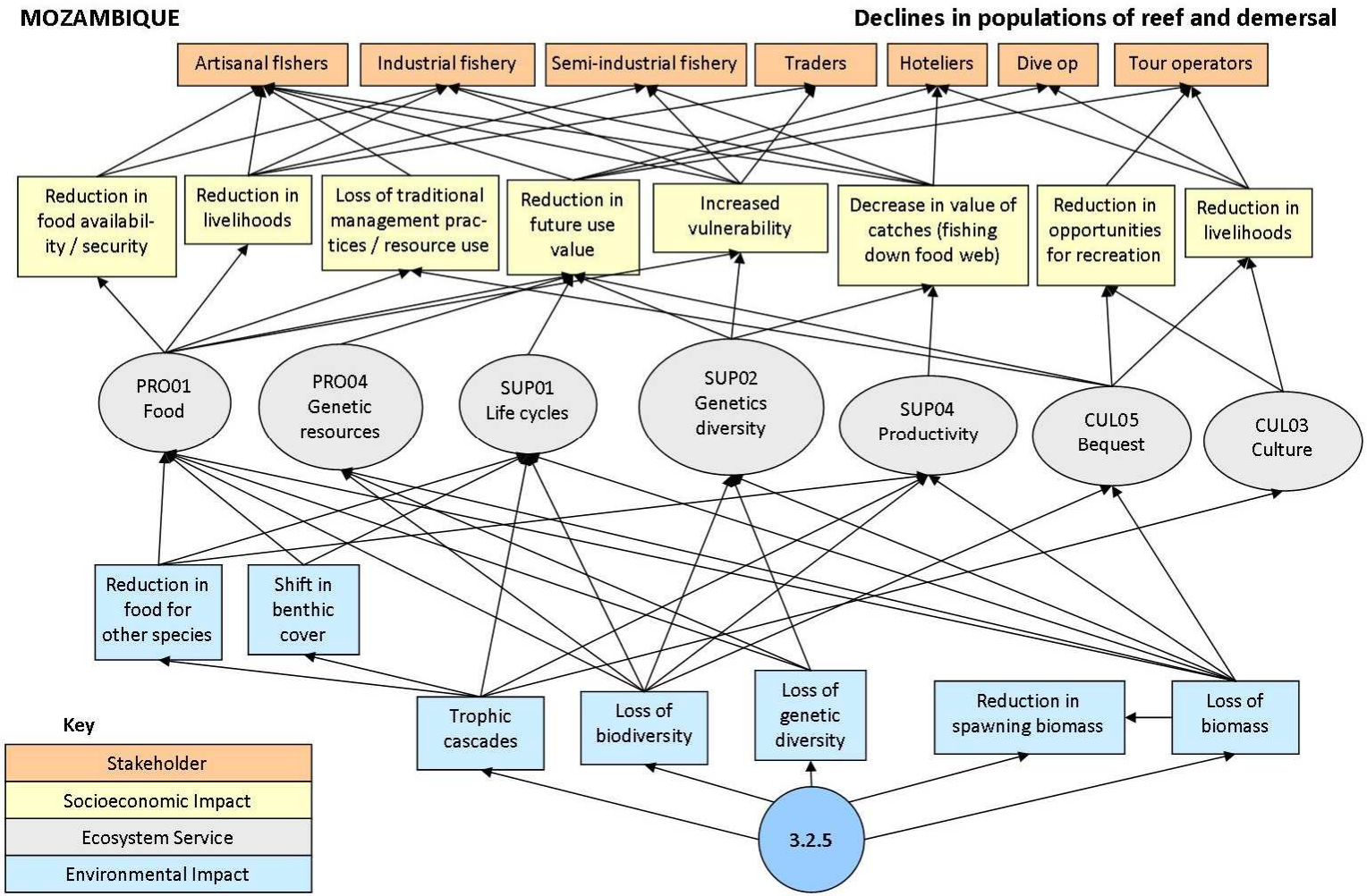

Figure 8: Example of the draft results of the Impact Analysis for the issue (3.2.5) Declines in populations of reef and demersal fish from the National Causal Chain Analysis meeting in Mozambique

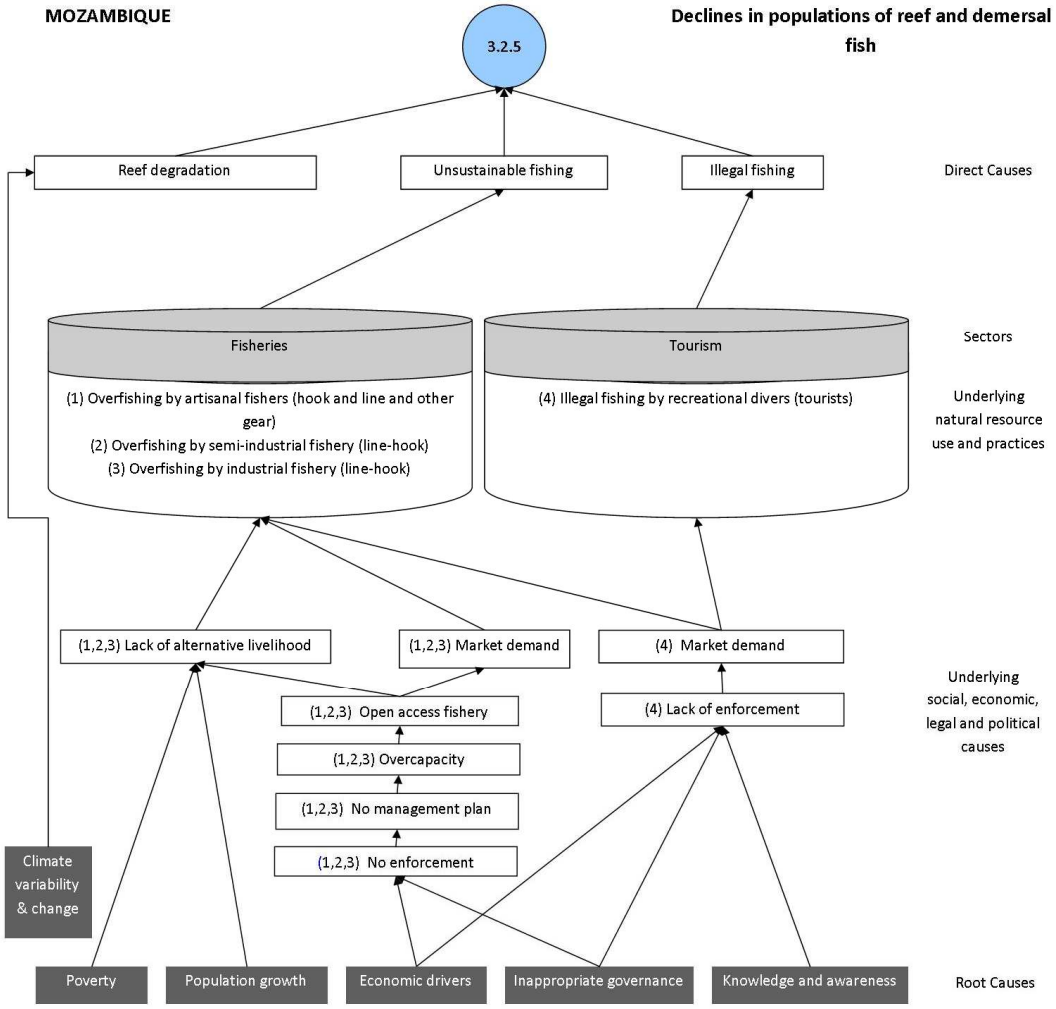

Figure 9: Example of the draft results of the Causal Chain Analysis for the issue (3.2.5) Declines in populations of reef and demersal fish from the National Causal Chain Analysis meeting in Mozambique

7.3.7 Analysis of the National Results

The outputs from each of the prioritisation exercises (Group Work Sessions 1 and 2) were captured in Excel tables. The outputs from impact chains and causal chains (Group Work Sessions 3 and 4) were all transferred into Microsoft Publisher files (examples of which are shown in Figure 8 and Figure 9). In addition to this, the impacts and causes captured in each of these chains were also transferred into Excel tables, to allow for cross comparisons of the impacts and causes of issues between countries at the regional level.

7.3.8 Review of the National Results

Countries were sent the consolidated set of results and given the opportunity to review their outputs, before the results were finalised.

8 NATIONAL CCA WORKSHOP RESULTS

The country outputs from all 9 of the National Causal Chain Analysis Workshops are presented in Annex 6. These national outputs include a table with the results of the Level 1 prioritisation exercise, a table with the results of the Level 2 prioritisation exercise and a set of spider diagrams (produced using Microsoft Publisher) that illustrate both the Impact Analysis and Causal Chain Analysis for the priority transboundary issues that were identified and discussed at the meetings within each Main Area of Concern. The final results from all the countries are presented below in a series of tables and key observations described below:

8.1.1 Group Work Session 1: Prioritization Level 1

Prioritization Level 1 results are shown in Tables 4 to 8.

Table 6 shows an updated version of the Draft Issues Framework (shown before in Table 3), after validation by the countries during the national CCA meetings. This table identifies which issues are considered to be relevant to the countries now (and in 10 years time).

Table 7 shows the first level ranking of the issues, in terms of whether countries consider the issue to be important at the national level.

Table 8 shows whether or not the countries considered the issue to be transboundary in nature as part of the Level 1 prioritisation.

Error! Reference source not found. **Table 8: Prioritization Level 1: Transboundary nature of the issue.**

Major Area of Concern	Issue No.	Issue	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles
MAC01.	1.1.	Alteration of natural river flow and changes in freshwater input and sediment load	FT	T	NT	NT	T	NT
	1.2.	Degradation of ground and surface water quality	FT	T	NT	T	T	NT
	1.3.	Degradation of coastal and marine water quality						
	1.3.1	Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources	NT	T	T	T	T	FT
	1.3.2	Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources	T	T	T	T	T	NT
	1.3.3	Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources	T	T	T	T	T	T
	1.3.4	Suspended solids in coastal waters due to human activities on land and in the coastal zone	T	T	NT	T	T	NT
	1.3.5	Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources	T	T	FT	T	T	T
	1.3.6	Oil spills (drilling, exploitation, transport, processing, storage, shipping).	T	T	T	T	T	T
MAC02:	2.1.	Shoreline change, due to modification, land reclamation and coastal erosion	T	T	NT	T	T	T
	2.2.	Disturbance, damage and loss of coastal, watershed and upland habitats						
	2.2.1.	Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)	NT	T	NT	NT	T	NR
	2.2.2.	Disturbance, damage and loss of coastal forest habitats	T	T	NT	NT	NR	T
	2.2.3.	Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)	T	T	NT	T	T	T
	2.2.4.	Disturbance, damage and loss of wetland habitats	NR	T	NT	NT	NT	T
	2.2.5.	Disturbance, damage and loss of estuarine habitats	NR	T	NT	NR	T	NR
	2.2.6.	Disturbance, damage and loss of mangrove habitats	T	T	T	NT/T	T	T
	2.3.	Disturbance, damage and loss of subtidal benthic habitats						
	2.3.1.	Disturbance, damage and loss of coral reef habitats	T	T	T	T	T	T
	2.3.2.	Disturbance, damage and loss of seagrass habitats	T	T	T	NT	T	T
	2.3.3.	Disturbance, damage and loss of macroalgal habitats	T	T	NT	NR	NT	NR
	2.3.4.	Disturbance, damage and loss of soft sediment habitats	NR	T	NT	NT	T	T
	2.3.5.	Disturbance, damage and loss of deep water habitats (including sea mounts)	NR	T	T	NR	NR	NR
	2.4.	Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)	NR	T	T	T	T	T
	2.5.	Increase in the occurrence of harmful or toxic algal blooms (HABs)	T	T	T	T	T	NR
	2.6.	Introduction of exotic non-native species, invasives and nuisance species	T	T	T	T	T	NR

Major Area of Concern	Issue No.	Issue	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	
MAC03:	3.1.	Decline in populations of focal species							
	3.1.1.	Decline in populations of marine mammals	T	T	NT	T	T	T	
	3.1.2.	Decline in populations of cetaceans	NR	T	T	T	T	T	
	3.1.3.	Decline in populations of seabirds	T	T	T	T	T	T	
	3.1.4.	Decline in populations of turtles	T	T	T	T	T	T	
	3.2.	Decline in populations of commercial fish stocks							
	3.2.1.	Decline in populations of sharks and rays	T	T	NT	T	T	T	
	3.2.2.	Decline in populations of large pelagic	T	T	T	T	T	T	
	3.2.3.	Decline in populations of small pelagic	T	T	T	NR	T	NR	
	3.2.4.	Decline in populations of deep water demersals	NR	T	NR	T	T	NT	
	3.2.5.	Decline in populations of reef and demersal fish	NT	T	NT	T	NT	FT	
	3.3.	Decline in populations of commercial invertebrates							
	3.3.1.	Decline in populations of molluscs (bivalves, gastropods)	NT	T	NT	T	T	NR	
	3.3.2.	Decline in populations of abalone	NR	NR	NR	NR	NR	NR	
	3.3.3.	Decline in populations of cephalopods	NT	T	NT	T	T	FT	
	3.3.4.	Decline in populations of sea cucumbers	NT	T	NT	NT	T	FT	
	3.3.5.	Decline in populations of sea urchins	NR	NT	NT	NR	NT	NR	
	3.3.6.	Decline in populations of prawns and shrimp	NT	T	NT	T	T	NR	
	3.3.7.	Decline in populations of lobsters	NR	T	FT	T	T	T	
	3.3.8.	Decline in populations of crayfish	NR	NR	NR	NR	NT	NR	
	3.3.9.	Decline in populations of crabs	NT	T	NT	T	T	NR	
	3.4.	Excessive bycatch and discards	T	T	T	T	T	T	
	3.5.	Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)	NT	T	NT	T	T	FT	

Key	
T	Transboundary
Ts	Transboundary shared
FT	Future transboundary
NT	Not transboundary
NR	Not relevant

shows the availability of baseline data pertinent to each of the issues. If there was further specific details provided on the type of data, or the organisations that holds the data, these information are included in the Level 1 Prioritization tables in Annex 6.

Table 10

Table 10 shows whether or not the countries have a monitoring programme related to the issue. If there was further specific details provided on the programme, such as the organization responsible for the monitoring, these information are included in the Level 1 Prioritization tables in Annex 6.

8.1.1.1 Relevance

The outputs from the relevance exercise are presented in Table 6. This table shows the issues that the countries considered to be 'Relevant', 'Future relevant' and 'Not relevant'. If countries identified issues as 'Relevant' that had not been included in the MEDA this information was fed-back into the MEDA review. The relevance of the issues in the Draft Issues Framework at the national level are summarised below:

- **Comoros** considered 7 of the 8 MAC01 issues to be 'Relevant' with the exception of degradation of ground and surface water (1.2), which was identified as 'Future relevant'. Only 9 of the 15 MAC02 issues were considered to be 'Relevant', and the exceptions included: wetlands (2.2.4), estuarine habitats (2.2.5), soft sediment habitats (2.3.4), deep water habitats (2.3.5), and pelagic habitats (2.4). Exotic or non-native species (2.6) was considered to be 'Future relevant'. Of the MAC03 issues, 14 of the 20 issues were considered 'Relevant', the exceptions included: cetaceans (3.1.2), deep water demersals (3.2.4), abalone (3.3.2), sea urchins (3.3.5), lobster (3.3.7), and crayfish (3.3.8). Molluscs (3.3.1) were identified as a 'Future relevant' issue. All MAC04 issues were 'Relevant'.
- **Kenya** considered all MAC01 and MAC02, issues to be 'Relevant'. Of the MAC03 issues, 18 of the 20 issues were considered 'Relevant', the exceptions included: abalone (3.3.2) and crayfish (3.3.8). All MAC04 issues were 'Relevant'.
- **Madagascar** considered all MAC01 and all MAC02 issues to be 'Relevant', although deep water habitats (2.3.5) were considered to be 'Future relevant'. Of the MAC03 issues, 17 of the 20 issues were considered 'Relevant', the exceptions included: deep water demersals (3.2.4), abalone (3.3.2), and crayfish (3.3.8). 'Future relevant' issues included: seabirds (3.1.3), turtles (3.1.4), small pelagics (3.2.3), molluscs (3.3.1) and, sea urchins (3.3.5). All MAC04 issues were 'Relevant'.
- **Mauritius** considered all MAC01 issues to be 'Relevant'. Of the MAC02 issues, 11 of 15 issues were identified as 'Relevant', the exceptions included: coastal forests (2.2.2), estuarine habitats (2.2.5), macroalagal habitats (2.3.3) and, deep water habitats (2.3.5). Of the MAC03 issues, 16 of the 20 issues were identified as 'Relevant', the exceptions included: small pelagics (3.2.4), abalone (3.3.2), sea urchins (3.3.5) and crayfish (3.3.8). Future relevant issues included marine mammals (3.1.1). All MAC04 issues were 'Relevant'.
- **Mozambique** considered all MAC01 to be 'Relevant', although nutrient enrichment (1.3.2) was considered to be 'Future Relevant'. Of the MAC02 issues, 13 of the 15 issues were identified as 'Relevant' the exceptions were: coastal forest habitats (2.2.2) and deep water habitats (2.3.5). Of the MAC03 issues, 19 of the 20 issues were considered 'Relevant', the exception being abalone (3.3.2). 'Future relevant' issues included: large pelagics (3.2.2), small pelagics (3.2.3), deep water demersals (3.2.4), cephalopods (3.3.3), sea urchins (3.3.5), crayfish (3.3.8) and crabs (3.3.9). All MAC04 issues were 'Relevant'.
- **Seychelles** considered all MAC01 issues to be 'Relevant'. Of the MAC02 issues, 10 of 15 issues were identified as 'Relevant', the exceptions included: upland watersheds (2.2.1), estuarine habitats (2.2.5), macroalgal habitats (2.3.3), deep water habitats (2.3.5), harmful algal blooms (2.5) and exotic or invasive species (2.6). 'Future relevant' issues included pelagic habitats (2.4). Of the MAC03 issues, 13 of the 20 issues were considered 'Relevant', the exceptions included: small pelagics (3.2.4), molluscs (3.3.1),

abalone (3.3.2), sea urchins (3.3.5), prawn and shrimp (3.3.6), and crayfish (3.3.8) and crabs (3.3.9). All MAC04 issues were 'Relevant'.

- **Somalia** considered all MAC01 and MAC02 issues to be 'Relevant'. Of the MAC03 issues, 17 of the 20 issues were considered 'Relevant', the exception being molluscs (3.3.1), abalone (3.3.2) and, sea urchins (3.3.5). All MAC04 issues were 'Relevant'.
- **South Africa** considered all MAC01 and MAC02 issues to be 'Relevant'. Of the MAC03 issues, only 12 of the 20 issues were considered 'Relevant', the exceptions included: marine mammals (3.1.1), cetaceans (3.1.2), cephalopods (3.3.3), sea cucumbers (3.3.4), sea urchins (3.3.5), lobsters (3.3.7), crayfish (3.3.8) and crabs (3.3.9). All MAC04 issues were 'Relevant'.
- **Tanzania** considered all MAC01 and MAC02 issues to be 'Relevant'. Of the MAC03 issues, 11 of the 20 issues were considered Relevant, the exception being marine mammals (3.1.1), cetaceans (3.1.2), seabirds (3.1.3), sharks and rays (3.2.1), abalone (3.3.2) and, sea urchins (3.3.5), and crayfish (3.3.8). All MAC04 issues were 'Relevant'.

Comparison of the issues across the countries revealed that the majority of the issues included in the 'Draft Issues Framework' were considered 'Relevant' by more than one of the countries. Key observations were as follows:

MAC01: All 8 issues (100 %) were recognised as 'Relevant' by one or more of the countries. Two issues were identified as being of 'Future relevant' by one of the countries, these were:

- 1.2 Degradation of ground and surface water quality (Comoros).
- 1.3.2 Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources (Mauritius).

No issues within MAC01 were considered as being 'Not relevant' by any of the countries

MAC02: All 15 issues (100 %) were considered 'Relevant' by one or more of the countries. Four issues were identified as being 'Future relevant', these were:

- 2.2.4 Disturbance, damage and loss of wetland habitats (Mozambique).
- 2.3.5. Disturbance, damage and loss of deep water habitats (including sea mounts) (Madagascar).
- 2.4. Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth) (Mozambique and Seychelles).
- 2.6. Introduction of exotic non-native species, invasives and nuisance species (Comoros).

Ten issues were were identified as being 'Not relevant' by one or more of the countries, 4 of which were identified as 'Not relevant' by more than one of the countries:

- 2.2.1. Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)' (Seychelles).
- 2.2.2. Disturbance, damage and loss of coastal forest habitats, (Mauritius and Mozambique).
- 2.2.4. Disturbance, damage and loss of wetland habitats, (Comoros).
- 2.2.5. Disturbance, damage and loss of estuarine habitats, (Comoros, Mauritius and Seychelles).
- 2.3.3. Disturbance, damage and loss of macroalgal habitats, (Mauritius, and Seychelles).
- 2.3.4. Disturbance, damage and loss of soft sediment habitats, (Comoros).
- 2.3.5. Disturbance, damage and loss of deep water habitats (including sea mounts), (Comoros, Mauritius, Mozambique and Seychelles).
- 2.4. Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth) (Comoros).

- 2.5. Increase in the occurrence of harmful or toxic algal blooms (HABs) (Seychelles).
- 2.6. Introduction of exotic non-native species, invasives and nuisance species (Seychelles).

MAC03: All of the 20 issues (100%) were recognised as 'Relevant' by one or more of the countries. Of the 20 issues, 12 were identified as being 'Future relevant', these were:

- 3.1.1. Decline in populations of marine mammals (Mauritius).
- 3.1.2. Decline in populations of cetaceans (Madagascar)
- 3.1.3. Decline in populations of seabirds (Madagascar)
- 3.2.2. Decline in populations of large pelagics (Mozambique)
- 3.2.3. Decline in populations of small pelagics (Madagascar and Mozambique).
- 3.2.4. Decline in populations of deep water demersals (Mozambique).
- 3.3.1. Decline in populations of mollusks (Comoros, Madagascar and Mozambique).
- 3.3.3. Decline in populations of cephalopods (Mozambique).
- 3.3.5. Decline in populations of sea urchins (Madagascar and Mozambique).
- 3.3.8. Decline in populations of crayfish (Mozambique).
- 3.3.9. Decline in populations of crabs (Mozambique).
- 3.5. Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality) (Mozambique, Somalia and South Africa).

Of the 20 issues, 15 were considered as 'Not relevant', by one or more of the countries:

- 3.1.1. Decline in populations of marine mammals (South Africa, Tanzania).
- 3.1.2. Decline in populations of cetaceans (Comoros, South Africa, and Tanzania).
- 3.2.1. Decline in populations of sharks and rays, (Tanzania).
- 3.2.3. Decline in populations of small pelagics (Kenya, Mauritius and Seychelles).
- 3.2.4. Decline in populations of deep water demersals (Comoros, Madagascar).
- 3.3.1. Decline in populations of molluscs (bivalves, gastropods) (Seychelles and Somalia).
- 3.3.2. Decline in populations of abalone (all with the exception of South Africa).
- 3.3.3. Decline in populations of cephalopods (South Africa).
- 3.3.4. Decline in populations of sea cucumbers (South Africa).
- 3.3.5. Decline in populations of sea urchins (all countries except Kenya, Madagascar and Mozambique).
- 3.3.6. Decline in populations of prawns and shrimp (Seychelles).
- 3.3.7. Decline in populations of lobsters (Comoros and South Africa).
- 3.3.8. Decline in populations of crayfish (all countries except Mozambique & Somalia).
- 3.3.9. Decline in populations of crabs (Seychelles and South Africa).

There were 4 issues that were only recognised as being 'Relevant' by one country included:

- 3.3.2. Decline in populations of abalone, which was only considered relevant by South Africa.
- 3.3.5. Decline in populations of sea urchins, which was only considered to be of future relevance to Madagascar and Mozambique.
- 3.3.8. Decline in populations of crayfish, which was only considered to be of relevance to Somalia and of future relevance to Mozambique.

These issues that could be removed from the regional 'Draft Issues Framework', or consolidated with other issues. For example, Issue 3.3.2 (abalone) could be combined with issue 3.3.1 (molluscs). Issue 3.3.5 (sea urchins) could be deleted. Issue 3.3.8 (crayfish) arose from the use of different terminology associated with deep water lobster, so could be consolidated with 3.3.7 (lobster).

8.1.1.2 Importance

The importance of the issue at the national level is shown in

Table 7. The ranking of these issues at the national level is summarised below:

- **Comoros** identified a total of 22 'High' importance issues, distributed between MAC01 (6 issues), MAC02 (4 issues) and MAC03 (12 issues). In MAC01, all issues were of 'High' importance except microbiological contamination (1.3.1) which was of 'Medium' importance and nutrient enrichment (1.3.2) which was of 'Low' importance. In MAC02, issues of 'High' importance included: upland watersheds (2.2.1), coastal habitats (2.2.3), coral reefs (2.3.5) and HABs (2.5). 'Medium' importance issues included: shoreline change (2.1), coastal forests (2.2.2), seagrass (2.3,2), and macroalgal (2.3.3) habitats. 'Low' importance issues included: mangroves (2.2.6) and exotics (2.6). All MAC03 (12 issues) that were 'Relevant' were also of 'High' importance, with the exception of marine mammals (3.1.1) and molluscs (3.3.1), which were of 'Medium' importance.
- **Kenya** identified a total of 31 'High' importance issues, distributed between MAC01 (6 issues), MAC02 (10 issues) and MAC03 (15 issues). In MAC01, all but two issues were of 'High' importance, the exceptions of 'Medium' importance included microbiological (1.3.1) and chemical (1.3.3) contamination. In MAC02 most issues were ranked as being of 'High' importance, with the exception four 'Medium' importance issues which included: soft sediments habitats (2.3.4) and HABs (2.5) and exotics (2.6). In MAC03, all 'Relevant' issues were ranked as being of 'High' importance, except for large pelagics (3.2.2), deepwater demersals and seabirds (3.1.3), which were identified as being of 'Medium' or 'Low' importance.
- **Madagascar** identified a total of 32 'High' importance issues, distributed between MAC01 (7 issues), MAC02 (12 issues) and MAC03 (13 issues). In MAC01, the one 'Medium' priority issue was chemical contamination (1.3.3). In MAC02, all 'Relevant' issues were of 'High' importance except for two 'Medium' importance issues: wetlands (2.2.4), macroalgal (2.3.3) and, soft sediment (2.3.4) habitats. In MAC03, all issues were of 'High' importance except, issues that were identified as 'Not relevant', 'Medium' importance issues which included, marine mammals (3.1.1) and molluscs (3.3.1), and; 'Low' importance issues which included seabirds (3.1.3) and sea urchins (3.3.5).
- **Mauritius** identified 23 'High' importance issues, distributed between MAC02 (7 issues) and MAC03 (16 issues). Mauritius was one of only two countries that did not identify any MAC01 issues as being of 'High' importance[2]. All issues in MAC01 were considered of 'Low' importance with the exception of oil spills (1.3.6), which was considered to be of 'Medium' importance. In MAC02, 'High' importance issues included: coastal habitats (2.2.3), wetlands (2.2.4), mangroves (2.2.6), coral reefs (2.3.1), pelagic habitats (2.4) and HABs (2.5). 'Medium' importance included watershed (2.2.1), coastal forest (2.2.2), seagrass (2.3.2) habitats, and exotics (2.6) and a 'Low' importance issue soft sediment (2.3.4). All relevant MAC03 issues were identified as 'High' importance.
- **Mozambique** identified 23 'High' importance issues distributed between MAC01 (6 issues), MAC02 (8 issues) and MAC03 (9 issues). In MAC01, microbiological contamination (1.3.1) was identified as being of 'Medium' importance, and chemical contamination (1.3.3) was identified as being of 'Low' importance. In MAC02, 'High' importance issues included: shoreline change (2.1), and coastal (2.2.3), estuarine (2.2.5), mangrove (2.2.6), coral reef (2.3.1), seagrass (2.3.2) and soft sediment (2.3.4) habitats. In MAC03, 'High' importance issues included marine mammals (3.1.1), turtles (3.1.4), sharks and rays (3.2.1), large pelagics (3.2.2), reef and demersals (3.2.5), sea cucumbers (3.3.4), spiny lobsters (3.3.7), by catch (3.4) and mariculture (3.5).
- **Seychelles** identified 16 'High' importance issues MAC02 (3 issues) and MAC03 (13 issues)no issues of 'High' importance Seychelles was one of two countries which identified

[2] The rationale for this was that the Government of Mauritius was already aware and had plans in place to deal with these issues.

no MAC01 issues as being of 'High' importance. All MAC01 issues were of 'Medium' importance with the exception of oil spills (1.3.6) which was considered to be of 'Low' importance. In MAC02, issues of 'High' importance included: shoreline change (2.1), coastal habitats (2.2.3), coral reef habitats (2.3.1). 'Medium' importance included coastal forests (2.2.2), wetlands (2.2.4) and soft sediments (2.3.4) habitats. Issues of 'Low' importance included mangrove (2.2.6), seagrass (2.3.2), pelagic (2.4) habitats. In contrast, all 'Relevant' MAC03 issues were of 'High' importance.

- **Somalia** identified 26 'High' importance issues distributed between MAC01 (3 issues), MAC02 (9 issues) and MAC03 (14 issues). In MAC01, 'High' importance issues included chemical contamination (1.3.3), solid wastes (1.3.5), and oil spills (1.3.6). Issues identified as being of 'Medium' importance included river flows (1.1), ground and surface water (1.2) and suspended solids (1.3.4). Issues of 'Low' importance included microbiological (1.3.1), nutrients (1.3.2). In MAC02, issues identified as being of 'High' importance included: upland watershed (2.2.1), coastal forest (2.2.2), wetlands (2.2.4), estuarine (2.2.5), mangrove (2.2.6), coral reef (2.3.1), seagrass (2.3.2) and pelagic (2.4) habitats. In MAC03, all 'Relevant' issues were identified as 'High' priority, with the exception of one 'Medium' importance issue, crabs (3.3.9), and two 'Low' importance issues: seabirds (3.1.3) and mariculture (3.5).
- **South Africa** identified 18 'High' importance issues distributed between MAC01 (4 issues), MAC02 (10 issues) and MAC03 (4 issues). In MAC01, 'High' importance issues included alteration of natural river flows (1.1), degradation of ground and surface water (1.2), microbiological contamination (1.3.1), oil spills (1.3.6). In MAC02, the majority of 'Relevant' issues were identified as being of 'High' importance with the exception of 3 'Medium' importance issues, shoreline change (2.1), coral reef (2.3.1), macroalgal (2.3.3) habitats, and two 'Low' importance issues, mangrove (2.2.6) and seagrass (2.3.2) habitats. In MAC03, 'High' importance issues included shark and rays (3.2.1), reef and demersal fish (3.2.5), abalone (3.3.2). 'Medium' importance issues included seabirds (3.1.3), turtles (3.1.4), molluscs (3.3.1), prawn and shrimps (3.3.6), bycatch (3.4) and mariculture (3.5). Low importance issues included large pelagics (3.2.2), small pelagics (3.2.3), and deep water demersals (3.2.4).
- **Tanzania** identified 24 'High' importance issues, distributed between MAC01 (4 issues), MAC02 (12 issues) and MAC03 (8 issues). In MAC01, the 'High' importance issues included alteration of river flows (1.1), degradation of ground and surface water (1.2), nutrient enrichment (1.3.2), and solid wastes (1.3.5). All other MAC01 issues were of 'Medium' importance. In MAC02, all 'Relevant' issues were of 'High' importance with the exception of two issues of 'Medium' importance: estuarine habitats (2.2.5) and HABs (2.5), and one issue of 'Low' importance, macroalgal habitats (2.3.3). In MAC03, all relevant issues were of 'High' importance with the exception of 3 issues of 'Medium' importance including, cetaceans (3.1.2), small pelagics (3.2.3), and mariculture (3.5), and one 'Low' importance issue, molluscs (3.3.1).

A summary of the importance of these issues within the ASLCMEs is presented below:

MAC01: There were no issues that were ranked as being of 'High' importance by all countries. There were 4 issues that were ranked as 'High' by 6 of the 9 (66.7 %) countries:

- 1.1. Alteration of natural river flow and changes in freshwater input and sediment load
- 1.2. Degradation of ground and surface water quality
- 1.3.5. Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources
- 1.3.6. Oil spills (drilling, exploitation, transport, processing, storage, shipping)

MAC02: There was one issue that was ranked as being of 'High' importance by all countries:

- 2.2.3. Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)

There was one issue that was ranked as 'High' by 8 of the 9 countries (88.9 %):

- 2.3.1. Disturbance, damage and loss of coral reef habitats

There was one issue that was ranked as 'High' by 7 of the 9 countries (88.9 %):

- 2.2.1.Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)

There were 3 issues that were ranked as 'High' by 6 of the 9 (66.7 %) countries:

- 2.1. Shoreline change, due to modification, land reclamation and coastal erosion
- 2.2.6 Disturbance, damage and loss of mangrove habitats
- 2.4. Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)

There were 3 issues that were ranked 'High' by 5 of the 9 (56 %) countries:

- 2.2.2. Disturbance, damage and loss of coastal forest habitats
- 2.2.4. Disturbance, damage and loss of wetland habitats.
- 2.3.1 Disturbance, damage and loss of seagrass habitats

MAC03: There was one issue that was ranked as being of 'High' importance by all countries:

- 3.2.5. Decline in populations of reef and demersal fish

There were 3 issues that were ranked as 'High' by 8 of the 9 countries (88.9 %):

- 3.2.1. Decline in populations of sharks and rays
- 3.3.4. Decline in populations of sea cucumbers
- 3.4. Excessive bycatch and discards

There were 3 issues that were ranked as 'High' by 7 of the 9 (77.8 %) countries:

- 3.1.4. Decline in populations of turtles
- 3.2.2. Decline in populations of large pelagics
- 3.3.3. Decline in populations of cephalopods

There were 3 issues that were ranked as 'High' by 6 of the 9 (66.7 %) countries:

- 3.3.6. Decline in populations of prawns and shrimp
- 3.3.7. Decline in populations of spiny lobsters
- 3.5. Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)

There were 2 issues that were ranked as 'High' by 5 of the 9 (56 %) countries:

- 3.1.1. Decline in populations of marine mammals
- 3.1.2. Decline in populations of cetaceans.
- 3.2.3. Decline in populations of small pelagics

All other issues were only ranked as being of 'High' importance by less than half of the countries (4 or less of the 9 countries).

8.1.1.3 Transboundary Issues

The majority of the issues in the Draft Issues Framework were identified as transboundary issues by more than 50 % of the countries (Table 8). Some issues were considered to be 'Future transboundary' or 'Not transboundary', however, the process of conducting this exercise in all countries demonstrated that the majority of these issues were also 'Transboundary' due to the shared or common nature of the problem or issue between countries within the ASCLMEs.

A summary of the findings within the region is presented below:

MAC01: All of the 8 issues (100 %) were identified as 'Transboundary' by more than 50 % of the countries., and 2 of the issues were considered to be 'Transboundary' by all 9 of the countries:

- 1.3.3 Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources
- 1.3.6 Oil spills (drilling, exploitation, transport, processing, storage, shipping).

There were 4 of the 8 issues (50 %) that were considered to be 'Future transboundary' by one or more of the countries:

- 1.1.Alteration of natural river flow and changes in freshwater input and sediment load
- 1.2 Degradation of ground and surface water quality
- 1.3.1 Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources
- 1.3.5 Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources

There were 6 of the 8 issues (75 %) that were considered to be 'Not transboundary' by one or more countries were:

- 1.1 Alteration of natural river flow and changes in freshwater input and sediment load
- 1.2. Degradation of ground and surface water quality
- 1.3.1 Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources
- 1.3.2 Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources
- 1.3.4 Suspended solids in coastal waters due to human activities on land and in the coastal zone
- 1.3.6 Oil spills

Both the 'Future' and 'Not transboundary' issues listed above can however be considered as transboundary, due to the shared or common nature of the problem between the countries within the ASCLMEs.

MAC02: All except 1 (14) of the 15 issues (93.3 %) were identified as being 'Transboundary' by more than 50 % of the countries, and one issue was recognised as being 'Transboundary' by all of the countries:

- 2.3.1. Disturbance, damage and loss of coral reef habitats

The issue considered to be 'Not Transboundary' by more than 50 % of the countries were:

- 2.3.3. Disturbance, damage and loss of macroalgal habitats

There were no issues that were considered to be 'Future transboundary' by any of the countries, suggesting that all the issues were considered relevant in the present day.

There were however 8 of the 15 issues (53.3 %) that were considered to be 'Not transboundary' by one or more countries, these included:

- 2.2.1. Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)
- 2.2.2. Disturbance, damage and loss of coastal forest habitats
- 2.2.3. Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)
- 2.2.4. Disturbance, damage and loss of wetland habitats
- 2.2.5. Disturbance, damage and loss of estuarine habitats
- 2.3.2. Disturbance, damage and loss of seagrass habitats
- 2.3.3. Disturbance, damage and loss of macroalgal habitats
- 2.3.4. Disturbance, damage and loss of soft sediment habitats

These issues are however all transboundary, despite being considered 'Not transboundary' by some of the countries at the national level, due to the shared or common nature of the problem within the countries of the ASCLMEs.

MAC03: There were 16 of the 20 issues (80 %) that were considered to be 'Transboundary' issues by more than 50 % of the countries, three of which were recognised as being 'Transboundary' by all countries:

- 3.1.4. Decline in populations of turtles
- 3.2.2 Decline in populations of large pelagics
- 3.4. Excessive bycatch and discards

There were 5 of the 20 issues that were identified as 'Future transboundary' issues by one or more of the countries:

- 3.2.5. Decline in populations of reef and demersal fish
- 3.3.3. Decline in populations of cephalopods
- 3.3.4. Decline in populations of sea cucumbers
- 3.3.7. Decline in populations of lobsters
- 3.5. Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)

There were also 13 of the 20 issues that were identified as 'Not transboundary' issues by one or more of the countries:

- 3.1.1. Decline in populations of marine mammals
- 3.2.1. Decline in populations of sharks and rays
- 3.2.3. Decline in populations of small pelagic
- 3.2.4. Decline in populations of deep water demersals
- 3.2.5. Decline in populations of reef and demersal fish
- 3.3.1. Decline in populations of molluscs (bivalves, gastropods)
- 3.3.3. Decline in populations of cephalopods
- 3.3.4. Decline in populations of sea cucumbers
- 3.3.5. Decline in populations of sea urchins
- 3.3.6. Decline in populations of prawns and shrimp
- 3.3.8. Decline in populations of deepwater lobster / crayfish
- 3.3.9. Decline in populations of crabs
- 3.5. Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)

Both the 'Future' and 'Not transboundary' issues listed above can, however, be considered as transboundary, due to the shared or common nature of the problem between the countries within the ASCLMEs.

8.1.1.4 Baseline Data

There appears to be baseline data available for all of the issues (43 of 43 issues, or 100%) included in the Draft Issues Framework within the ASCLMEs (**Error! Reference source not found.**). There are however common shared concerns about the quality, extent, age and also often the accessibility of these data. A summary of the findings within the region is presented below:

MAC01: Over half (50 %) of the countries have some baseline data for 6 out of the 8 issues (75 %). The only issue for which the majority of countries (7 or more of the 9 countries) have baseline data is:

- 1.1. Alteration of natural river flow and changes in freshwater input and sediment load

Issues where there appears to be a particular gap in the availability of baseline data in more than half the countries (5 or more of the 9 countries) includes:

- 1.3.2. Nutrient enrichment from land-based (domestic, industrial, agriculture, livestock) and marine (mariculture) sources
- 1.3.4. Suspended solids in coastal waters due to human activities on land and in the coastal zone

MAC02: Over half (50 %) of the countries have some baseline data available for 9 out of the 15 issues (60 %). The majority of countries (7 or more of the 9 countries) have baseline data available for:

- 2.2.1. Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)
- 2.2.2. Disturbance, damage and loss of coastal forest habitats
- 2.2.6. Disturbance, damage and loss of mangrove habitats
- 2.3.1. Disturbance, damage and loss of coral reef habitats

Issues where there appears to be a gap in the availability of baseline data in more than half of the ASCLMEs countries include:

- 2.2.5. Disturbance, damage and loss of estuarine habitats
- 2.3.4. Disturbance, damage and loss of soft sediment habitats
- 2.3.5. Disturbance, damage and loss of deep water habitats (including sea mounts)
- 2.4. Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)
- 2.6. Introduction of exotic non-native species, invasives and nuisance species

MAC03: Over half (50 %) of the countries have some baseline data available for 10 out of the 20 issues (50 %). The majority of countries (7 or more of the 9 countries) have baseline data for:

- 3.1.4. Decline in populations of turtles
- 3.2.2. Decline in populations of large pelagics
- 3.2.5. Decline in populations of reef and demersal fish

Other issues where there does appear to be a gap in the availability of baseline data includes:

- 3.1.1. Decline in populations of marine mammals
- 3.2.3. Decline in populations of small pelagics
- 3.3.1. Decline in populations of molluscs (bivalves, gastropods)
- 3.3.3. Decline in populations of cephalopods
- 3.3.9. Decline in populations of crabs

There were a further two issues, where there was no baseline data for any of the countries (but this is perhaps unsurprising as the issues were also not considered to be relevant by the many of the countries):

- 3.3.5. Decline in populations of sea urchins
- 3.3.8. Decline in populations of crayfish

The findings presented in Annex 6 and summarised above still need to be validated against the monitoring framework document prepared by the PCU (Lucy Scott, pers. comm.).

8.1.1.5 Monitoring Programmes

There are monitoring programmes for the majority of the issues (36 of 43 issues, or 74 %) in the Draft the Draft Issues Framework, in one or more of the countries in the ASCLMEs (Table 9Table 8: Prioritization Level 1: Transboundary nature of the issue.

Major Area of Concern	Issue No.	Issue	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles
MAC01.	1.1.	Alteration of natural river flow and changes in freshwater input and sediment load	FT	T	NT	NT	T	NT
	1.2.	Degradation of ground and surface water quality	FT	T	NT	T	T	NT
	1.3.	Degradation of coastal and marine water quality						
	1.3.1	Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources	NT	T	T	T	T	FT
	1.3.2	Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources	T	T	T	T	T	NT
	1.3.3	Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources	T	T	T	T	T	T
	1.3.4	Suspended solids in coastal waters due to human activities on land and in the coastal zone	T	T	NT	T	T	NT
	1.3.5	Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources	T	T	FT	T	T	T
	1.3.6	Oil spills (drilling, exploitation, transport, processing, storage, shipping).	T	T	T	T	T	T
MAC02:	2.1.	Shoreline change, due to modification, land reclamation and coastal erosion	T	T	NT	T	T	T
	2.2.	Disturbance, damage and loss of coastal, watershed and upland habitats						
	2.2.1.	Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)	NT	T	NT	NT	T	NR
	2.2.2.	Disturbance, damage and loss of coastal forest habitats	T	T	NT	NT	NR	T
	2.2.3.	Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)	T	T	NT	T	T	T
	2.2.4.	Disturbance, damage and loss of wetland habitats	NR	T	NT	NT	NT	T
	2.2.5.	Disturbance, damage and loss of estuarine habitats	NR	T	NT	NR	T	NR
	2.2.6.	Disturbance, damage and loss of mangrove habitats	T	T	T	NT/T	T	T
	2.3.	Disturbance, damage and loss of subtidal benthic habitats						
	2.3.1.	Disturbance, damage and loss of coral reef habitats	T	T	T	T	T	T
	2.3.2.	Disturbance, damage and loss of seagrass habitats	T	T	T	NT	T	T
	2.3.3.	Disturbance, damage and loss of macroalgal habitats	T	T	NT	NR	NT	NR
	2.3.4.	Disturbance, damage and loss of soft sediment habitats	NR	T	NT	NT	T	T
	2.3.5.	Disturbance, damage and loss of deep water habitats (including sea mounts)	NR	T	T	NR	NR	NR
	2.4.	Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)	NR	T	T	T	T	T
	2.5.	Increase in the occurrence of harmful or toxic algal blooms (HABs)	T	T	T	T	T	NR
	2.6.	Introduction of exotic non-native species, invasives and nuisance species	T	T	T	T	T	NR
MAC03:	3.1.	Decline in populations of focal species						
	3.1.1.	Decline in populations of marine mammals	T	T	NT	T	T	T
	3.1.2.	Decline in populations of cetaceans	NR	T	T	T	T	T
	3.1.3.	Decline in populations of seabirds	T	T	T	T	T	T
	3.1.4.	Decline in populations of turtles	T	T	T	T	T	T

Major Area of Concern	Issue No.	Issue	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles
	3.2.	Decline in populations of commercial fish stocks						
	3.2.1.	Decline in populations of sharks and rays	T	T	NT	T	T	T
	3.2.2.	Decline in populations of large pelagic	T	T	T	T	T	T
	3.2.3.	Decline in populations of small pelagic	T	T	T	NR	T	NR
	3.2.4.	Decline in populations of deep water demersals	NR	T	NR	T	T	NT
	3.2.5.	Decline in populations of reef and demersal fish	NT	T	NT	T	NT	FT
	3.3.	Decline in populations of commercial invertebrates						
	3.3.1.	Decline in populations of molluscs (bivalves, gastropods)	NT	T	NT	T	T	NR
	3.3.2.	Decline in populations of abalone	NR	NR	NR	NR	NR	NR
	3.3.3.	Decline in populations of cephalopods	NT	T	NT	T	T	FT
	3.3.4.	Decline in populations of sea cucumbers	NT	T	NT	NT	T	FT
	3.3.5.	Decline in populations of sea urchins	NR	NT	NT	NR	NT	NR
	3.3.6.	Decline in populations of prawns and shrimp	NT	T	NT	T	T	NR
	3.3.7.	Decline in populations of lobsters	NR	T	FT	T	T	T
	3.3.8.	Decline in populations of crayfish	NR	NR	NR	NR	NT	NR
	3.3.9.	Decline in populations of crabs	NT	T	NT	T	T	NR
	3.4.	Excessive bycatch and discards	T	T	T	T	T	T
	3.5.	Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)	NT	T	NT	T	T	FT

Key	
T	Transboundary
T_s	Transboundary shared
FT	Future transboundary
NT	Not transboundary
NR	Not relevant

). There were however 6 issues (14 %) for which there is no monitoring or only limited monitoring (site specific or periodic) in any of the countries.

A summary of the findings within the ASCLMEs is presented below:

MAC01: Only 1 of the 8 issues (12.5 %) is being routinely monitored by more than half of the countries (5 out of 9 countries):

- 1.1 Alteration of natural river flow and changes in freshwater input and sediment load

For 2 of the 8 issues (33.3 %), there is either routine monitoring or limited monitoring (site specific or periodic) in more than half (50 %) of the countries are as follows:

- 1.1 Alteration of natural river flow and changes in freshwater input and sediment load
- 1.2 Degradation of ground and surface water quality

Conversely, for 6 of the 8 issues (75 %), there is either no routine monitoring or only limited monitoring (site specific or periodic) in more than half (50 %) of the countries as follows:

- 1.2 Degradation of ground and surface water quality
- 1.3.1 Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources
- 1.3.2 Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources
- 1.3.3 Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources
- 1.3.5 Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources
- 1.3.6 Oil spills (drilling, exploitation, transport, processing, storage, shipping).

For 2 of the 8 issues (33.3 %), there is either no routine monitoring or only limited monitoring in all the countries in the ASCLMEs:

- 1.3.1 Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources
- 1.3.4 Suspended solids in coastal waters due to human activities on land and in the coastal zone

MAC02: Only 1 of the 15 issues (6.67 %) is being routinely monitored in more than half of the countries (5 out of 9 countries):

- 2.3.1. Disturbance, damage and loss of coral reef habitats

For 3 of the 15 issues (20 %), there is either routine monitoring or limited monitoring (site specific or periodic), in more than half of the countries (5 out of 9 countries):

- 2.1. Shoreline change, due to modification, land reclamation and coastal erosion
- 2.2.2. Disturbance, damage and loss of coastal forest habitats
- 2.3.1. Disturbance, damage and loss of coral reef habitats

Conversely, for 8 of the 15 issues (53 %) there is no routine monitoring or only limited monitoring (site specific or periodic) in more than half (50 %) of the countries:

- 2.1. Shoreline change, due to modification, land reclamation and coastal erosion
- 2.2.3. Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)
- 2.2.4. Disturbance, damage and loss of wetland habitats
- 2.2.6. Disturbance, damage and loss of mangrove habitats
- 2.3.2. Disturbance, damage and loss of seagrass habitats
- 2.3.4. Disturbance, damage and loss of soft sediment habitats
- 2.4. Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)

There are 3 issues for which there is no routine monitoring or only limited monitoring:

- 2.2.3. Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)
- 2.3.3. Disturbance, damage and loss of macroalgal habitats
- 2.3.5. Disturbance, damage and loss of deep water habitats (including sea mounts)

MAC03: Only 5 of the 20 issues (25 %) are being routinely monitored by more than half of the countries (5 or more of 9 countries):

- 3.1.4. Decline in populations of turtles
- 3.2.2. Decline in populations of large pelagic
- 3.2.5. Decline in populations of reef and demersal fish

- 3.3.6. Decline in populations of prawns and shrimp
- 3.5. Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)

For 8 of the 20 issues (40 %), there is either routine monitoring or limited monitoring (site specific or periodic) in more than half (50 %) of the countries:

- 3.1.3. Decline in populations of seabirds
- 3.1.4. Decline in populations of turtles
- 3.2.2. Decline in populations of large pelagic
- 3.2.5. Decline in populations of reef and demersal fish
- 3.3.6. Decline in populations of prawns and shrimp
- 3.3.7. Decline in populations of lobsters
- 3.4. Excessive bycatch and discards
- 3.5. Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)

Conversely, for 7 of the 20 issues (35 %) there is no routine monitoring or only limited monitoring (site specific or periodic monitoring) in more than half (50 %) of the countries:

- 3.1.1. Decline in populations of marine mammals
- 3.1.2. Decline in populations of cetaceans
- 3.2.1. Decline in populations of sharks and rays
- 3.3.1. Decline in populations of molluscs (bivalves, gastropods)
- 3.3.3. Decline in populations of cephalopods
- 3.3.4. Decline in populations of sea cucumbers
- 3.3.5. Decline in populations of sea urchins

Issues that are not being monitored by the countries (because they are not relevant) include:

- 3.3.2. Decline in populations of abalone
- 3.3.5. Decline in populations of sea urchins
- 3.3.8. Decline in populations of crayfish

The findings presented in Annex 6 and summarised above still need to be validated against the monitoring framework document prepared by the PCU (Lucy Scott, pers. comm.).

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Table 6 National Relevance of issues presented in Draft Issues Framework, as validated during Causal Chain Analysis Workshops (July-August 2011)

Major Area of Concern	Issue no.	Issue	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	Relevant now	Relevant future	Not relevant
MAC01.	1.1.	Alteration of natural river flow and changes in freshwater input and sediment load	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	1.2.	Degradation of ground and surface water quality	✓f	✓	✓	✓	✓	✓	✓	✓	✓	8	1	0
	1.3.	Degradation of coastal and marine water quality	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	1.3.1	Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	1.3.2	Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources	✓	✓	✓	✓	✓f	✓	✓	✓	✓	8	1	0
	1.3.3	Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	1.3.4	Suspended solids in coastal waters due to human activities on land and in the coastal zone	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	1.3.5	Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	1.3.6	Oil spills (drilling, exploitation, transport, processing, storage, shipping).	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
MAC02:	2.1.	Shoreline change, due to modification, land reclamation and coastal erosion	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	2.2.	Disturbance, damage and loss of coastal, watershed and upland habitats	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	2.2.1.	Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)	✓	✓	✓	✓	✓	NR	✓	✓	✓	8	0	1
	2.2.2.	Disturbance, damage and loss of coastal forest habitats	✓	✓	✓	NR	NR	✓	✓	✓	✓	7	0	2
	2.2.3.	Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	2.2.4.	Disturbance, damage and loss of wetland habitats	NR	✓	✓	✓	✓f	✓	✓	✓	✓	7	1	1
	2.2.5.	Disturbance, damage and loss of estuarine habitats	NR	✓	✓	NR	✓	NR	✓	✓	✓	6	0	3
	2.2.6.	Disturbance, damage and loss of mangrove habitats	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	2.3.	Disturbance, damage and loss of subtidal benthic habitats	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0

Major Area of Concern	Issue no.	Issue	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	Relevant now	Relevant future	Not relevant
	2.3.1.	Disturbance, damage and loss of coral reef habitats	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	2.3.2.	Disturbance, damage and loss of seagrass habitats	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	2.3.3.	Disturbance, damage and loss of macroalgal habitats	✓	✓	✓	NR	✓	NR	✓	✓	✓	7	0	2
	2.3.4.	Disturbance, damage and loss of soft sediment habitats	NR	✓	✓	✓	✓	✓	✓	✓	✓	8	0	1
	2.3.5.	Disturbance, damage and loss of deep water habitats (including sea mounts)	NR	✓	✓f	NR	NR	NR	✓	✓	✓	4	1	4
	2.4.	Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)	NR	✓	✓	✓	✓f	✓f	✓	✓	✓	6	2	1
	2.5.	Increase in the occurrence of harmful or toxic algal blooms (HABs)	✓	✓	✓	✓	✓	NR	✓	✓	✓	8	0	1
	2.6.	Introduction of exotic non-native species, invasives and nuisance species	✓f	✓	✓	✓	✓	NR	✓	✓	✓	7	1	1
MAC03:	3.1.	Decline in populations of focal species	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	3.1.1.	Decline in populations of marine mammals	✓	✓	✓	✓f	✓	✓	✓	NR	NR	6	1	2
	3.1.2.	Decline in populations of cetaceans	NR	✓	✓f	✓	✓	✓	✓	NR	NR	5	1	3
	3.1.3.	Decline in populations of seabirds	✓	✓	✓f	✓	✓	✓	✓	✓	NR	7	1	1
	3.1.4.	Decline in populations of turtles	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	3.2.	Decline in populations of commercial fish stocks	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	3.2.1.	Decline in populations of sharks and rays	✓	✓	✓	✓	✓	✓	✓	✓	NR	8	0	1
	3.2.2.	Decline in populations of large pelagic	✓	✓	✓	✓	✓f	✓	✓	✓	✓	8	1	0
	3.2.3.	Decline in populations of small pelagic	✓	✓	✓f	NR	✓f	NR	✓	✓	✓	5	2	2
	3.2.4.	Decline in populations of deep water demersals	NR	✓	NR	✓	✓f	✓	✓	✓	✓	6	1	2
	3.2.5.	Decline in populations of reef and demersal fish	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	3.3.	Decline in populations of commercial invertebrates	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	3.3.1.	Decline in populations of molluscs (bivalves, gastropods)	✓f	✓	✓f	✓	✓f	NR	NR	✓	✓	4	3	2
	3.3.2.	Decline in populations of abalone	NR	NR	NR	NR	NR	NR	NR	✓	NR	1	0	8

Major Area of Concern	Issue no.	Issue	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	Relevant now	Relevant future	Not relevant
	3.3.3.	Decline in populations of cephalopods	✓	✓	✓	✓	✓f	✓	✓	NR	✓	7	1	1
	3.3.4.	Decline in populations of sea cucumbers	✓	✓	✓	✓	✓	✓	✓	NR	✓	8	0	1
	3.3.5.	Decline in populations of sea urchins	NR	✓	✓f	NR	✓f	NR	NR	NR	NR	1	2	6
	3.3.6.	Decline in populations of prawns and shrimp	✓	✓	✓	✓	✓	NR	✓	✓	✓	8	0	1
	3.3.7.	Decline in populations of lobsters	NR	✓	✓	✓	✓	✓	✓	NR	✓	7	0	2
	3.3.8.	Decline in populations of crayfish	NR	NR	NR	NR	✓f	NR	✓	NR	NR	1	1	7
	3.3.9.	Decline in populations of crabs	✓	✓	✓	✓	✓f	NR	✓	NR	✓	6	1	2
	3.4.	Excessive bycatch and discards	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	3.5.	Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)	✓	✓	✓	✓	✓f	✓	✓f	✓f	✓	6	3	0
MAC04: Unpredictable Environmental Variability and Extreme Events	4.1.	Climate hazards and extreme weather events (cyclones, storms, rainfall, coastal flooding)	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	4.2.	Sea level change	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	4.3.	Ocean acidification	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	4.4.	Changes in seawater temperatures	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	4.5.	Changes to hydrodynamics and ocean circulation	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	4.6.	Changes in productivity (shifts in primary and secondary production)	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0
	4.7.	Geohazards (tsunamis, volcanic eruptions, earthquakes)	✓	✓	✓	✓	✓	✓	✓	✓	✓	9	0	0

Table 7 Prioritization Level 1: National Importance of Issues

Main Area of Concern	Issue No.	Issue	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	H	M	L	NR
MAC01.	1.1.	Alteration of natural river flow and changes in freshwater input and sediment load	H	H	H	L	H	M	M	H	H	6	2	1	0
	1.2.	Degradation of ground and surface water quality	H	H	H	L	H	M	M	H	H	6	2	1	0
	1.3.	Degradation of coastal and marine water quality													
	1.3.1	Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources	M	M	H	L	M	M	L	H	M	2	5	2	0
	1.3.2	Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources	L	H	H	L	H	M	L	M	H	4	2	3	0
	1.3.3	Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources	H	M	M	L	L	M	H	M	M	2	5	2	0
	1.3.4	Suspended solids in coastal waters due to human activities on land and in the coastal zone	H	H	H	L	H	M	M	M	M	4	4	1	0
	1.3.5	Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources	H	H	H	L	H	M	H	M	H	6	2	1	0
	1.3.6	Oil spills (drilling, exploitation, transport, processing, storage, shipping).	H	H	H	M	H	L	H	H	M	6	2	1	0
MAC02:	2.1.	Shoreline change, due to modification, land reclamation and coastal erosion	M	H	H	H	H	H	L	M	H	6	2	1	0
	2.2.	Disturbance, damage and loss of coastal, watershed and upland habitats													
	2.2.1.	Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)	H	H	H	M	H	NR	H	H	H	7	1	0	1
	2.2.2.	Disturbance, damage and loss of coastal forest habitats	M	H	H	M	NR	M	H	H	H	5	3	0	1
	2.2.3.	Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)	H	H	H	H	H	H	H	H	H	9	0	0	0
	2.2.4.	Disturbance, damage and loss of wetland habitats	NR	H	M	H	M	M	H	H	H	5	3	0	1
	2.2.5.	Disturbance, damage and loss of estuarine habitats	NR	H	H	NR	H	NR	H	H	M	5	1	0	3
	2.2.6.	Disturbance, damage and loss of mangrove habitats	L	H	H	H	H	L	H	L	H	6	0	3	0

Main Area of Concern	Issue No.	Issue	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	H	M	L	NR
	2.3.	Disturbance, damage and loss of subtidal benthic habitats													
	2.3.1.	Disturbance, damage and loss of coral reef habitats	H	H	H	H	H	H	H	M	H	8	1	0	0
	2.3.2.	Disturbance, damage and loss of seagrass habitats	M	H	H	M	H	L	H	L	H	5	2	2	0
	2.3.3.	Disturbance, damage and loss of macroalgal habitats	M	L	M	NR	M	NR	M	M	L	0	5	2	2
	2.3.4.	Disturbance, damage and loss of soft sediment habitats	NR	M	M	L	H	M	M	H	H	3	4	1	1
	2.3.5.	Disturbance, damage and loss of deep water habitats (including sea mounts)	NR	L	H	NR	NR	NR	L	H	H	3	0	2	4
	2.4.	Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)	NR	H	H	H	M	L	H	H	H	6	1	1	1
	2.5.	Increase in the occurrence of harmful or toxic algal blooms (HABs)	H	M	H	H	L	NR	M	H	M	4	3	1	1
	2.6.	Introduction of exotic non-native species, invasives and nuisance species	L	M	H	M	M	NR	L	H	H	3	3	2	1
MAC03:	3.1.	Decline in populations of focal species													
	3.1.1.	Decline in populations of marine mammals	M	H	M	H	H	H	H	NR	NR	5	2	0	2
	3.1.2.	Decline in populations of cetaceans	NR	H	H	H	M	H	H	NR	NR	5	1	0	3
	3.1.3.	Decline in populations of seabirds	H	L	L	H	M	H	L	M	NR	3	2	3	1
	3.1.4.	Decline in populations of turtles	H	H	H	H	H	H	H	M	M	7	2	0	0
	3.2.	Decline in populations of commercial fish stocks													
	3.2.1.	Decline in populations of sharks and rays	H	H	H	H	H	H	H	H	NR	8	0	0	1
	3.2.2.	Decline in populations of large pelagics	H	M	H	H	H	H	H	L	H	7	1	1	0
	3.2.3.	Decline in populations of small pelagics	H	H	H	NR	L	NR	H	L	H	5	0	2	2
	3.2.4.	Decline in populations of deep water demersals	NR	L	NR	H	L	H	H	L	H	4	0	3	2
	3.2.5.	Decline in populations of reef and demersal fish	H	H	H	H	H	H	H	H	H	9	0	0	0

Main Area of Concern	Issue No.	Issue	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	H	M	L	NR
	3.3.	Decline in populations of commercial invertebrates													
	3.3.1.	Decline in populations of molluscs (bivalves, gastropods)	M	H	M	H	L	NR	NR	M	L	2	3	2	2
	3.3.2.	Decline in populations of abalone	NR	NR	NR	NR	NR	NR	NR	H	NR	1	0	0	8
	3.3.3.	Decline in populations of cephalopods	H	H	H	H	M	H	H	NR	H	7	1	0	1
	3.3.4.	Decline in populations of sea cucumbers	H	H	H	H	H	H	H	NR	H	8	0	0	1
	3.3.5.	Decline in populations of sea urchins	NR	H	L	NR	L	NR	NR	NR	NR	1	0	2	6
	3.3.6.	Decline in populations of prawns and shrimp	H	H	H	H	M	NR	H	M	H	6	2	0	1
	3.3.7.	Decline in populations of spiny lobsters	NR	H	H	H	H	H	H	NR	M	6	1	0	2
	3.3.8.	Decline in populations of deepwater lobster (crayfish)	NR	NR	NR	NR	L	NR	H	NR	NR	1	0	1	7
	3.3.9.	Decline in populations of crabs	H	H	H	H	M	NR	M	NR	L	4	2	1	2
	3.4.	Excessive bycatch and discards	H	H	H	H	H	H	H	M	H	8	1	0	0
	3.5.	Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)	H	H	H	H	H	H	L	M	M	6	2	1	0

Table 8: Prioritization Level 1: Transboundary nature of the issue.

Major Area of Concern	Issue No.	Issue	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	T	FT	NT	NR
MAC01.	1.1.	Alteration of natural river flow and changes in freshwater input and sediment load	FT	T	NT	NT	T	NT	T	T	T	5	1	3	0
	1.2.	Degradation of ground and surface water quality	FT	T	NT	T	T	NT	T	T	T	6	1	2	0
	1.3.	Degradation of coastal and marine water quality													
	1.3.1	Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources	NT	T	T	T	T	FT	T	T	T_S	7	1	1	0
	1.3.2	Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources	T	T	T	T	T	NT	T	T	T_S	8	0	1	0
	1.3.3	Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources	T	T	T	T	T	T	T	T	T_S	9	0	0	0
	1.3.4	Suspended solids in coastal waters due to human activities on land and in the coastal zone	T	T	NT	T	T	NT	T	T	T_S	7	0	2	0
	1.3.5	Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources	T	T	FT	T	T	T	T	T	T_S	8	1	0	0
	1.3.6	Oil spills (drilling, exploitation, transport, processing, storage, shipping).	T	T	T	T	T	T	T	T	T_S	9	0	0	0
MAC02:	2.1.	Shoreline change, due to modification, land reclamation and coastal erosion	T	T	NT	T	T	T	T	T_S	T	8	0	1	0
	2.2.	Disturbance, damage and loss of coastal, watershed and upland habitats													
	2.2.1.	Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)	NT	T	NT	NT	T	NR	T	T_S	T	5	0	3	1
	2.2.2.	Disturbance, damage and loss of coastal forest habitats	T	T	NT	NT	NR	T	T	T_S	T	6	0	2	1
	2.2.3.	Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)	T	T	NT	T	T	T	T	T_S	T	8	0	1	0
	2.2.4.	Disturbance, damage and loss of wetland habitats	NR	T	NT	NT	NT	T	T	T_S	T	5	0	3	1
	2.2.5.	Disturbance, damage and loss of estuarine habitats	NR	T	NT	NR	T	NR	T	T	T	5	0	1	3

Major Area of Concern	Issue No.	Issue	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	T	FT	NT	NR
	2.2.6.	Disturbance, damage and loss of mangrove habitats	T	T	T	NT/T	T	T	T	T	T	8	0	0	0
	2.3.	Disturbance, damage and loss of subtidal benthic habitats													
	2.3.1.	Disturbance, damage and loss of coral reef habitats	T	T	T	T	T	T	T	T	T	9	0	0	0
	2.3.2.	Disturbance, damage and loss of seagrass habitats	T	T	T	NT	T	T	T	T	T	8	0	1	0
	2.3.3.	Disturbance, damage and loss of macroalgal habitats	T	T	NT	NR	NT	NR	T	T_S	NT	4	0	3	2
	2.3.4.	Disturbance, damage and loss of soft sediment habitats	NR	T	NT	NT	T	T	T	T_S	T	6	0	2	1
	2.3.5.	Disturbance, damage and loss of deep water habitats (including sea mounts)	NR	T	T	NR	NR	NR	T	T_S	T	5	0	0	4
	2.4.	Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)	NR	T	T	T	T	T	T	T	T	8	0	0	1
	2.5.	Increase in the occurrence of harmful or toxic algal blooms (HABs)	T	T	T	T	T	NR	T	T_S	T	8	0	0	1
	2.6.	Introduction of exotic non-native species, invasives and nuisance species	T	T	T	T	T	NR	T	T	T	8	0	0	1
MAC03:	3.1.	Decline in populations of focal species													
	3.1.1.	Decline in populations of marine mammals	T	T	NT	T	T	T	T	NR	NR	6	0	1	2
	3.1.2.	Decline in populations of cetaceans	NR	T	T	T	T	T	T	NR	NR	6	0	0	3
	3.1.3.	Decline in populations of seabirds	T	T	T	T	T	T	T	T	NR	8	0	0	1
	3.1.4.	Decline in populations of turtles	T	T	T	T	T	T	T	T	T	9	0	0	0
	3.2.	Decline in populations of commercial fish stocks													
	3.2.1.	Decline in populations of sharks and rays	T	T	NT	T	T	T	T	T	NR	7	0	1	1
	3.2.2.	Decline in populations of large pelagic	T	T	T	T	T	T	T	T	T	9	0	0	0
	3.2.3.	Decline in populations of small pelagic	T	T	T	NR	T	NR	T	NT	T	6	0	1	2
	3.2.4.	Decline in populations of deep water demersals	NR	T	NR	T	T	NT	T	T_S	T	6	0	1	2

Major Area of Concern	Issue No.	Issue	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	T	FT	NT	NR
	3.2.5.	Decline in populations of reef and demersal fish	NT	T	NT	T	NT	FT	T	T	T	5	1	3	0
	3.3.	Decline in populations of commercial invertebrates													
	3.3.1.	Decline in populations of molluscs (bivalves, gastropods)	NT	T	NT	T	T	NR	NR	T	T	5	0	2	2
	3.3.2.	Decline in populations of abalone	NR	NR	NR	NR	NR	NR	NR	T	NR	1	0	0	8
	3.3.3.	Decline in populations of cephalopods	NT	T	NT	T	T	FT	T	NR	T	5	1	2	1
	3.3.4.	Decline in populations of sea cucumbers	NT	T	NT	NT	T	FT	T	NR	T	4	1	3	1
	3.3.5.	Decline in populations of sea urchins	NR	NT	NT	NR	NT	NR	NR	NR	NR	0	0	3	6
	3.3.6.	Decline in populations of prawns and shrimp	NT	T	NT	T	T	NR	T	T	T	6	0	2	1
	3.3.7.	Decline in populations of lobsters	NR	T	FT	T	T	T	T	NR	T	6	1	0	2
	3.3.8.	Decline in populations of crayfish	NR	NR	NR	NR	NT	NR	T	NR	NR	1	0	1	7
	3.3.9.	Decline in populations of crabs	NT	T	NT	T	T	NR	T_S	NR	T	5	0	2	2
	3.4.	Excessive bycatch and discards	T	T	T	T	T	T	T	T	T	9	0	0	0
	3.5.	Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)	NT	T	NT	T	T	FT	NT	T	T	5	1	3	0

Key	
T	Transboundary
T_S	Transboundary shared
FT	Future transboundary
NT	Not transboundary
NR	Not relevant

Table 9 Prioritization Level 1: Availability of baseline data related to the issue.

Main Area of Concern	Issue No.	Issue	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	?	NR	✗	✓	•
MAC01.	1.1.	Alteration of natural river flow and changes in freshwater input and sediment load	✗	✓	✓	✓	✓	✓	✓	✓	✓	0	0	1	8	0
	1.2.	Degradation of ground and surface water quality	✗	✓	✗	✓	✓	✗	✓	✓	✓	0	0	3	6	0
	1.3.	Degradation of coastal and marine water quality														
	1.3.1	Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources	✗	✓	✓	•	✓	✗	✗	✓	✓	0	0	3	5	1
	1.3.2	Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources	✗	✓	✓	•	✗	✗	?	✓	✓	1	0	3	4	1
	1.3.3	Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources	✗	✓	✗	•	✓	✗	✓	✓	✓	0	0	3	5	1
	1.3.4	Suspended solids in coastal waters due to human activities on land and in the coastal zone	✗	✓	✗	•	✓	✗	✗	•	✓	0	0	4	3	2
	1.3.5	Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources	✗	✓	✓	•	✓	✗	✗	✓	✓	0	0	3	5	1
	1.3.6	Oil spills (drilling, exploitation, transport, processing, storage, shipping).	✗	✓	✓	✗	✓	✗	✗	✓	✓	0	0	4	5	0
MAC02:	2.1.	Shoreline change, due to modification, land reclamation and coastal erosion	✓	•	✓	✓	✓	✓	✗	✓	•	0	0	1	6	2
	2.2.	Disturbance, damage and loss of coastal, watershed and upland habitats														
	2.2.1.	Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)	✓	•	✓	✓	✓	✓	✓	✓	•	0	0	0	7	2
	2.2.2.	Disturbance, damage and loss of coastal forest habitats	✓	✓	✓	?	NR	✓	✓	✓	✓	1	1	0	7	0
	2.2.3.	Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)	✓	?	?	✗	✓	✓	?	✓	•	3	0	1	4	1
	2.2.4.	Disturbance, damage and loss of wetland habitats	NR	✓	✓	✓	✓	✓	?	✓	•	1	1	0	6	1

Main Area of Concern	Issue No.	Issue	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	?	NR	✗	✓	•
	2.2.5.	Disturbance, damage and loss of estuarine habitats	NR	✓	✓	NR	✓	NR	?	✓	•	1	3	0	4	1
	2.2.6.	Disturbance, damage and loss of mangrove habitats	✓	✓	✓	✓	✓	✓	✓	•	•	0	0	0	7	2
	2.3.	Disturbance, damage and loss of subtidal benthic habitats														
	2.3.1.	Disturbance, damage and loss of coral reef habitats	✓	✓	✓	✓	✓	✓	✓	✓	•	0	0	0	8	1
	2.3.2.	Disturbance, damage and loss of seagrass habitats	✓	✓	✓	✗	✓	✓	✓	✗	•	0	0	2	6	1
	2.3.3.	Disturbance, damage and loss of macroalgal habitats	✓	✓	✓	NR	✓	NR	✓	✗	✓	0	2	1	6	0
	2.3.4.	Disturbance, damage and loss of soft sediment habitats	NR	✗	?	✗	✓	✗	?	✗	•	2	1	4	1	1
	2.3.5.	Disturbance, damage and loss of deep water habitats (including sea mounts)	NR	✗	✓	NR	NR	NR	✗	✗	•	0	4	3	1	1
	2.4.	Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)	NR	✓	✓	✓	✗	✗	✓	✗	•	0	1	3	4	1
	2.5.	Increase in the occurrence of harmful or toxic algal blooms (HABs)	✓	✓	✓	✓	✓	NR	✓	✗	•	0	1	1	6	1
	2.6.	Introduction of exotic non-native species, invasives and nuisance species	?	✓	?	✗	✓	NR	✗	✗	•	2	1	3	2	1
MAC03:	3.1.	Decline in populations of focal species														
	3.1.1.	Decline in populations of marine mammals	•	✓	✗	✓	•	✗	✓	NR	NR	0	2	2	3	2
	3.1.2.	Decline in populations of cetaceans	NR	✓	✗	✓	•	✗	✓	NR	NR	0	3	2	3	1
	3.1.3.	Decline in populations of seabirds	✗	✓	✓	✓	✓	✓	✗	✓	NR	0	1	2	6	0
	3.1.4.	Decline in populations of turtles	✓	✓	✓	✓	✓	✗	✓	✓	✓	0	0	1	8	0
	3.2.	Decline in populations of commercial fish stocks														
	3.2.1.	Decline in populations of sharks and rays	✗	✓	✓	✓	✗	✗	✓	✓	NR	0	1	3	5	0
	3.2.2.	Decline in populations of large pelagics	✓	✓	✓	✓	•	✓	✓	✓	✓	0	0	0	8	1
	3.2.3.	Decline in populations of small pelagics	✗	✓	✓	NR	•	NR	✓	✓	✓	0	2	1	5	1

Main Area of Concern	Issue No.	Issue	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania		?	NR	✗	✓	•
	3.2.4.	Decline in populations of deep water demersals	NR	?	NR	✓	•	✓	✓	✓	✓		1	2	0	5	1
	3.2.5.	Decline in populations of reef and demersal fish	✗	✓	✓	✓	•	✓	✓	✓	✓		0	0	1	7	1
	3.3.	Decline in populations of commercial invertebrates															
	3.3.1.	Decline in populations of molluscs (bivalves, gastropods)	✗	✓	✗	✓	•	NR	NR	•	✓		0	2	2	3	2
	3.3.2.	Decline in populations of abalone	NR	NR	NR	NR	NR	NR	NR	✓	NR		0	8	0	1	0
	3.3.3.	Decline in populations of cephalopods	✗	✓	✓	✓	•	✗	✗	NR	✓		0	1	3	4	1
	3.3.4.	Decline in populations of sea cucumbers	✗	✓	✓	✓	•	✓	✗	NR	✓		0	1	2	5	1
	3.3.5.	Decline in populations of sea urchins	NR	✓	✗	NR	•	NR	NR	NR	NR		0	6	1	1	1
	3.3.6.	Decline in populations of prawns and shrimp	✗	✓	✓	•	✓	NR	✓	✓	✓		0	1	1	6	1
	3.3.7.	Decline in populations of lobsters	NR	✓	✓	•	•	✓	✓	NR	✓		0	2	0	5	2
	3.3.8.	Decline in populations of crayfish	NR	NR	NR	NR	•	NR	✗	NR	NR		0	7	1	0	1
	3.3.9.	Decline in populations of crabs	✗	✓	✓	•	•	NR	✗	NR	✓		0	2	2	3	2
	3.4.	Excessive bycatch and discards	✗	✓	✓	•	✓	✗	✓	✓	✓		0	0	2	6	1
	3.5.	Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)	✗	✓	✓	✓	•	✗	✗	✓	✓		0	0	3	5	1

Key	
✓	Yes baseline data available
•	Limited baseline (site specific)
✗	No baseline data
?	Don't know
NR	Not relevant

Table 10: Prioritization Level 1: Existence of a monitoring programme related to the issue.

Main Area of Concern	Issue No.	Issue	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	?	NR	✗	✓	•
MAC01. Water quality degradation	1.1.	Alteration of natural river flow and changes in freshwater input and sediment load	✓	✗	✗	•	✓	✓	✓	✓	•	0	0	2	5	2
	1.2.	Degradation of ground and surface water quality	•	✗	✗	✓	✓	✗	✓	✓	•	0	0	3	4	2
	1.3.	Degradation of coastal and marine water quality														
	1.3.1	Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources	✗	✗	✗	•	•	✗	✗	•	•	0	0	5	0	4
	1.3.2	Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources	✗	✗	✓	✓	✗	✗	✗	✓	•	0	0	5	3	1
	1.3.3	Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources	✗	✗	✓	✗	✗	✗	✗	✓	•	0	0	6	2	1
	1.3.4	Suspended solids in coastal waters due to human activities on land and in the coastal zone	•	✗	✗	✗	✗	✗	✗	•	•	0	0	6	0	3
	1.3.5	Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources	•	✗	✓	✗	✗	✗	✗	•	•	0	0	5	1	3
	1.3.6	Oil spills (drilling, exploitation, transport, processing, storage, shipping).	✗	✗	✓	✗	✓	✗	✗	✗	•	0	0	6	2	1
MAC02: Habitat and community modification	2.1.	Shoreline change, due to modification, land reclamation and coastal erosion	✗	✓	✗	•	•	✓	✗	✗	•	0	0	4	2	3
	2.2.	Disturbance, damage and loss of coastal, watershed and upland habitats														
	2.2.1.	Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)	✗	✗	?	•	✓	NR	?	✓	?	3	1	2	2	1
	2.2.2.	Disturbance, damage and loss of coastal forest habitats	✗	✓	✓	NR	•	•	?	•	?	2	1	1	2	3
	2.2.3.	Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)	✗	•	?	✗	•	✗	✗	✗	?	2	0	5	0	2
	2.2.4.	Disturbance, damage and loss of wetland habitats	✗	•	?	✗	•	✗	✗	✓	?	2	0	4	1	2

Main Area of Concern	Issue No.	Issue	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	?	NR	✗	✓	•
	2.2.5.	Disturbance, damage and loss of estuarine habitats	✗	✗	?	NR	•	NR	✗	✓	?	2	2	3	1	1
	2.2.6.	Disturbance, damage and loss of mangrove habitats	✗	✗	✓	✓	•	✓	✗	✗	?	1	0	4	3	1
	2.3.	Disturbance, damage and loss of subtidal benthic habitats														
	2.3.1.	Disturbance, damage and loss of coral reef habitats	?	✓	✓	✓	•	✓	✗	✗	✓	1	0	2	5	1
	2.3.2.	Disturbance, damage and loss of seagrass habitats	?	•	✓	✗	•	✗	✗	✗	✓	1	0	4	2	2
	2.3.3.	Disturbance, damage and loss of macroalgal habitats	?	?	?	NR	•	NR	✗	✗	✗	3	2	3	0	1
	2.3.4.	Disturbance, damage and loss of soft sediment habitats	NR	✗	?	✗	✓	✗	✗	✗	✗	1	1	6	1	0
	2.3.5.	Disturbance, damage and loss of deep water habitats (including sea mounts)	NR	?	?	NR	NR	NR	✗	✗	✗	2	4	3	0	0
	2.4.	Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)	NR	•	✓	✓	✗	✗	✗	✗	✗	0	1	5	2	1
	2.5.	Increase in the occurrence of harmful or toxic algal blooms (HABs)	?	✓	✓	✓	✗	NR	✗	✗	?	2	1	3	3	0
	2.6.	Introduction of exotic non-native species, invasives and nuisance species	?	✓	✗	✓	✗	NR	✗	✗	?	2	1	4	2	0
MAC03: Declines in living marine resources	3.1.	Decline in populations of focal species														
	3.1.1.	Decline in populations of marine mammals	✗	✓	✗	✓	•	✗	✗	NR	NR	0	2	4	2	1
	3.1.2.	Decline in populations of cetaceans	NR	✓	✗	✓	•	✗	✗	NR	NR	0	3	3	2	1
	3.1.3.	Decline in populations of seabirds	✗	?	✓	✓	•	✓	✗	✓	NR	1	1	2	4	1
	3.1.4.	Decline in populations of turtles	✓	✓	✓	?	•	✓	✗	✓	•	1	0	1	5	2
	3.2.	Decline in populations of commercial fish stocks														
	3.2.1.	Decline in populations of sharks and rays	✗	•	✗	✓	✗	✗	✗	✓	NR	0	1	5	2	1
	3.2.2.	Decline in populations of large pelagic	✓	?	✓	✓	•	✓	✓	✓	✗	1	0	1	6	1
	3.2.3.	Decline in populations of small pelagic	✗	?	✓	NR	•	NR	✗	✓	•	1	2	2	2	2

Main Area of Concern	Issue No.	Issue	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	?	NR	✗	✓	•
	3.2.4.	Decline in populations of deep water demersals	NR	?	NR	✓	✗	✓	✗	✓	•	1	2	2	3	1
	3.2.5.	Decline in populations of reef and demersal fish	✗	✓	✓	✓	•	✓	✗	✓	•	0	0	2	5	2
	3.3.	Decline in populations of commercial invertebrates														
	3.3.1.	Decline in populations of molluscs (bivalves, gastropods)	✗	•	✗	✓	•	NR	NR	✓	•	0	2	2	2	3
	3.3.2.	Decline in populations of abalone	NR	NR	NR	NR	NR	NR	NR	✓	NR	0	8	0	1	0
	3.3.3.	Decline in populations of cephalopods	✗	?	✗	✓	•	✗	✗	NR	•	1	1	4	1	2
	3.3.4.	Decline in populations of sea cucumbers	✗	?	✗	✓	✗	✓	✗	NR	•	1	1	4	2	1
	3.3.5.	Decline in populations of sea urchins	NR	?	✗	NR	✗	NR	NR	NR	NR	1	6	2	0	0
	3.3.6.	Decline in populations of prawns and shrimp	✗	✓	✓	✓	✓	NR	✗	✓	•	0	1	2	5	1
	3.3.7.	Decline in populations of lobsters	NR	•	✓	✓	•	✓	✓	NR	•	0	2	0	4	3
	3.3.8.	Decline in populations of crayfish	NR	NR	NR	NR	•	NR	✗	NR	NR	0	7	1	0	1
	3.3.9.	Decline in populations of crabs	✗	•	✗	✓	•	NR	✗	NR	•	0	2	3	1	3
	3.4.	Excessive bycatch and discards	✗	•	✓	✓	✓	✗	✗	✓	•	0	0	3	4	2
	3.5.	Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)	✗	✓	✓	✓	✓	✗	✗	✓	•	0	0	3	5	1

Key	
✓	Yes monitoring programme (operational)
•	Limited monitoring (site specific or periodic)
✗	No monitoring programme
?	Don't know
NR	Not relevant

8.1.2 Group Work Session 2: Prioritization Level 2

Prioritisation Level 2 results for all countries are shown in Table 11 to Table 19.

Table 11 shows the ranking of the issues in terms of the severity of the environmental impacts caused by the issue. Table 12 shows the ranking of the issues in terms of the severity of the socio-economic impacts caused by the issue. Table 13 shows the ranking of the issues in terms of the severity of the macro-economic impacts caused by the issue.

Table 14 shows the ranking in terms of the 'Overall severity' of the issues at the national scale for all countries (sum of the scores from Table 11, Table 12, Table 13).

Table 15 shows the perceived transboundary nature of the issues. Table 16 shows the ranking in terms of the scale of benefits that could be brought about by resolving the issue at the regional scale. Table 17 shows the perceived feasibility of solving the issue.

Table 18 is the ranking of the issues in terms of the 'Overall scope' of the issue (sum of the scores from Table 15, Table 16, and Table 17).

Table 19 presents the 'Overall ranking' from the Level 2 prioritisation exercise, which is a composite score of the 'Overall Severity' and 'Overall Scope'. The results from the Prioritisation Level 2 were compared with Prioritisation 1 results, and those issues with above average scores were then further examined in the Impact Analysis and the Causal Chain Analysis.

8.1.2.1 Overall Severity

The 'Overall Severity' of the issues in the Draft Issues Framework (

Table 14), is a composite of the scores for environmental (Table 11Table 11), socio-economic (Table 12Table 12) and macro-economic (Table 13

Table 13) severity. A summary of the findings within the region is presented below:

MAC01 One or more of the countries scored 6 of the 8 issues 'Very High' (10 to 12) in terms of their 'Overall Severity'. Only one of these issues was scored 'Very High' by more of than half the countries (5 out of 9 countries):

- 1.1 Alteration of natural river flow and changes in freshwater input and sediment load

The two issues that were not scored as 'Very High' by any of the countries included:

- 1.3.2 Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources
- 1.3.4 Suspended solids in coastal waters due to human activities on land and in the coastal zone

All the issues were ranked as 'High' (7 to 9) in terms of their 'Overall Severity' by one or more of the countries. But only one of the 8 issues was scored 'High' by more of than half the countries:

- 1.2 Degradation of ground and surface water quality

Another one of the 8 issues was scored 'High' (7 to 9) in terms of 'Overall severity' by 4 of the 9 countries:

- 1.3.4 Suspended solids in coastal waters due to human activities on land and in the coastal zone

More than half of the countries also identified the following two of the issues as being of 'Moderate' in terms of their 'Overall Severity':

- 1.3.2 Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources
- 1.3.6 Oil spills (drilling, exploitation, transport, processing, storage, shipping).

All other issues were scored as either 'Moderate' or 'Low' for 'Overall severity', and four out of the 9 countries ranked one of the issues as 'Low' severity:

- 1.3.3 Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources

MAC02 One or more of the countries scored 12 of the 15 issues 'Very High' (10 to 12) in terms of their 'Overall Severity'. Only 2 of the 15 issues scored 'Very High' by more than half of the countries (5 or more of the 9 countries):

- 2.2.6. Disturbance, damage and loss of mangrove habitats
- 2.3.1. Disturbance, damage and loss of coral reef habitats

The 3 issues that were not ranked as being of 'Very High' in terms of their 'Overall Severity' by any of the countries included:

- 2.2.5. Disturbance, damage and loss of estuarine habitats
- 2.3.5. Disturbance, damage and loss of deep water habitats (including sea mounts)
- 2.5. Increase in the occurrence of harmful or toxic algal blooms (HABs)

A further two of the 15 issues scored 'Very High' in terms of their 'Overall severity' by 4 out of the 9 countries:

- 2.1. Shoreline change, due to modification, land reclamation and coastal erosion
- 2.2.3. Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)

All but one of the 15 issues were ranked as 'High' (7 to 9) in terms of their 'Overall Severity' by one or more of the countries, but none was scored 'High' by more of than half the countries.

There were however 4 issues that were ranked as 'High' in terms of their 'Overall Severity' by 4 of the 9 countries :

- 2.2.1. Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)
- 2.2.4. Disturbance, damage and loss of wetland habitats
- 2.2.5. Disturbance, damage and loss of estuarine habitats
- 2.4. Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)

All other issues were scored as either 'Moderate' or 'Low' for 'Overall severity',

MAC03: One or more of the countries scored 13 of the 20 issues as 'Very High' (10 to 12) in terms of their 'Overall Severity'. Only 3 of the 20 issues scored 'Very High' by more of than half the countries (5 or more out of 9 countries):

- 3.2.1. Decline in populations of sharks and rays
- 3.2.5. Decline in populations of reef and demersal fish
- 3.3.6. Decline in populations of prawns and shrimp

The 7 issues that did not score 'Very High' in terms of their 'Overall Severity' by any of the countries included:

- 3.1.2. Decline in populations of cetaceans
- 3.1.3. Decline in populations of seabirds
- 3.2.3. Decline in populations of small pelagics
- 3.3.1. Decline in populations of molluscs (bivalves, gastropods)
- 3.3.2. Decline in populations of abalone
- 3.3.5. Decline in populations of sea urchins
- 3.3.9. Decline in populations of crabs

Another 3 issues scored 'Very High' in terms of 'Overall severity' in 4 out of the 9 countries:

- 3.2.2. Decline in populations of large pelagics
- 3.3.4. Decline in populations of sea cucumbers
- 3.5. Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality).

There were 3 of the 20 issues that scored 'High' in terms of their 'Overall severity' in more than half the countries (5 or more of the 9 countries):

- 3.1.3. Decline in populations of seabirds
- 3.1.4. Decline in populations of turtles
- 3.2.3. Decline in populations of small pelagics

There were a further 4 issues that scored 'High' in terms of 'Overall severity' in 4 of the 9 countries:

- 3.1.2. Decline in populations of cetaceans
- 3.3.1. Decline in populations of molluscs (bivalves, gastropods)
- 3.3.9. Decline in populations of crabs
- 3.4. Excessive bycatch and discards

All other issues were scored as being 'Moderate' or 'Low' in terms of their 'Overall severity'.

8.1.2.2 Overall Scope

The 'Overall Scope' of the issues (

Table 18

Table 14), is a composite of the scores for transboundary scope (Table 15Table 11), scale of benefits (Table 16Table 12) and feasibility (Table 17).

A summary of the findings within the region is presented below:

MAC01 One or more of the countries scored all issues as 'Very High' in terms of their 'Overall scope'. Only one of the issues was scored as 'Very High' by more than half of the countries (6 of the 9 countries):

- 1.3.5 Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources

Another of the issues was scored as 'Very High' in terms of their 'Overall scope' by 4 of the 9 countries:

- 1.3.6 Oil spills (drilling, exploitation, transport, processing, storage, shipping).

All issues were also scored as 'High' in terms of their 'Overall scope' by one or more of the countries. There were 4 of the 8 issues that were scored as 'High' by 5 or more of the 9 countries:

- 1.1 Alteration of natural river flow and changes in freshwater input and sediment load
- 1.3.1 Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources
- 1.3.2 Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources
- 1.3.3 Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources
- 1.3.4 Suspended solids in coastal waters due to human activities on land and in the coastal zone

Another two issues were scored as 'High' by 4 of the countries

- 1.2 Degradation of ground and surface water quality
- 1.3.1 Microbiological contamination

The remainder of the countries scored the issues as 'Moderate' (4 to 6) in terms of their 'Overall scope'. None of the issues were scored as 'Low' (1 to 3).

MAC02 One or more of the countries scored 14 of the 15 issues as 'Very High' in terms of their 'Overall scope'. Three issues were scored as 'Very High' by more than half of the countries (5 or more of the 9 countries):

- 2.1. Shoreline change, due to modification, land reclamation and coastal erosion
- 2.2.6. Disturbance, damage and loss of mangrove habitats
- 2.3.1. Disturbance, damage and loss of coral reef habitats

The issue that was the exception, and was not scored as 'Very High' by any country was:

- 2.3.5. Disturbance, damage and loss of deep water habitats (including sea mounts)

Another 2 of the 15 issues were scored as 'Very High' in terms of their 'Overall scope' by 4 of the 9 countries:

- 2.2.3. Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)
- 2.6. Introduction of exotic non-native species, invasives and nuisance species

All but one of the 15 issues were also scored as 'High' in terms of their 'Overall scope' by one or more of the countries. There were 4 of the 15 issues that were scored as 'High' by 5 or more of the 9 countries:

- 2.2.1. Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)
- 2.2.2. Disturbance, damage and loss of coastal forest habitats
- 2.2.4. Disturbance, damage and loss of wetland habitats

Another issue was scored as 'High' by 4 of the countries.

- 2.5. Increase in the occurrence of harmful or toxic algal blooms (HABs)

The exception which was not scored as 'High' by any of the countries was:

- 2.3.3. Disturbance, damage and loss of macroalgal habitats

The remainder of the countries scored the issues as 'Moderate' (4 to 6) or 'Low' (1 to 3) in terms of their 'Overall scope'.

MAC03 One or more of the countries scored 14 of the 20 issues as 'Very High' in terms of their 'Overall scope'. Two of these issues were scored as 'Very High' by more than half of the countries (5 or more of the 9 countries):

- 3.2.1. Decline in populations of sharks and rays
- 3.2.2. Decline in populations of large pelagics

Indeed all but one of the countries where issue 3.2.2 was relevant, ranked it as 'Very High'.

The 6 issues that were not scored as 'Very high' by any of the countries included:

- 3.3.2. Decline in populations of abalone
- 3.3.3. Decline in populations of cephalopods
- 3.3.4. Decline in populations of sea cucumbers
- 3.3.5. Decline in populations of sea urchins
- 3.3.8. Decline in populations of crayfish
- 3.3.9. Decline in populations of crabs

Another issue was scored as 'Very High' in terms of 'Overall scope' by 4 of the 9 countries:

- 3.4. Excess bycatch and discards

All but 3 of the 20 issues were also scored as 'High' in terms of their 'Overall scope' by one or more of the countries. There were 4 issues that were scored as 'High' by 5 or more of the countries:

- 3.1.4. Decline in populations of turtles
- 3.3.3. Decline in populations of cephalopods
- 3.3.4. Decline in populations of sea cucumbers
- 3.3.6. Decline in populations of prawns and shrimp

Another 4 issues that were scored as 'High' by 4 or more of the countries:

- 3.2.3. Decline in populations of small pelagics
- 3.2.4. Decline in populations of deep water demersals
- 3.2.5. Decline in populations of reef and demersal fish
- 3.4. Excessive bycatch and discards

The remainder of the countries scored the issues as 'Moderate' (4 to 6). No issues were scored as 'Low' (1 to 3) in terms of their 'Overall scope'.

8.1.2.3 Overall Ranking

The 'Overall ranking' scores for all issues for all countries from Prioritisation Level 2 are shown in Table 19. Highlighted scores are above average within each MAC for each country.

Comoros: had 13 issues with above average 'Overall ranking' scores distributed between MAC01 (4 issues), MAC02 (5 issues), and MAC03 (4 issues). The issues with top 3 highest scores within each MAC are listed below in descending order:

- 3.1.4. Decline in populations of turtles (24)
- 3.2.2. Decline in populations of large pelagics (23)
- 3.2.1. Decline in populations of sharks and rays (22)
- 2.3.1. Disturbance, damage and loss of coral reef habitats (20)
- 2.1. Shoreline change, due to modification, land reclamation and coastal erosion (17)
- 2.2.1. Disturbance, damage and loss of upland / watershed habitats (>10 m elevation) (17)
- 2.2.3. Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation) (17)
- 1.3.1 Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources (16)
- 1.1 Alteration of natural river flow and changes in freshwater input and sediment load (15)
- 1.3.5 Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources (15)
- 1.3.6 Oil spills (drilling, exploitation, transport, processing, storage, shipping) (15)

Kenya: had 20 issues with above average 'Overall ranking' scores distributed between MAC01 (4 issues), MAC02 (9 issues), and MAC03 (7 issues). The issues with top 3 highest scores within each MAC are listed below in descending order:

- 2.2.1. Disturbance, damage and loss of upland / watershed habitats (>10 m elevation) (24)
- 2.2.6. Disturbance, damage and loss of mangrove habitats (22)
- 2.3.1. Disturbance, damage and loss of coral reef habitats (22)
- 2.2.4. Disturbance, damage and loss of wetland habitats (21)
- 3.2.5. Decline in populations of reef and demersal fish (21)
- 3.3.5. Decline in populations of prawns and shrimp (20)
- 3.3.2. Decline in populations of cephalopods (19)
- 3.3.3. Decline in populations of sea cucumbers (19)
- 3.4. Excessive bycatch and discards (19)
- 3.5. Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality) (19)
- 1.3.5 Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources (18)
- 1.1 Alteration of natural river flow and changes in freshwater input and sediment load (17)
- 1.3.2 Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources (15)

Madagascar: had 12 issues with above average 'Overall ranking' scores distributed between MAC01 (3 issues), MAC02 (6 issues), and MAC03 (5 issues, which were pre-selected i.e. not all issues within MAC03 were ranked). The issues with top 3 highest scores within each MAC are listed below in descending order:

- 1.3.1 Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources (24).
- 2.2.6. Disturbance, damage and loss of mangrove habitats (24)
- 2.2.2. Disturbance, damage and loss of coastal forest habitats (21)
- 1.3.6 Oil spills (drilling, exploitation, transport, processing, storage, shipping) (20)
- 2.3.1. Disturbance, damage and loss of coral reef habitats (19)
- 2.3.2. Disturbance, damage and loss of seagrass habitats (19)

- 2.4. Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth) (19)
- 3.1.4. Decline in populations of turtles (19)
- 1.3.3 Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources (18).
- 3.3.5. Decline in populations of prawns and shrimp (17)
- 3.1.2. Decline in populations of cetaceans (16)

Mauritius: had 20 issues with above average 'Overall ranking' scores distributed between MAC01 (4 issues), MAC02 (6 issues), and MAC03 (10 issues). The issues with top 3 highest scores within each MAC are listed below in descending order:

- 3.2.4. Decline in populations of deep water demersals (24)
- 3.2.5. Decline in populations of reef and demersal fish (24)
- 3.2.2. Decline in populations of large pelagics (23)
- 3.5. Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality) (22)
- 2.1. Shoreline change, due to modification, land reclamation and coastal erosion (22)
- 2.3.1. Disturbance, damage and loss of coral reef habitats (21)
- 2.2.6. Disturbance, damage and loss of mangrove habitats (20)
- 1.3.1 Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources (14)
- 1.3.5 Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources (14)
- 1.1 Alteration of natural river flow and changes in freshwater input and sediment load (13)
- 1.2 Degradation of ground and surface water quality (13)

Mozambique: had 24 issues with above average 'Overall ranking' scores distributed between MAC01 (5 issues), MAC02 (9 issues), and MAC03 (10 issues). The issues with top 3 highest scores within each MAC are listed below in descending order:

- 3.3.5. Decline in populations of prawns and shrimp (24)
- 3.5. Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality) (23)
- 2.2.3. Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation) (23)
- 2.2.6. Disturbance, damage and loss of mangrove habitats (23)
- 2.1. Shoreline change, due to modification, land reclamation and coastal erosion (22)
- 3.1.4. Decline in populations of turtles (22)
- 2.2.1. Disturbance, damage and loss of upland / watershed habitats (>10 m elevation) (21)
- 1.1 Alteration of natural river flow and changes in freshwater input and sediment load (19)
- 1.3.5 Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources (17)
- 1.2 Degradation of ground and surface water quality (15)
- 1.3.1 Microbiological contamination from land-based (domestic, industrial, agriculture) (15)

Seychelles: had 16 issues with above average 'Overall ranking' scores distributed between MAC01 (3 issues), MAC02 (4 issues), and MAC03 (9 issues). The issues with top 3 highest scores within each MAC are listed below in descending order:

- 2.1. Shoreline change, due to modification, land reclamation and coastal erosion (24)
- 2.3.1. Disturbance, damage and loss of coral reef habitats (24)
- 1.3.6 Oil spills (drilling, exploitation, transport, processing, storage, shipping) (22)
- 3.2.1. Decline in populations of sharks and rays (21)
- 3.2.2. Decline in populations of large pelagics (21)
- 1.3.5 Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources (19)
- 3.4. Excessive bycatch and discards (19)

- 1.1 Alteration of natural river flow and changes in freshwater input and sediment load (18)
- 2.4. Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth) (18)

Somalia: had 22 issues with above average 'Overall ranking' scores distributed between MAC01 (5 issues), MAC02 (9 issues), and MAC03 (8 issues). The issues with top 3 highest scores within each MAC are listed below in descending order:

- 3.2.1. Decline in populations of sharks and rays (22)
- 3.2.2. Decline in populations of large pelagics (22)
- 3.4. Excessive bycatch and discards (21)
- 3.2.5. Decline in populations of reef and demersal fish (20)
- 2.3.1. Disturbance, damage and loss of coral reef habitats (19)
- 1.3.6 Oil spills (drilling, exploitation, transport, processing, storage, shipping) (17)
- 1.3.3 Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources (17)
- 2.2.1. Disturbance, damage and loss of upland / watershed habitats (>10 m elevation) (17)
- 1.3.1 Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources (16)
- 1.3.5 Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources (16)
- 2.2.2. Disturbance, damage and loss of coastal forest habitats (16)
- 2.2.6. Disturbance, damage and loss of mangrove habitats (16)
- 2.4. Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth) (16)
- 1.3.2 Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources (15)

South Africa: had 19 issues with above average 'Overall ranking' scores distributed between MAC01 (2 issues), MAC02 (9 issues), and MAC03 (8 issues). The issues with top 3 highest scores within each MAC are listed below in descending order:

- 1.1 Alteration of natural river flow and changes in freshwater input and sediment load (19)
- 1.2 Degradation of ground and surface water quality (19)
- 2.2.3. Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation) (19)
- 2.2.4. Disturbance, damage and loss of wetland habitats (19)
- 2.2.5. Disturbance, damage and loss of estuarine habitats (19)
- 2.3.4. Disturbance, damage and loss of soft sediment habitats (19)
- 2.2.1. Disturbance, damage and loss of upland / watershed habitats (>10 m elevation) (18)
- 2.2.2. Disturbance, damage and loss of coastal forest habitats (18)
- 2.2.6. Disturbance, damage and loss of mangrove habitats (17)
- 3.2.1. Decline in populations of sharks and rays (16)
- 3.2.2. Decline in populations of large pelagics (15)
- 3.2.5. Decline in populations of reef and demersal fish (15)
- 3.3.1. Decline in populations of molluscs (bivalves, gastropods) (14)
- 3.2.3. Decline in populations of small pelagics (14)
- 3.2.4. Decline in populations of deep water demersals (14)

Tanzania: had 19 issues with above average 'Overall ranking' scores distributed between MAC01 (4 issues), MAC02 (8 issues), and MAC03 (7 issues). The issues with top 3 highest scores within each MAC are listed below in descending order:

- 2.2.6. Disturbance, damage and loss of mangrove habitats (24)
- 2.2.3. Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation) (23)

- 2.3.1. Disturbance, damage and loss of coral reef habitats (23)
- 2.1. Shoreline change, due to modification, land reclamation and coastal erosion (22)
- 1.1 Alteration of natural river flow and changes in freshwater input and sediment load (20)
- 3.3.3 Decline in populations of cephalopods (19)
- 3.3.6 Decline in populations of prawns and shrimp (19)
- 3.2.3 Decline in populations of small pelagics (18)
- 3.3.5 Decline in populations of reef and demersal fish (18)
- 1.2 Degradation of ground and surface water quality (18)
- 1.3.5 Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources (18)
- 1.3.4 Suspended solids in coastal waters due to human activities on land and in the coastal zone (17)
- 3.3.4 Decline in populations of sea cucumbers (16)
- 3.4 Excessive bycatch and discards (16)

The summary columns in Table 19 shows the total number of countries with above average 'Overall ranking' scores and the percentage of above average scores. The percentages were adjusted to discount countries where the issue was considered as 'Not relevant' (i.e. these percentages are calculated using the number of countries for which the issue was considered to be relevant and not the total number of countries).

This Level 2 prioritisation exercise identified 20 potential priority transboundary issues, distributed between MAC01 (4 issues), MAC02 (7 issues) and MAC03 (8 issues).

A summary of the findings within the region is presented below:

MAC01: The 'Overall ranking' scores was above average in more than half of the countries for 4 of the 8 issues (50 %). All the issues were identified as 'Relevant' by the countries, so there was no need to adjust the percentages. The 4 priority transboundary issues within MAC01 (in reverse order starting with the issue with the highest number of countries with above average scores) were as follows:

- 1.1 Alteration of natural river flow and changes in freshwater input and sediment load (7 countries, 3 islands and 4 mainland, 77.8 % of countries)
- 1.3.5 Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources (7 countries, 3 islands and 4 mainland, 77.8 % of countries).
- 1.2 Degradation of ground and surface water quality (5 countries, 2 islands and 3 mainland, 55.6 % of countries)
- 1.3.1 Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources (5 countries, 3 islands and 2 mainland, 55.6 % of countries).

MAC02: The 'Overall ranking' was above average in more than half of the countries for 7 of the 15 issues (47 %). These 7 priority transboundary issues within MAC02 (in reverse order starting with the issue with the highest number of countries with above average scores) were as follows:

- 2.2.6. Disturbance, damage and loss of mangrove habitats (8 countries, 3 islands, 5 mainland, 88.9 % of countries)
- 2.3.1. Disturbance, damage and loss of coral reef habitats (8 countries, 4 islands and 4 mainland, 88.9 % of countries)
- 2.1. Shoreline change, due to modification, land reclamation and coastal erosion (7 countries, 3 islands and 4 mainland, 77.8 % of countries)

- 2.2.3. Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation) (7 countries, 2 islands and 4 mainland, 77.8 % of countries)
- 2.4. Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth) (7 countries, 3 islands, 4 mainland, 77.8 % [adjusted] of countries)
- 2.2.1. Disturbance, damage and loss of upland / watershed habitats (>10 m elevation) (6 countries, 2 islands and 4 mainland, 75.0 % of countries where relevant).
- 2.2.2. Disturbance, damage and loss of coastal forest habitats (6 countries, 2 island and 4 mainland, 85.7 % [adjusted] of countries)

MAC03: The 'Overall ranking' was above average for 8 of the 20 issues (40 %). These 8 priority transboundary issues (in reverse order starting with the issue with the highest number of countries with above average scores) were as follows:

- 3.2.1. Decline in populations of sharks and rays (7 countries, 3 islands and 2 mainland, 87.5 % [adjusted] of countries)
- 3.2.5. Decline in populations of reef and demersal fish (7 countries, 2 islands and 5 mainland, 87.5 % [adjusted] of countries).
- 3.4. Excessive bycatch and discards (7 countries, 2 islands and 5 mainland, 87.5 % [adjusted] of countries)
- 3.1.4. Decline in populations of turtles (6 countries, 4 islands and 3 mainland, 77.8 % [adjusted] countries)
- 3.2.2. Decline in populations of large pelagics (6 countries, 3 islands and 3 mainland, 100 % [adjusted] of countries)
- 3.2.3. Decline in populations of small pelagics (5 countries, 1 island, 4 mainland, 83.3 % [adjusted] of countries)
- 3.3.5. Decline in populations of prawns and shrimp (5 countries, 2 islands and 3 mainland, 62.5 % of countries where relevant)
- 3.3.4. Decline in populations of sea cucumber (4 countries, 1 islands and 3 mainland, 57.1 % [adjusted] of countries)
- 3.5. Expansion of mariculture industry (4 countries, 2 islands and 2 mainland, 66.7 % [adjusted] of countries)

Table 11: Prioritisation Level 2: Severity of Environmental Impact at National Level

Main Area of Concern	Issue No.	Issue	Environmental Impact									Summary			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	L	M	H	VH
MAC01	1.1.	Alteration of natural river flow and changes in freshwater input and sediment load	3	3	4	1	3	4	2	4	4	1	1	3	4
	1.2.	Degradation of ground and surface water quality	1	2	2	1	4	3	3	4	3	2	2	3	2
	1.3.	Degradation of coastal and marine water quality													
	1.3.1	Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources	3	1	4	1	1	3	3	1	2	4	1	3	1
	1.3.2	Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources	1	3	1	1	2	3	2	2	2	3	4	2	0
	1.3.3	Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources	1	2	2	1	1	2	4	1	2	4	4	0	1
	1.3.4	Suspended solids in coastal waters due to human activities on land and in the coastal zone	1	3	3	1	2	3	2	1	3	3	2	4	0
	1.3.5	Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources	3	3	2	1	3	4	3	1	3	2	1	5	1
	1.3.6	Oil spills (drilling, exploitation, transport, processing, storage, shipping).	2	3	3	1	2	4	3	2	2	1	4	3	1
MAC02:	2.1.	Shoreline change, due to modification, land reclamation and coastal erosion	3	3	2	4	4	4	1	1	4	2	1	2	4
	2.2.	Disturbance, damage and loss of coastal, watershed and upland habitats													
	2.2.1.	Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)	3	4	4	2	4		3	3	3	0	1	4	3
	2.2.2.	Disturbance, damage and loss of coastal forest habitats	3	3	4			2	3	3	4	0	1	4	2

Main Area of Concern	Issue No.	Issue	Environmental Impact: Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	Summary: L	M	H	VH
	2.2.3.	Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)	4	3	2	4	4	3	2	3	4	0	2	3	4
	2.2.4.	Disturbance, damage and loss of wetland habitats		3	3	4	4	2	2	3	3	0	2	4	2
	2.2.5.	Disturbance, damage and loss of estuarine habitats		2	2		3		2	3	3	0	3	3	0
	2.2.6.	Disturbance, damage and loss of mangrove habitats	2	4	4	4	4	1	3	3	4	1	1	2	5
	2.3.	Disturbance, damage and loss of subtidal benthic habitats													
	2.3.1.	Disturbance, damage and loss of coral reef habitats	4	4	2	4	4	4	4	3	4	0	1	1	7
	2.3.2.	Disturbance, damage and loss of seagrass habitats	2	1		3	4	1	3	1	4	3	1	2	2
	2.3.3.	Disturbance, damage and loss of macroalgal habitats	1	1			4		2	3	1	3	1	1	1
	2.3.4.	Disturbance, damage and loss of soft sediment habitats		1	1	?	4	1	2	3	4	3	1	1	2
	2.3.5.	Disturbance, damage and loss of deep water habitats (including sea mounts)	1	1	2			1	1	3	3	4	1	2	0
	2.4.	Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)	1	4	3	3	4	1	3	2	4	2	1	3	3
	2.5.	Increase in the occurence of harmful or toxic algal blooms (HABs)	2	2	2	3	2		1	1	2	2	5	1	0
	2.6.	Introduction of exotic non-native species, invasives and nuisance species	1	3	1	3	4		1	2	3	3	1	3	1
MAC03:	3.1.	Decline in populations of focal species													
	3.1.1.	Decline in populations of marine mammals	4	2	2	2	4	1	3			1	3	1	2
	3.1.2.	Decline in populations of cetaceans		2	2	3	3	4	?			0	2	2	1
	3.1.3.	Decline in populations of seabirds	4	1		3	3	4	?	4		1	0	2	3
	3.1.4.	Decline in populations of turtles	4	2	2	3	4	4	4	4	3	0	2	2	5

Main Area of Concern	Issue No.	Issue	Environmental Impact									Summary			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	L	M	H	VH
	3.2.	Decline in populations of commercial fish stocks													
	3.2.1.	Decline in populations of sharks and rays	3	2	2	3	4	4	4	4		0	2	2	4
	3.2.2.	Decline in populations of large pelagics	3	2		3	4	4	4	2		0	2	2	3
	3.2.3.	Decline in populations of small pelagics	3	3			4		3	3	3	0	0	5	1
	3.2.4.	Decline in populations of deep water demersals		1		4	1	2	1	3	3	3	1	2	1
	3.2.5.	Decline in populations of reef and demersal fish	4	4		4	4	4	4	3	4	0	0	1	7
	3.3.	Decline in populations of commercial invertebrates													
	3.3.1.	Decline in populations of molluscs (bivalves, gastropods)	4	4		4	3			2	1	1	1	1	3
	3.3.2.	Decline in populations of abalone								2		0	1	0	0
	3.3.3.	Decline in populations of cephalopods	4	4		2	3	2	1		3	1	2	2	2
	3.3.4.	Decline in populations of sea cucumbers	4	4		3	4	4	1		3	1	0	2	4
	3.3.5.	Decline in populations of sea urchins		3			1					1	0	1	0
	3.3.6.	Decline in populations of prawns and shrimp	4	4	3	3	4		3	2	4	0	1	3	4
	3.3.7.	Decline in populations of lobsters		3		3	3	2	4		1	1	1	3	1
	3.3.8.	Decline in populations of crayfish					1		4			1	0	0	1
	3.3.9.	Decline in populations of crabs	4	3		3	2		2		1	1	2	2	1
	3.4.	Excessive bycatch and discards	3	4		4	4	3	4	3	3	0	0	4	4
	3.5.	Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)	3	4		4	4	4		2		0	1	1	4

Table 12: Prioritization Level 2: Severity of Socio-economic Impact at National Level

Main Area of Concern	Issue No.	Issue	Socioeconomic Impact									Summary			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	L	M	H	VH
MAC01	1.1.	Alteration of natural river flow and changes in freshwater input and sediment load	2	4	3	1	4	3	2	3	4	1	2	3	3
	1.2.	Degradation of ground and surface water quality	1	3	3	1	3	2	3	4	3	2	1	5	1
	1.3.	Degradation of coastal and marine water quality													
	1.3.1	Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources	2	1	4	1	3	3	3	2	2	2	3	3	1
	1.3.2	Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources	1	2	3	1	2	3	2	1	2	3	4	2	0
	1.3.3	Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources	1	1	3	1	1	2	4	1	2	5	2	1	1
	1.3.4	Suspended solids in coastal waters due to human activities on land and in the coastal zone	1	2	2	1	3	3	1	1	3	4	2	3	0
	1.3.5	Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources	1	3	2	1	3	3	2	1	3	3	2	4	0
	1.3.6	Oil spills (drilling, exploitation, transport, processing, storage, shipping).	1	2	3	1	1	4	2	1	1	5	2	1	1
MAC02	2.1.	Shoreline change, due to modification, land reclamation and coastal erosion	3	3	2	4	4	4	1	3	4	1	1	3	4
	2.2.	Disturbance, damage and loss of coastal, watershed and upland habitats													
	2.2.1.	Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)	3	4	4	2	4		3	3	3	0	1	4	3
	2.2.2.	Disturbance, damage and loss of coastal forest habitats	2	3	4			1	3	3	4	1	1	3	2

Main Area of Concern	Issue No.	Issue	Socioeconomic Impact									Summary			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	L	M	H	VH
	2.2.3.	Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)	3	3	2	4	4	1	2	3	4	1	2	3	3
	2.2.4.	Disturbance, damage and loss of wetland habitats		4	3	2	4	1	2	3	3	1	2	3	2
	2.2.5.	Disturbance, damage and loss of estuarine habitats		3	1		3		1	3	3	2	0	4	0
	2.2.6.	Disturbance, damage and loss of mangrove habitats	1	4	4	4	4	1	2	2	4	2	2	0	5
	2.3.	Disturbance, damage and loss of subtidal benthic habitats													
	2.3.1.	Disturbance, damage and loss of coral reef habitats	4	4	3	4	2	4	4	2	4	0	2	1	6
	2.3.2.	Disturbance, damage and loss of seagrass habitats	1	1		2	3	1	3	1	4	4	1	2	1
	2.3.3.	Disturbance, damage and loss of macroalgal habitats	1	1			3		1	2	1	4	1	1	0
	2.3.4.	Disturbance, damage and loss of soft sediment habitats		1	3	?	3	1	1	3	3	3	0	4	0
	2.3.5.	Disturbance, damage and loss of deep water habitats (including sea mounts)	1	1	3			4	1	1	1	5	0	1	1
	2.4.	Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)	1	4	3	3	4	4	3	2	3	1	1	4	3
	2.5.	Increase in the occurence of harmful or toxic algal blooms (HABs)	2	3	3	3	1		1	2	2	2	3	3	0
	2.6.	Introduction of exotic non-native species, invasives and nuisance species	1	2	1	3	3		1	3	2	3	2	3	0
MAC03	3.1.	Decline in populations of focal species													
	3.1.1.	Decline in populations of marine mammals	2	4	2	1	3	1	1			3	2	1	1
	3.1.2.	Decline in populations of cetaceans		2	3	4	2	2	1			1	3	1	1
	3.1.3.	Decline in populations of seabirds	2	2		2	2	3	1	2		1	5	1	0
	3.1.4.	Decline in populations of turtles	4	4	4	3	3	3	3	2	1	1	1	4	3
	3.2.	Decline in populations of commercial fish stocks													
	3.2.1.	Decline in populations of sharks and rays	4	3	4	4	4	3	4	2		0	1	2	5

Main Area of Concern	Issue No.	Issue	Socioeconomic Impact									Summary			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	L	M	H	VH
	3.2.2.	Decline in populations of large pelagics	4	2		4	1	3	4	2		1	2	1	3
	3.2.3.	Decline in populations of small pelagics	3	3			3		3	3	4	0	0	5	1
	3.2.4.	Decline in populations of deep water demersals		1		4	1	3	1	3	3	3	0	3	1
	3.2.5.	Decline in populations of reef and demersal fish	4	4		4	4	4	3	3	4	0	0	2	6
	3.3.	Decline in populations of commercial invertebrates													
	3.3.1.	Decline in populations of molluscs (bivalves, gastropods)	3	2		3	4			3	1	1	1	3	1
	3.3.2.	Decline in populations of abalone								3		0	0	1	0
	3.3.3.	Decline in populations of cephalopods	3	4		4	4	2	1		4	1	1	1	4
	3.3.4.	Decline in populations of sea cucumbers	4	4		3	4	4	1		1	2	0	1	4
	3.3.5.	Decline in populations of sea urchins		3			2					0	1	1	0
	3.3.6.	Decline in populations of prawns and shrimp	4	4	4	4	4		2	2	3	0	2	1	5
	3.3.7.	Decline in populations of lobsters		4		4	2	2	4		1	1	2	0	3
	3.3.8.	Decline in populations of crayfish					1		3			1	0	1	0
	3.3.9.	Decline in populations of crabs	2	3		2	3		1		1	2	2	2	0
	3.4.	Excessive bycatch and discards	3	4		4	4	3	3	2	3	0	1	4	3
	3.5.	Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)	3	3		4	4	3		1		1	0	3	2

Table 13: Prioritization Level 2: Severity of Macro-economic Impact at National Level

Main Area of Concern	Issue No.	Issue	Macroeconomic Impact									Summary			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	L	M	H	VH
MAC01	1.1.	Alteration of natural river flow and changes in freshwater input and sediment load	1	2	3	1	3	3	2	4	4	2	2	3	2
	1.2.	Degradation of ground and surface water quality	1	1	2	1	2	2	3	3	3	3	3	3	0
	1.3.	Degradation of coastal and marine water quality													
	1.3.1	Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources	1	1	4	1	2	2	3	1	2	4	3	1	1
	1.3.2	Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources	1	1	1	1	1	3	3	1	2	6	1	2	0
	1.3.3	Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources	1	1	3	1	1	2	4	1	1	6	1	1	1
	1.3.4	Suspended solids in coastal waters due to human activities on land and in the coastal zone	1	1	2	1	2	3	1	1	2	5	3	1	0
	1.3.5	Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources	1	1	2	1	2	3	1	1	2	5	3	1	0
	1.3.6	Oil spills (drilling, exploitation, transport, processing, storage, shipping).	1	1	3	1	1	4	2	1	1	6	1	1	1
MAC02	2.1.	Shoreline change, due to modification, land reclamation and coastal erosion	3	3	2	4	4	4	1	1	4	2	1	2	4
	2.2.	Disturbance, damage and loss of coastal, watershed and upland habitats													
	2.2.1.	Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)	3	4	4	1	4		3	3	3	1	0	4	3
	2.2.2.	Disturbance, damage and loss of coastal forest habitats	1	4	4			1	2	1	4	3	1	0	3

Main Area of Concern	Issue No.	Issue	Macroeconomic Impact									Summary			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	L	M	H	VH
	2.2.3.	Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)	4	3	2	2	4	1	1	3	4	2	2	2	3
	2.2.4.	Disturbance, damage and loss of wetland habitats		4	2	2	4	1	1	3	3	2	2	2	2
	2.2.5.	Disturbance, damage and loss of estuarine habitats		3	2		2		1	3	2	1	3	2	0
	2.2.6.	Disturbance, damage and loss of mangrove habitats	1	4	4	2	4	3	2	1	4	2	2	1	4
	2.3.	Disturbance, damage and loss of subtidal benthic habitats													
	2.3.1.	Disturbance, damage and loss of coral reef habitats	2	4	2	4	3	4	2	1	4	1	3	1	4
	2.3.2.	Disturbance, damage and loss of seagrass habitats	1	1		1	3	1	1	1	4	6	0	1	1
	2.3.3.	Disturbance, damage and loss of macroalgal habitats	1	1			3		1	1	1	5	0	1	0
	2.3.4.	Disturbance, damage and loss of soft sediment habitats		2	2	?	3	1	1	3	4	2	2	2	1
	2.3.5.	Disturbance, damage and loss of deep water habitats (including sea mounts)	1	2	3			4	1	1	4	3	1	1	2
	2.4.	Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)	1	2	1	1	3	4	2	2	4	3	3	1	2
	2.5.	Increase in the occurence of harmful or toxic algal blooms (HABs)	1	1	1	1	1		1	1	1	8	0	0	0
	2.6.	Introduction of exotic non-native species, invasives and nuisance species	1	1	1	2	3		1	2	2	4	3	1	0
MAC03	3.1.	Decline in populations of focal species													
	3.1.1.	Decline in populations of marine mammals	1	1	1	1	3	1	1			6	0	1	0
	3.1.2.	Decline in populations of cetaceans		1	3	2	2	1	1			3	2	1	0
	3.1.3.	Decline in populations of seabirds	1	1		2	2	2	1	1		4	3	0	0
	3.1.4.	Decline in populations of turtles	4	2	4	2	3	1	1	1	1	4	2	1	2

Main Area of Concern	Issue No.	Issue	Macroeconomic Impact									Summary			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	L	M	H	VH
	3.2.	Decline in populations of commercial fish stocks													
	3.2.1.	Decline in populations of sharks and rays	4	2	4	3	3	3	4	1		1	1	3	3
	3.2.2.	Decline in populations of large pelagics	4	2		4	3	4	4	1		1	1	1	4
	3.2.3.	Decline in populations of small pelagics	3	3			2		3	1	1	2	1	3	0
	3.2.4.	Decline in populations of deep water demersals		1		4	1	3	1	1	1	5	0	1	1
	3.2.5.	Decline in populations of reef and demersal fish	2	4		4	3	3	3	1	1	2	1	3	2
	3.3.	Decline in populations of commercial invertebrates													
	3.3.1.	Decline in populations of molluscs (bivalves, gastropods)	1	1		2	1			1	1	5	1	0	0
	3.3.2.	Decline in populations of abalone								1		1	0	0	0
	3.3.3.	Decline in populations of cephalopods	3	3		2	2	1	1		3	2	2	3	0
	3.3.4.	Decline in populations of sea cucumbers	3	3		2	3	3	1		3	1	1	5	0
	3.3.5.	Decline in populations of sea urchins		3			1					1	0	1	0
	3.3.6.	Decline in populations of prawns and shrimp	1	3	4	4	4		2	1	3	2	1	2	3
	3.3.7.	Decline in populations of lobsters		3		2	2	1	3		1	2	2	2	0
	3.3.8.	Decline in populations of crayfish					1		4			1	0	0	1
	3.3.9.	Decline in populations of crabs	1	1		2	2		1		1	4	2	0	0
	3.4.	Excessive bycatch and discards	3	3		2	1	3	3	1	1	3	1	4	0
	3.5.	Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)	3	3		4	4	3		1		1	0	3	2

Table 14: Prioritization Level 2: Overall Severity at National Level

Main Area of Concern	Issue No.	Issue	OVERALL SEVERITY									SUMMARY			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	1 to 3	4 to 6	7 to 9	10 to 12
MAC01	1.1.	Alteration of natural river flow and changes in freshwater input and sediment load	6	9	10	3	10	10	6	11	12	1	2	1	5
	1.2.	Degradation of ground and surface water quality	3	6	7	3	9	7	9	11	9	2	1	5	1
	1.3.	Degradation of coastal and marine water quality													
	1.3.1	Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources	6	3	12	3	6	8	9	4	6	2	4	2	1
	1.3.2	Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources	3	6	5	3	5	9	7	4	6	2	5	2	0
	1.3.3	Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources	3	4	8	3	3	6	12	3	5	4	3	1	1
	1.3.4	Suspended solids in coastal waters due to human activities on land and in the coastal zone	3	6	7	3	7	9	4	3	8	3	2	4	0
	1.3.5	Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources	5	7	6	3	8	10	6	3	8	2	3	3	1
	1.3.6	Oil spills (drilling, exploitation, transport, processing, storage, shipping).	4	6	9	3	4	12	7	4	4	1	5	2	1
MAC02	2.1.	Shoreline change, due to modification, land reclamation and coastal erosion	9	9	6	12	12	12	3	5	12	1	2	2	4
	2.2.	Disturbance, damage and loss of coastal, watershed and upland habitats													
	2.2.1.	Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)	9	12	12	5	12		9	9	9	0	1	4	3
	2.2.2.	Disturbance, damage and loss of coastal forest habitats	6	10	12			4	8	7	12	0	2	2	3

Main Area of Concern	Issue No.	Issue	OVERALL SEVERITY									SUMMARY			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	1 to 3	4 to 6	7 to 9	10 to 12
	2.2.3.	Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)	11	9	6	10	12	5	5	9	12	0	3	2	4
	2.2.4.	Disturbance, damage and loss of wetland habitats		11	8	8	12	4	5	9	9	0	2	4	2
	2.2.5.	Disturbance, damage and loss of estuarine habitats		8	5		8		4	9	8	0	2	4	0
	2.2.6.	Disturbance, damage and loss of mangrove habitats	4	12	12	10	12	5	7	6	12	0	3	1	5
	2.3.	Disturbance, damage and loss of subtidal benthic habitats													
	2.3.1.	Disturbance, damage and loss of coral reef habitats	10	12	7	12	9	12	10	6	12	0	1	2	6
	2.3.2.	Disturbance, damage and loss of seagrass habitats	4	1		6	10	3	7	3	12	3	2	1	2
	2.3.3.	Disturbance, damage and loss of macroalgal habitats	3	3			10		4	6	3	3	2	0	1
	2.3.4.	Disturbance, damage and loss of soft sediment habitats		4	6		10	3	4	9	11	1	3	1	2
	2.3.5.	Disturbance, damage and loss of deep water habitats (including sea mounts)	3	4	8			9	3	5	8	2	2	3	0
	2.4.	Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)	3	10	7	7	11	9	8	6	11	1	1	4	3
	2.5.	Increase in the occurence of harmful or toxic algal blooms (HABs)	5	6	6	7	4		3	4	5	1	6	1	0
	2.6.	Introduction of exotic non-native species, invasives and nuisance species	3	6	3	8	10		3	7	7	3	1	3	1
MAC03	3.1.	Decline in populations of focal species													
	3.1.1.	Decline in populations of marine mammals	7	7	5	4	10	3	5			1	3	2	1
	3.1.2.	Decline in populations of cetaceans		5	8	9	7	7	2			1	1	4	0
	3.1.3.	Decline in populations of seabirds	7	4		7	7	9	2	7		1	1	5	0
	3.1.4.	Decline in populations of turtles	12	8	10	8	10	8	8	7	5	0	1	5	3

Main Area of Concern	Issue No.	Issue	OVERALL SEVERITY									SUMMARY			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	1 to 3	4 to 6	7 to 9	10 to 12
	3.2.	Decline in populations of commercial fish stocks													
	3.2.1.	Decline in populations of sharks and rays	11	7	10	10	11	10	12	7		0	0	2	6
	3.2.2.	Decline in populations of large pelagics	11	6		11	8	11	12	5		0	2	1	4
	3.2.3.	Decline in populations of small pelagics	9	9			9		9	7	8	0	0	6	0
	3.2.4.	Decline in populations of deep water demersals		3		12	3	8	3	7	7	3	0	3	1
	3.2.5.	Decline in populations of reef and demersal fish	10	12		12	11	11	10	7	9	0	0	2	6
	3.3.	Decline in populations of commercial invertebrates													
	3.3.1.	Decline in populations of molluscs (bivalves, gastropods)	8	7		9	8			6	3	1	1	4	0
	3.3.2.	Decline in populations of abalone								6		0	1	0	0
	3.3.3.	Decline in populations of cephalopods	10	11		8	9	5	3		10	1	1	2	3
	3.3.4.	Decline in populations of sea cucumbers	11	11		8	11	11	3		7	1	0	2	4
	3.3.5.	Decline in populations of sea urchins		9			4					0	1	1	0
	3.3.6.	Decline in populations of prawns and shrimp	9	11	11	11	12		7	5	10	0	1	2	5
	3.3.7.	Decline in populations of lobsters		10		9	7	5	11		3	1	1	2	2
	3.3.8.	Decline in populations of crayfish					3		11			1	0	0	1
	3.3.9.	Decline in populations of crabs	7	7		7	7		4		3	1	1	4	0
	3.4.	Excessive bycatch and discards	9	11		10	9	9	10	6	7	0	1	4	3
	3.5.	Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)	9	10		12	12	10		4		0	1	1	4

Table 15: Prioritization Level 2: Transboundary Scope

Main Area of Concern	Issue No.	Issue	Transboundary Scope									Summary			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	L	M	H	VH
MAC01	1.1.	Alteration of natural river flow and changes in freshwater input and sediment load	3	2	1	4	3	3	2	4	3	1	2	4	2
	1.2.	Degradation of ground and surface water quality	3	2	4	4	2	4	1	3	3	1	2	3	3
	1.3.	Degradation of coastal and marine water quality				`		4							
	1.3.1	Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources	3	1	4	4	2	2	3	3	4	1	2	3	3
	1.3.2	Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources	2	2	4	3	2	3	2	3	2	0	5	3	1
	1.3.3	Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources	2	1	4	3	2	4	1	1	2	3	3	1	2
	1.3.4	Suspended solids in coastal waters due to human activities on land and in the coastal zone	3	2	4	3	2	4	2	1	3	1	3	3	2
	1.3.5	Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources	2	4	4	3	2	4	3	3	4	0	2	3	4
	1.3.6	Oil spills (drilling, exploitation, transport, processing, storage, shipping).	3	1	4	3	1	4	2	2	2	2	3	2	2
MAC02	2.1.	Shoreline change, due to modification, land reclamation and coastal erosion	3	2	1	4	4	4	4	4	4	1	1	1	6
	2.2.	Disturbance, damage and loss of coastal, watershed and upland habitats													
	2.2.1.	Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)	3	4	1	2	4		3	4	3	1	1	3	3
	2.2.2.	Disturbance, damage and loss of coastal forest habitats	2	2	1			1	3	4	3	2	2	2	1

Main Area of Concern	Issue No.	Issue	Transboundary Scope									Summary			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	L	M	H	VH
	2.2.3.	Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)	2	2	1	3	4	1	3	4	4	2	2	2	3
	2.2.4.	Disturbance, damage and loss of wetland habitats		2	1	2	3	2	3	4	3	1	3	3	1
	2.2.5.	Disturbance, damage and loss of estuarine habitats		2	3		4		2	4	3	0	2	2	2
	2.2.6.	Disturbance, damage and loss of mangrove habitats	2	4	4	4	4	4	4	4	4	0	1	0	8
	2.3.	Disturbance, damage and loss of subtidal benthic habitats													
	2.3.1.	Disturbance, damage and loss of coral reef habitats	4	4	4	4	4	4	4	4	4	0	0	0	9
	2.3.2.	Disturbance, damage and loss of seagrass habitats	2	1		2	4	2	3	4	3	1	3	2	2
	2.3.3.	Disturbance, damage and loss of macroalgal habitats	1	1			4		1	4	1	4	0	0	2
	2.3.4.	Disturbance, damage and loss of soft sediment habitats		1	1	2	4	1	3	4	3	3	1	2	2
	2.3.5.	Disturbance, damage and loss of deep water habitats (including sea mounts)		1	3			1	2	4	3	2	1	2	1
	2.4.	Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)		2	4	4	4	4	3	2	3	0	2	2	4
	2.5.	Increase in the occurence of harmful or toxic algal blooms (HABs)	3	2	2	3	4		1	3	3	1	2	4	1
	2.6.	Introduction of exotic non-native species, invasives and nuisance species	3	2	4	4	4		2	3	4	0	2	2	4
MAC03	3.1.	Decline in populations of focal species													
	3.1.1.	Decline in populations of marine mammals	4	3	1	4	4	4	3			1	0	2	4
	3.1.2.	Decline in populations of cetaceans		3	4	4	3	4	3			0	0	3	3
	3.1.3.	Decline in populations of seabirds	4	1		4	4	4	2	2		1	2	0	4
	3.1.4.	Decline in populations of turtles	4	4	4	4	4	4	3	3	3	0	0	3	6

Main Area of Concern	Issue No.	Issue	Transboundary Scope									Summary			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	L	M	H	VH
	3.2.	Decline in populations of commercial fish stocks													
	3.2.1.	Decline in populations of sharks and rays	4	4	1	4	4	4	4	4		1	0	0	7
	3.2.2.	Decline in populations of large pelagics	4	3		4	4	4	4	4		0	0	1	6
	3.2.3.	Decline in populations of small pelagics	3	2			2		3	2	3	0	3	3	0
	3.2.4.	Decline in populations of deep water demersals		1		4	2	2	2	2	3	1	4	1	1
	3.2.5.	Decline in populations of reef and demersal fish	1	4		4	4	2	4	3	3	1	1	2	4
	3.3.	Decline in populations of commercial invertebrates													
	3.3.1.	Decline in populations of molluscs (bivalves, gastropods)	1	4		4	2			3	1	2	1	1	2
	3.3.2.	Decline in populations of abalone								1		1	0	0	0
	3.3.3.	Decline in populations of cephalopods	1	4		2	2	1	3		3	2	2	2	1
	3.3.4.	Decline in populations of sea cucumbers	1	4		1	4	1	3		3	3	0	2	2
	3.3.5.	Decline in populations of sea urchins		1			1					2	0	0	0
	3.3.6.	Decline in populations of prawns and shrimp	1	4	1	3	4		3	3	3	2	0	4	2
	3.3.7.	Decline in populations of lobsters		4		4	2	1	3		1	2	1	1	2
	3.3.8.	Decline in populations of crayfish					1		2			1	1	0	0
	3.3.9.	Decline in populations of crabs	1	1		2	1		3		1	4	1	1	0
	3.4.	Excessive bycatch and discards	2	4		4	4	4	4	3	3	0	1	2	5
	3.5.	Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)	2	4		4	4	1		2		1	2	0	3

Table 16: Prioritization Level 2: Scale of Benefits of finding a solution to the issue

Main Area of Concern	Issue No.	Issue	Scale of Benefits									Summary			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	L	M	H	VH
MAC01	1.1.	Alteration of natural river flow and changes in freshwater input and sediment load	3	2	2	4	3	4	2	2	3	0	4	3	2
	1.2.	Degradation of ground and surface water quality	3	2	4	4	3	3	2	3	4	0	2	4	3
	1.3.	Degradation of coastal and marine water quality													
	1.3.1	Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources	3	2	4	4	4	2	2	1	3	1	3	2	3
	1.3.2	Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources	2	3	4	3	3	3	4	1	2	1	2	4	2
	1.3.3	Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources	3	2	4	3	4	4	2	1	2	1	3	2	3
	1.3.4	Suspended solids in coastal waters due to human activities on land and in the coastal zone	2	3	4	4	3	3	2	1	4	1	2	3	3
	1.3.5	Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources	4	3	4	4	4	4	4	1	3	1	0	2	6
	1.3.6	Oil spills (drilling, exploitation, transport, processing, storage, shipping).	4	3	4	4	2	4	4	2	3	0	2	2	5
MAC02	2.1.	Shoreline change, due to modification, land reclamation and coastal erosion	3	3	1	4	4	4	4	4	4	1	0	2	6
	2.2.	Disturbance, damage and loss of coastal, watershed and upland habitats													
	2.2.1.	Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)	2	4	1	3	4		3	4	3	1	1	3	3
	2.2.2.	Disturbance, damage and loss of coastal forest habitats	2	3	4			1	3	4	3	1	1	3	2

Main Area of Concern	Issue No.	Issue	Scale of Benefits									Summary			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	L	M	H	VH
	2.2.3.	Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)	2	4	1	4	4	1	3	4	4	2	1	1	5
	2.2.4.	Disturbance, damage and loss of wetland habitats		4	3	4	2	3	3	4	3	0	1	4	3
	2.2.5.	Disturbance, damage and loss of estuarine habitats		2	1		3		2	4	3	1	2	2	1
	2.2.6.	Disturbance, damage and loss of mangrove habitats	2	4	4	4	4	4	3	4	4	0	1	1	7
	2.3.	Disturbance, damage and loss of subtidal benthic habitats													
	2.3.1.	Disturbance, damage and loss of coral reef habitats	3	4	4	4	3	4	3	4	4	0	0	3	6
	2.3.2.	Disturbance, damage and loss of seagrass habitats	2	1		2	3	1	3	4	3	2	2	3	1
	2.3.3.	Disturbance, damage and loss of macroalgal habitats	1	1			3		1	3	1	4	0	2	0
	2.3.4.	Disturbance, damage and loss of soft sediment habitats		2	1	2	3	1	2	4	3	2	3	2	1
	2.3.5.	Disturbance, damage and loss of deep water habitats (including sea mounts)		2	3			1	2	1	3	2	2	2	0
	2.4.	Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)		2	4	4	3	4	3	2	4	0	2	2	4
	2.5.	Increase in the occurence of harmful or toxic algal blooms (HABs)	3	3	1	3	3		2	3	2	1	2	5	0
	2.6.	Introduction of exotic non-native species, invasives and nuisance species	4	4	4	4	3		2	3	3	0	1	3	4
MAC03	3.1.	Decline in populations of focal species													
	3.1.1.	Decline in populations of marine mammals	4	4	1	4	4	3	3			1	0	2	4
	3.1.2.	Decline in populations of cetaceans		3	3	4	4	4	3			0	0	3	3
	3.1.3.	Decline in populations of seabirds	4	3		3	3	2	2	1		1	2	3	1

Main Area of Concern	Issue No.	Issue	Scale of Benefits									Summary			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	L	M	H	VH
	3.1.4.	Decline in populations of turtles	4	3	2	4	4	3	3	2	2	0	3	3	3
	3.2.	Decline in populations of commercial fish stocks													
	3.2.1.	Decline in populations of sharks and rays	4	3	2	4	4	4	4	2		0	2	1	5
	3.2.2.	Decline in populations of large pelagics	4	3		4	4	4	4	3		0	0	2	5
	3.2.3.	Decline in populations of small pelagics	4	2			4		3	2	4	0	2	1	3
	3.2.4.	Decline in populations of deep water demersals		1		4	2	3	2	2	2	1	4	1	1
	3.2.5.	Decline in populations of reef and demersal fish	3	4		4	4	3	4	3	3	0	0	4	4
	3.3.	Decline in populations of commercial invertebrates													
	3.3.1.	Decline in populations of molluscs (bivalves, gastropods)	3	3		4	2			3	1	1	1	3	1
	3.3.2.	Decline in populations of abalone								2		0	1	0	0
	3.3.3.	Decline in populations of cephalopods	2	3		4	3	2	3		3	0	2	4	1
	3.3.4.	Decline in populations of sea cucumbers	3	3		4	4	1	3		3	1	0	4	2
	3.3.5.	Decline in populations of sea urchins		1			2					1	1	0	0
	3.3.6.	Decline in populations of prawns and shrimp	3	3	1	4	4		3	3	3	1	0	5	2
	3.3.7.	Decline in populations of lobsters		3		4	3	1	3		1	2	0	3	1
	3.3.8.	Decline in populations of crayfish					1		2			1	1	0	0
	3.3.9.	Decline in populations of crabs	3	3		2	3		2		1	1	2	3	0
	3.4.	Excessive bycatch and discards	3	3		4	4	4	4	3	3	0	0	4	4
	3.5.	Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)	3	3		4	4	2		2		0	2	2	2

Table 17: Prioritization Level 2: Feasibility of finding a solution to the issue

Main Area of Concern	Issue No.	Issue	Feasibility									Summary			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	L	M	H	VH
MAC01	1.1.	Alteration of natural river flow and changes in freshwater input and sediment load	3	4	2	2	3	1	2	2	2	1	5	2	1
	1.2.	Degradation of ground and surface water quality	3	2	4	2	1	2	2	2	2	1	6	1	1
	1.3.	Degradation of coastal and marine water quality													
	1.3.1	Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources	4	4	4	3	3	2	2	2	2	0	4	2	3
	1.3.2	Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources	4	4	2	2	2	2	2	2	2	0	7	0	2
	1.3.3	Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources	4	4	2	3	3	1	2	2	2	1	4	2	2
	1.3.4	Suspended solids in coastal waters due to human activities on land and in the coastal zone	3	2	2	2	3	1	2	3	2	1	5	3	0
	1.3.5	Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources	4	4	2	4	3	1	3	3	3	1	1	4	3
	1.3.6	Oil spills (drilling, exploitation, transport, processing, storage, shipping).	4	2	3	2	1	2	4	1	3	2	3	2	2
MAC02	2.1.	Shoreline change, due to modification, land reclamation and coastal erosion	2	4	4	2	2	4	2	1	2	1	5	0	3
	2.2.	Disturbance, damage and loss of coastal, watershed and upland habitats													
	2.2.1.	Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)	3	4	4	2	1		2	1	3	2	2	2	2
	2.2.2.	Disturbance, damage and loss of coastal forest habitats	3	4	4			1	2	3	3	1	1	3	2
	2.2.3.	Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)	2	4	3	2	3	4	2	2	3	0	4	3	2
	2.2.4.	Disturbance, damage and loss of wetland habitats		4	2	2	2	3	2	2	3	0	5	2	1
	2.2.5.	Disturbance, damage and loss of estuarine habitats		1	1		2		2	2	2	2	4	0	0

Main Area of Concern	Issue No.	Issue	Feasibility									Summary			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	L	M	H	VH
	2.2.6.	Disturbance, damage and loss of mangrove habitats	2	2	4	2	3	4	2	3	4	0	4	2	3
	2.3.	Disturbance, damage and loss of subtidal benthic habitats													
	2.3.1.	Disturbance, damage and loss of coral reef habitats	3	2	4	1	1	4	2	2	3	2	3	2	2
	2.3.2.	Disturbance, damage and loss of seagrass habitats	2	4		2	3	4	2	2	3	0	4	2	2
	2.3.3.	Disturbance, damage and loss of macroalgal habitats	1	1			3		2	3	3	2	1	3	0
	2.3.4.	Disturbance, damage and loss of soft sediment habitats		1	1	2	3	3	2	2	3	2	3	3	0
	2.3.5.	Disturbance, damage and loss of deep water habitats (including sea mounts)		1	2			3	2	2	3	1	3	2	0
	2.4.	Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)		2	4	2	2	1	2	2	3	1	5	1	1
	2.5.	Increase in the occurence of harmful or toxic algal blooms (HABs)	3	4	1	2	4		1	1	3	3	1	2	2
	2.6.	Introduction of exotic non-native species, invasives and nuisance species	4	4	4	2	3		2	1	2	1	3	1	3
MAC03	3.1.	Decline in populations of focal species													
	3.1.1.	Decline in populations of marine mammals	3	2	4	3	3	1	2			1	2	3	1
	3.1.2.	Decline in populations of cetaceans		2	1	3	3	2	2			1	3	2	0
	3.1.3.	Decline in populations of seabirds	3	2		3	3	1	2	2		1	3	3	0
	3.1.4.	Decline in populations of turtles	4	1	3	3	4	2	2	3	2	1	3	3	2
	3.2.	Decline in populations of commercial fish stocks													
	3.2.1.	Decline in populations of sharks and rays	3	1	1	3	2	3	2	3		2	2	4	0
	3.2.2.	Decline in populations of large pelagics	4	3		4	3	2	2	3		0	2	3	2
	3.2.3.	Decline in populations of small pelagics	4	3			3		2	3	3	0	1	4	1

Main Area of Concern	Issue No.	Issue	Feasibility									Summary			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	L	M	H	VH
	3.2.4.	Decline in populations of deep water demersals		1		4	4	2	2	3	2	1	3	1	2
	3.2.5.	Decline in populations of reef and demersal fish	3	1		4	2	1	2	2	3	2	3	2	1
	3.3.	Decline in populations of commercial invertebrates													
	3.3.1.	Decline in populations of molluscs (bivalves, gastropods)	2	1		4	2			2	2	1	4	0	1
	3.3.2.	Decline in populations of abalone								2		0	1	0	0
	3.3.3.	Decline in populations of cephalopods	2	1		3	3	2	3		3	1	2	4	0
	3.3.4.	Decline in populations of sea cucumbers	2	1		3	1	3	2		3	2	2	3	0
	3.3.5.	Decline in populations of sea urchins		3			4					0	0	1	1
	3.3.6.	Decline in populations of prawns and shrimp	3	2	4	3	4		2	2	3	0	3	3	2
	3.3.7.	Decline in populations of lobsters		1		3	4	3	2		2	1	2	2	1
	3.3.8.	Decline in populations of crayfish					4		2			0	1	0	1
	3.3.9.	Decline in populations of crabs	3	1		2	2		2		1	2	3	1	0
	3.4.	Excessive bycatch and discards	3	1		3	2	2	3	2	3	1	3	4	0
	3.5.	Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)	3	2		2	3	3		3		0	2	4	0

Table 18: Prioritization Level 2: Overall Scope

Main Area of Concern	Issue No.	Issue	OVERALL SCOPE									SUMMARY			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	1 to 3	4 to 6	7 to 9	10 to 12
MAC01	1.1.	Alteration of natural river flow and changes in freshwater input and sediment load	9	8	5	10	9	8	6	8	8	0	2	6	1
	1.2.	Degradation of ground and surface water quality	9	6	12	10	6	9	5	8	9	0	3	4	2
	1.3.	Degradation of coastal and marine water quality													
	1.3.1	Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources	10	7	12	11	9	6	7	6	9	0	2	4	3
	1.3.2	Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources	8	9	10	8	7	8	8	6	6	0	2	6	1
	1.3.3	Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources	9	7	10	9	9	9	5	4	6	0	3	5	1
	1.3.4	Suspended solids in coastal waters due to human activities on land and in the coastal zone	8	7	10	9	8	8	6	5	9	0	2	6	1
	1.3.5	Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources	10	11	10	11	9	9	10	7	10	0	0	3	6
	1.3.6	Oil spills (drilling, exploitation, transport, processing, storage, shipping).	11	6	11	9	4	10	10	5	8	0	3	2	4
MAC02	2.1.	Shoreline change, due to modification, land reclamation and coastal erosion	8	9	6	10	10	12	10	9	10	0	1	3	5
	2.2.	Disturbance, damage and loss of coastal, watershed and upland habitats													
	2.2.1.	Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)	8	12	6	7	9		8	9	9	0	1	6	1
	2.2.2.	Disturbance, damage and loss of coastal forest habitats	7	9	9			3	8	11	9	1	0	5	1
	2.2.3.	Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)	6	10	5	9	11	6	8	10	11	0	3	2	4
	2.2.4.	Disturbance, damage and loss of wetland habitats		10	6	8	7	8	8	10	9	0	1	5	2

Main Area of Concern	Issue No.	Issue	OVERALL SCOPE									SUMMARY			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	1 to 3	4 to 6	7 to 9	10 to 12
	2.2.5.	Disturbance, damage and loss of estuarine habitats		5	5		9		6	10	8	0	3	2	1
	2.2.6.	Disturbance, damage and loss of mangrove habitats	6	10	12	10	11	12	9	11	12	0	1	1	7
	2.3.	Disturbance, damage and loss of subtidal benthic habitats													
	2.3.1.	Disturbance, damage and loss of coral reef habitats	10	10	12	9	8	12	9	10	11	0	0	3	6
	2.3.2.	Disturbance, damage and loss of seagrass habitats	6	1	12	6	10	7	8	10	9	1	2	3	3
	2.3.3.	Disturbance, damage and loss of macroalgal habitats	3	3			10		4	10	5	2	2	0	2
	2.3.4.	Disturbance, damage and loss of soft sediment habitats		4	3	6	10	5	7	10	9	1	3	2	2
	2.3.5.	Disturbance, damage and loss of deep water habitats (including sea mounts)		4	8			5	6	7	9	0	3	3	0
	2.4.	Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)		6	12	10	9	9	8	6	10	0	2	3	3
	2.5.	Increase in the occurence of harmful or toxic algal blooms (HABs)	3	9	4	8	11		4	7	8	1	2	4	1
	2.6.	Introduction of exotic non-native species, invasives and nuisance species	4	10	12	10	10		6	7	9	0	2	2	4
MAC03	3.1.	Decline in populations of focal species													
	3.1.1.	Decline in populations of marine mammals	11	9	6	11	11	8	8			0	1	3	3
	3.1.2.	Decline in populations of cetaceans		8	8	11	10	10	8			0	0	3	3
	3.1.3.	Decline in populations of seabirds	11	6		10	10	7	6	5		0	3	1	3
	3.1.4.	Decline in populations of turtles	12	8	9	11	12	9	8	8	7	0	0	6	3
	3.2.	Decline in populations of commercial fish stocks													
	3.2.1.	Decline in populations of sharks and rays	11	8	4	11	10	11	10	9		0	1	2	5
	3.2.2.	Decline in populations of large pelagics	12	9		12	11	10	10	10		0	0	1	6

Main Area of Concern	Issue No.	Issue	OVERALL SCOPE									SUMMARY			
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	1 to 3	4 to 6	7 to 9	10 to 12
	3.2.3.	Decline in populations of small pelagics	11	7			9		8	7	10	0	0	4	2
	3.2.4.	Decline in populations of deep water demersals		3		12	8	7	6	7	7	1	1	4	1
	3.2.5.	Decline in populations of reef and demersal fish	7	9		12	10	6	10	8	9	0	1	4	3
	3.3.	Decline in populations of commercial invertebrates													
	3.3.1.	Decline in populations of molluscs (bivalves, gastropods)	6	8		12	6			8	4	0	3	2	1
	3.3.2.	Decline in populations of abalone								5		0	1	0	0
	3.3.3.	Decline in populations of cephalopods	5	8		9	8	5	9		9	0	2	5	0
	3.3.4.	Decline in populations of sea cucumbers	6	8		8	9	5	8		9	0	2	5	0
	3.3.5.	Decline in populations of sea urchins		5			7					0	1	1	0
	3.3.6.	Decline in populations of prawns and shrimp	7	9	6	10	12		8	8	9	0	1	5	2
	3.3.7.	Decline in populations of lobsters		8		11	9	5	8		4	0	2	3	1
	3.3.8.	Decline in populations of crayfish					6		6			0	2	0	0
	3.3.9.	Decline in populations of crabs	7	5		6	6		7		3	1	3	2	0
	3.4.	Excessive bycatch and discards	8	8		11	10	10	11	8	9	0	0	4	4
	3.5.	Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)	8	9		10	11	6		7		0	1	3	2

Table 19: Prioritization Level 2: Overall Ranking

Main Area of Concern	Issue No.	Issue	OVERALL RANKING									SUMMARY	
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	No. above average	% above average
MAC01	1.1.	Alteration of natural river flow and changes in freshwater input and sediment load	15	17	15	13	19	18	12	19	20	7	77.8
	1.2.	Degradation of ground and surface water quality	12	12	19	13	15	16	14	19	18	5	55.6
	1.3.	Degradation of coastal and marine water quality											
	1.3.1	Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources	16	10	24	14	15	14	16	10	15	5	55.6
	1.3.2	Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources	11	15	15	11	12	17	15	10	12	2	22.2
	1.3.3	Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources	12	11	18	12	12	15	17	7	11	1	11.1
	1.3.4	Suspended solids in coastal waters due to human activities on land and in the coastal zone	11	13	17	12	15	17	10	8	17	2	22.2
	1.3.5	Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources	15	18	16	14	17	19	16	10	18	7	77.8
	1.3.6	Oil spills (drilling, exploitation, transport, processing, storage, shipping).	15	12	20	12	8	22	17	9	12	4	44.4
MAC02	2.1.	Shoreline change, due to modification, land reclamation and coastal erosion	17	18	12	22	22	24	13	14	22	7	77.8
	2.2.	Disturbance, damage and loss of coastal, watershed and upland habitats											
	2.2.1.	Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)	17	24	18	12	21		17	18	18	6	75.0
	2.2.2.	Disturbance, damage and loss of coastal forest habitats	13	19	21			7	16	18	21	6	85.7
	2.2.3.	Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)	17	19	11	19	23	11	13	19	23	7	77.8

Main Area of Concern	Issue No.	Issue	OVERALL RANKING									SUMMARY	
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	No. above average	% above average
	2.2.4.	Disturbance, damage and loss of wetland habitats		21	14	16	19	12	13	19	18	3	37.5
	2.2.5.	Disturbance, damage and loss of estuarine habitats		13	10		17		10	19	16	1	16.7
	2.2.6.	Disturbance, damage and loss of mangrove habitats	10	22	24	20	23	17	16	17	24	8	88.9
	2.3.	Disturbance, damage and loss of subtidal benthic habitats											
	2.3.1.	Disturbance, damage and loss of coral reef habitats	20	22	19	21	17	24	19	16	23	8	88.9
	2.3.2.	Disturbance, damage and loss of seagrass habitats	10	2	12	12	20	10	15	13	21	3	33.3
	2.3.3.	Disturbance, damage and loss of macroalgal habitats	6	6			20		8	16	8	2	33.3
	2.3.4.	Disturbance, damage and loss of soft sediment habitats		8	9	6	20	8	11	19	20	3	37.5
	2.3.5.	Disturbance, damage and loss of deep water habitats (including sea mounts)	3	8	16			14	9	12	17	1	14.3
	2.4.	Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)	3	16	19	17	20	18	16	12	21	7	77.8
	2.5.	Increase in the occurence of harmful or toxic algal blooms (HABs)	8	15	10	15	15		7	11	13	0	0.0
	2.6.	Introduction of exotic non-native species, invasives and nuisance species	7	16	15	18	20		9	14	16	2	25.0
MAC03	3.1.	Decline in populations of focal species											
	3.1.1.	Decline in populations of marine mammals	18	16	11	15	21	11	13			2	28.6
	3.1.2.	Decline in populations of cetaceans		13	16	20	17	17	10			3	50.0
	3.1.3.	Decline in populations of seabirds	18	10		17	17	16	8	12		1	14.3
	3.1.4.	Decline in populations of turtles	24	16	19	19	22	17	16	15	12	6	66.7
	3.2.	Decline in populations of commercial fish stocks											
	3.2.1.	Decline in populations of sharks and rays	22	15	14	21	21	21	22	16		7	87.5

Main Area of Concern	Issue No.	Issue	OVERALL RANKING									SUMMARY	
			Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	No. above average	% above average
	3.2.2.	Decline in populations of large pelagics	23	15		23	19	21	22	15		6	85.7
	3.2.3.	Decline in populations of small pelagics	20	16			18		17	14	18	5	83.3
	3.2.4.	Decline in populations of deep water demersals				24	11	15	9	14	14	3	50.0
	3.2.5.	Decline in populations of reef and demersal fish	17	21		24	21	17	20	15	18	7	87.5
	3.3.	Decline in populations of commercial invertebrates											
	3.3.1.	Decline in populations of molluscs (bivalves, gastropods)	14	15		21	14			14	7	2	33.3
	3.3.2.	Decline in populations of abalone								11		0	0.0
	3.3.3.	Decline in populations of cephalopods	15	19		17	17	10	12		19	2	28.5
	3.3.4.	Decline in populations of sea cucumbers	17	19		16	20	16	11		16	4	57.1
	3.3.5.	Decline in populations of sea urchins		14			11					0	0.0
	3.3.6.	Decline in populations of prawns and shrimp	16	20	17	21	24		15	13	19	5	62.5
	3.3.7.	Decline in populations of lobsters		18		20	16	10	19		7	3	50.0
	3.3.8.	Decline in populations of crayfish					9		17			1	50.0
	3.3.9.	Decline in populations of crabs	14	12		13	13		11		6	0	0.0
	3.4.	Excessive bycatch and discards	17	19		21	19	19	21	14	16	7	87.5
	3.5.	Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)	17	19		22	23	16		11		4	66.7

8.1.3 Group Work Session 3 & 4: Impact and Causal Chain Analysis

Collectively the countries completed impact and causal chain analyses for 29 of the 43 issues (67.4 %) included in the Draft Issues Framework. The impact and causal chain analyses completed by each of the countries is shown in Table 20 and the diagrams illustrating these analyses are presented in Annex 6.

The number of issues for which impact and causal chain analyses were completed by each country ranged from 1 and 12 issues. Some countries managed to complete more chains. These were often the countries where the meeting participants had some previous experience of CCA, or where there was no language challenges.

Following is a short summary of the chains completed by each country as included in Annex 6:

- **Comoros** prepared impact and causal chains for 3 of their top priority issues, one within each of the MACs, including: solid wastes (1.3.5), coral reef habitats (2.3.1), and large pelagics (3.2.2).
- **Kenya** prepared impact and causal chains for 9 of their top priority issues including: 3 impact and causal chains for MAC01 issues degradation of ground and surface water (1.2), nutrient enrichment (1.3.2) and solid wastes (1.3.5); an impact chain for mangrove (2.2.6) and an impact and causal chain for coral reefs (2.3.1); 4 impact and causal chains for MAC03 issues reef and demersal fish (3.2.5), prawn and shrimp (3.3.6), bycatch (3.4) and, mariculture (3.5).
- **Madagascar** prepared chains for 12 of their top priority issues including: two causal chains in MAC01 for alteration of river flow (1.1) and oil spills (1.3.6); 4 causal chains in MAC02 for coastal forests (2.2.2), mangroves (2.2.6), coral reef (2.3.1) and pelagic (2.4) habitats and; 6 impact and causal chains in MAC03, including marine mammals (3.1.1), cetaceans (3.1.2), sea turtles (3.1.4), sharks and rays (3.2.1), sea cucumbers (3.2.4), and prawn and shrimp (3.3.6).
- **Mauritius** prepared impact and causal chains for 12 of their top priority issues including: 3 impact and causal chains for MAC01 issues, microbial contamination (1.3.1), nutrient enrichment (1.3.2), chemical contamination (1.3.3); four impact and causal chains for MAC02 issues, shoreline change (2.1), mangroves (2.2.6), coral reefs (2.3.1) and exotics (2.6) and; 5 impact and causal chains for MAC03 issues, cetaceans (3.1.2), large pelagics (3.2.2), reef and demersal fish (3.2.5), sea cucumbers (3.3.4), and mariculture (3.5).
- **Mozambique** prepared chains for 10 issues including: 3 impact and causal chains for MAC01 issues, alteration of river flows (1.1), degradation of ground and surface water (1.2), solid wastes (1.3.5); 2 impact and causal chains for MAC02 issues shoreline change (2.1) and mangrove (2.2.6) and one causal chain for upland / watershed habitats (2.2.1) and; 3 impact and causal chains for MAC03, turtles (3.1.4), reef and demersal fish (3.2.5) and prawn and shrimp (3.3.6).
- **Seychelles** prepared chains for 12 of their top priority issues including: two impact and causal chains for MAC01 issues alteration of river flows (1.1) and oil spills (1.3.6); impact chains for 5 MAC02 issues, shoreline change (2.1), coastal forests (2.2.2), coastal habitats (2.2.3), mangroves (2.2.6), coral reefs (2.3.1) and one causal chain for coral reefs (2.3.1) and; two impact chains for cetaceans (3.1.2) and mariculture (3.5), and 3 impact and causal chains for large pelagics (3.2.2), sea cucumbers (3.3.4), and bycatch (3.4).
- **Somalia** completed an impact and causal chains for 1 of their top priority issues, lobster (3.3.7).
- **South Africa** prepared chains for 7 issues including: 2 impact and causal chains for MAC01 issues alteration of natural river flows (1.1) and degradation of ground and

surface water (1.2); 3 impact and causal chains for MAC02 issues, coastal habitats (2.2.3), wetlands (2.2.4) and soft sediment habitats (2.3.4) and; two impact and causal chains for MAC03 issues sharks and rays (3.2.1) and reef and demersal fish (3.2.5).

- **Tanzania** prepared chains for 7 issues including: one impact and causal chain for MAC01 issue alteration of river flows (1.1); two impact and causal chains for MAC02 issues, shoreline change (2.1), and coral reefs (2.3.1) and, one impact chain for coastal forests and; three impact and causal chains for MAC03 issues, small pelagics (3.2.3), prawn and shrimp (3.3.6) and, bycatch (3.4).

The 14 issues for which chains were not prepared included:

- 1.3.4 Suspended solids in coastal waters due to human activities on land and in the coastal zone
- 2.2.5. Disturbance, damage and loss of estuarine habitats
- 2.3.2. Disturbance, damage and loss of seagrass habitats
- 2.3.3. Disturbance, damage and loss of macroalgal habitats
- 2.3.5. Disturbance, damage and loss of deep water habitats (including sea mounts)
- 2.5. Increase in the occurrence of harmful or toxic algal blooms (HABs)
- 3.1.3. Declines in populations of seabirds
- 3.2.4. Declines in populations of deep water demersals
- 3.3.1. Declines in populations of molluscs (bivalves, gastropods)
- 3.3.2. Declines in populations of abalone
- 3.3.3. Declines in populations of cephalopods
- 3.3.5. Declines in populations of sea urchins
- 3.3.8. Declines in populations of crayfish
- 3.3.9. Declines in populations of crabs

None of these issues were identified as high priority issues by more than half the countries at the during the National CCA meetings.

8.1.4 Summary of National Causal Chain Analysis Results

Table 21 summarises the results from the National CCA Meetings. The table shows the 'Relevance' from before the meetings as originally identified from the MEDA, and the 'Relevance' of the issues as validated by the countries during the meetings. It also shows some of the results from the Level 1 and Level 2 prioritisation exercises, including the 'Importance', the availability of 'Baseline' data, the existence of 'Monitoring' programmes.

Table 20 Issues for which Impact and Causal Chain diagrams have been prepared during the national CCA meetings (see Annex 6 for diagrams)

Major Area of Concern	Issue no.	Issue	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	Causal Chain Analysis
MAC01. Water quality degradation	1.1.	Alteration of natural river flow and changes in freshwater input and sediment load			✓		✓	✓		✓	✓	5
	1.2.	Degradation of ground and surface water quality		✓			✓			✓		3
	1.3.	Degradation of coastal and marine water quality										
	1.3.1	Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources				✓						1
	1.3.2	Nutrient enrichment from land-based (domestic , industrial, agriculture, livestock) and marine (mariculture) sources		✓		✓						2
	1.3.3	Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources				✓						1
	1.3.4	Suspended solids in coastal waters due to human activities on land and in the coastal zone										0
	1.3.5	Solid wastes / marine debris (plastics etc.) from shipping and land-based-sources	✓	✓			✓					3
	1.3.6	Oil spills (drilling, exploitation, transport, processing, storage, shipping).			✓			✓				2
MAC02: Habitat and community modification	2.1.	Shoreline change, due to modification, land reclamation and coastal erosion				✓	✓	✓			✓	4
	2.2.	Disturbance, damage and loss of coastal, watershed and upland habitats										
	2.2.1.	Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)					✓					1
	2.2.2.	Disturbance, damage and loss of coastal forest habitats			✓			✓			✓	3
	2.2.3.	Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)						✓		✓		2
	2.2.4.	Disturbance, damage and loss of wetland habitats								✓		1
	2.2.5.	Disturbance, damage and loss of estuarine habitats										0
	2.2.6.	Disturbance, damage and loss of mangrove habitats		✓	✓	✓	✓	✓				5
	2.3.	Disturbance, damage and loss of subtidal benthic habitats										

Major Area of Concern	Issue no.	Issue	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	Causal Chain Analysis
	2.3.1.	Disturbance, damage and loss of coral reef habitats	✓	✓	✓	✓		✓			✓	6
	2.3.2.	Disturbance, damage and loss of seagrass habitats										0
	2.3.3.	Disturbance, damage and loss of macroalgal habitats										0
	2.3.4.	Disturbance, damage and loss of soft sediment habitats								✓		1
	2.3.5.	Disturbance, damage and loss of deep water habitats (including sea mounts)										0
	2.4.	Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)			✓							1
	2.5.	Increase in the occurrence of harmful or toxic algal blooms (HABs)										0
	2.6.	Introduction of exotic non-native species, invasives and nuisance species				✓						1
MAC03: Declines in living marine resources	3.1.	Decline in populations of focal species										
	3.1.1.	Decline in populations of marine mammals			✓					✓		2
	3.1.2.	Decline in populations of cetaceans			✓	✓		✓				3
	3.1.3.	Decline in populations of seabirds										0
	3.1.4.	Decline in populations of turtles			✓		✓					2
	3.2.	Decline in populations of commercial fish stocks										
	3.2.1.	Decline in populations of sharks and rays			✓							1
	3.2.2.	Decline in populations of large pelagics	✓			✓		✓				3
	3.2.3.	Decline in populations of small pelagics									✓	1
	3.2.4.	Decline in populations of deep water demersals										0
	3.2.5.	Decline in populations of reef and demersal fish		✓		✓	✓			✓		4
	3.3.	Decline in populations of commercial invertebrates										
	3.3.1.	Decline in populations of molluscs (bivalves, gastropods)										0
	3.3.2.	Decline in populations of abalone										0
	3.3.3.	Decline in populations of cephalopods										0

Major Area of Concern	Issue no.	Issue	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	Causal Chain Analysis
	3.3.4.	Decline in populations of sea cucumbers			✓	✓		✓				3
	3.3.5.	Decline in populations of sea urchins										0
	3.3.6.	Decline in populations of prawns and shrimp		✓	✓		✓				✓	4
	3.3.7.	Decline in populations of lobsters							✓			1
	3.3.8.	Decline in populations of crayfish										0
	3.3.9.	Decline in populations of crabs										0
	3.4.	Excessive bycatch and discards		✓				✓			✓	3
	3.5.	Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)		✓		✓		✓				3
MAC04: Unpredictable Environmental Variability and Extreme Events	4.1.	Climate hazards and extreme weather events (cyclones, storms, rainfall, coastal flooding)										0
	4.2.	Sea level change										0
	4.3.	Ocean acidification										0
	4.4.	Changes in seawater temperatures										0
	4.5.	Changes to hydrodynamics and ocean circulation										0
	4.6.	Changes in productivity (shifts in primary and secondary production)										0
	4.7.	Geohazards (tsunamis, volcanic eruptions, earthquakes)										0

Table 21: Summary of National Casual Chain Analysis meeting results (number of countries), showing the 'Relevance' of the issues before (from the MEDAs) and after the meetings, the results of the Level 1 Prioritisation, including the 'Importance', availability of 'Baseline' data and existence of 'Monitoring' programmes, the results of the Level 2 Prioritisation and the number of impact and causal chain analyses completed for each issue.

			Relevance				Level 1 Importance			Baseline data					Monitoring					Level 2 Priority		
Main Area of Concern	No.	Issue	Before (8 x MEDAs)	Relevant now	Relevant future	Not relevant	High	Medium	Low	Yes	Partial	No	Not relevant	Unknown	Yes	Partial	No	Not relevant	Unknown	No. above average	% above average	Number of CCA
MAC01.	1.1.	Alteration of natural river flow and changes in freshwater input and sediment load	8	9	0	0	6	2	1	8	0	1	0	0	5	2	2	0	0	7	77.8	5
	1.2.	Degradation of ground and surface water quality	7	8	1	0	6	2	1	6	0	3	0	0	4	2	3	0	0	5	55.6	3
	1.3.	Degradation of coastal and marine water quality	8																			
	1.3.1	Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources	6	9	0	0	2	5	2	5	1	3	0	0	0	4	5	0	0	5	55.6	1
	1.3.2	Nutrient enrichment from land-based (domestic, industrial, agriculture, livestock) and marine (mariculture) sources	7	8	1	0	4	2	3	4	1	3	0	1	3	1	5	0	0	2	22.2	2
	1.3.3	Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources	7	9	0	0	2	5	2	5	1	3	0	0	2	1	6	0	0	1	11.1	1
	1.3.4	Suspended solids in coastal waters due to human activities on land and in the coastal zone	7	9	0	0	4	4	1	3	2	4	0	0	0	3	6	0	0	2	22.2	0
	1.3.5	Solid wastes / marine debris (plastics	6	9	0	0	6	2	1	5	1	3	0	0	1	3	5	0	0	7	77.8	3

Main Area of Concern	No.	Issue	Relevance				Level 1 Importance			Baseline data					Monitoring					Level 2 Priority		
			Before (8 x MEDAs)	Relevant now	Relevant future	Not relevant	High	Medium	Low	Yes	Partial	No	Not relevant	Unknown	Yes	Partial	No	Not relevant	Unknown	No. above average	% above average	Number of CCA
		etc.) from shipping and land-based-sources																				
	1.3.6	Oil spills (drilling, exploitation, transport, processing, storage, shipping).	8	9	0	0	6	2	1	5	0	4	0	0	2	1	6	0	0	4	44.4	2
MAC02	2.1.	Shoreline change, due to modification, land reclamation and coastal erosion	8	9	0	0	6	2	1	6	2	1	0	0	2	3	4	0	0	7	77.8	4
	2.2.	Disturbance, damage and loss of coastal, watershed and upland habitats																				
	2.2.1.	Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)	5	8	0	1	7	1	0	7	2	0	0	0	2	1	2	1	3	6	75.0	1
	2.2.2.	Disturbance, damage and loss of coastal forest habitats	4	7	0	2	5	3	0	7	0	0	1	1	2	3	1	1	2	6	85.7	3
	2.2.3.	Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)	8	9	0	0	9	0	0	4	1	1	0	3	0	2	5	0	2	7	77.8	2
	2.2.4.	Disturbance, damage and loss of wetland habitats	3	7	1	1	5	3	0	6	1	0	1	1	1	2	4	0	2	3	37.5	1
	2.2.5.	Disturbance, damage and loss of estuarine habitats	3	6	0	3	5	1	0	4	1	0	3	1	1	1	3	2	2	1	16.7	0
	2.2.6.	Disturbance, damage and loss of mangrove habitats	7	9	0	0	6	0	3	7	2	0	0	0	3	1	4	0	1	8	88.9	5
	2.3.	Disturbance, damage and loss of subtidal benthic habitats																				

Main Area of Concern	No.	Issue	Relevance				Level 1 Importance			Baseline data					Monitoring					Level 2 Priority		
			Before (8 x MEDAs)	Relevant now	Relevant future	Not relevant	High	Medium	Low	Yes	Partial	No	Not relevant	Unknown	Yes	Partial	No	Not relevant	Unknown	No. above average	% above average	Number of CCA
	2.3.1.	Disturbance, damage and loss of coral reef habitats	8	9	0	0	8	1	0	8	1	0	0	0	5	1	2	0	1	8	88.9	6
	2.3.2.	Disturbance, damage and loss of seagrass habitats	7	9	0	0	5	2	2	6	1	2	0	0	2	2	4	0	1	3	33.3	0
	2.3.3.	Disturbance, damage and loss of macroalgal habitats	1	7	0	2	0	5	2	6	0	1	2	0	0	1	3	2	3	2	33.3	0
	2.3.4.	Disturbance, damage and loss of soft sediment habitats	8	8	0	1	3	4	1	1	1	4	1	2	1	0	6	1	1	3	37.5	1
	2.3.5.	Disturbance, damage and loss of deep water habitats (including sea mounts)	2	4	1	4	3	0	2	1	1	3	4	0	0	0	3	4	2	1	14.3	0
	2.4.	Disturbance, damage and degradation of pelagic habitats (nearshore<30 m, neritic 30-200m and oceanic >200m depth)	6	6	2	1	6	1	1	4	1	3	1	0	2	1	5	1	0	7	77.8	1
	2.5.	Increase in the occurrence of harmful or toxic algal blooms (HABs)	6	8	0	1	4	3	1	6	1	1	1	0	3	0	3	1	2	0	0.0	0
	2.6.	Introduction of exotic non-native species, invasives and nuisance species	8	7	1	1	3	3	2	2	1	3	1	2	2	0	4	1	2	2	25.0	1
MAC03	3.1.	Declines in populations of focal species																				
	3.1.1.	Declines in populations of marine mammals	8	6	1	2	5	2	0	3	2	2	2	0	2	1	4	2	0	2	28.6	2
	3.1.2.	Declines in populations of cetaceans	4	5	1	3	5	1	0	3	1	2	3	0	2	1	3	3	0	3	50.0	3
	3.1.3.	Declines in populations of seabirds	7	7	1	1	3	2	3	6	0	2	1	0	4	1	2	1	1	1	14.3	0
	3.1.4.	Declines in populations of turtles	8	9	0	0	7	2	0	8	0	1	0	0	5	2	1	0	1	6	66.7	2
	3.2.	Declines in populations of commercial																				

Main Area of Concern	No.	Issue	Relevance				Level 1 Importance			Baseline data					Monitoring					Level 2 Priority		
			Before (8 x MEDAs)	Relevant now	Relevant future	Not relevant	High	Medium	Low	Yes	Partial	No	Not relevant	Unknown	Yes	Partial	No	Not relevant	Unknown	No. above average	% above average	Number of CCA
		fish stocks																				
	3.2.1.	Declines in populations of sharks and rays	6	8	0	1	8	0	0	5	0	3	1	0	2	1	5	1	0	7	87.5	1
	3.2.2.	Declines in populations of large pelagic	5	8	1	0	7	1	1	8	1	0	0	0	6	1	1	0	1	6	85.7	3
	3.2.3.	Declines in populations of small pelagic	4	5	2	2	5	0	2	5	1	1	2	0	2	2	2	2	1	5	83.3	1
	3.2.4.	Declines in populations of deep water demersals	2	6	1	2	4	0	3	5	1	0	2	1	3	1	2	2	1	3	50.0	0
	3.2.5.	Declines in populations of reef and demersal fish	8	9	0	0	9	0	0	7	1	1	0	0	5	2	2	0	0	7	87.5	4
	3.3.	Declines in populations of commercial invertebrates																				
	3.3.1.	Declines in populations of molluscs (bivalves, gastropods)	4	4	3	2	2	3	2	3	2	2	2	0	2	3	2	2	0	2	33.3	0
	3.3.2.	Declines in populations of abalone	1	1	0	8	1	0	0	1	0	0	8	0	1	0	0	8	0	0	0.0	0
	3.3.3.	Declines in populations of cephalopods	3	7	1	1	7	1	0	4	1	3	1	0	1	2	4	1	1	2	28.6	0
	3.3.4.	Declines in populations of sea cucumbers	6	8	0	1	8	0	0	5	1	2	1	0	2	1	4	1	1	4	57.1	3
	3.3.5.	Declines in populations of sea urchins	1	1	2	6	1	0	2	1	1	1	6	0	0	0	2	6	1	0	0.0	0
	3.3.6.	Declines in populations of prawns and shrimp	5	8	0	1	6	2	0	6	1	1	1	0	5	1	2	1	0	5	62.5	4
	3.3.7.	Declines in populations of lobsters	3	7	0	2	6	1	0	5	2	0	2	0	4	3	0	2	0	3	50.0	1
	3.3.8.	Declines in populations of crayfish	2	1	1	7	1	0	1	0	1	1	7	0	0	1	1	7	0	1	50.0	0
	3.3.9.	Declines in populations of crabs	3	6	1	2	4	2	1	3	2	2	2	0	1	3	3	2	0	0	0.0	0

Main Area of Concern	No.	Issue	Relevance				Level 1 Importance			Baseline data					Monitoring					Level 2 Priority		
			Before (8 x MEDAs)	Relevant now	Relevant future	Not relevant	High	Medium	Low	Yes	Partial	No	Not relevant	Unknown	Yes	Partial	No	Not relevant	Unknown	No. above average	% above average	Number of CCA
	3.4.	Excessive bycatch and discards	7	9	0	0	8	1	0	6	1	2	0	0	4	2	3	0	0	7	87.5	3
	3.5.	Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)	6	6	3	0	6	2	1	5	1	3	0	0	5	1	3	0	0	4	66.7	3

9 MAJOR AREA OF CONCERNS & ISSUES

9.1 INTRODUCTION

The following chapter presents a summary description of each of the issue categories. A short description of the MAC and each associated issue are presented for the first three MAC01, MAC02 and MAC03. The MAC04 issues are also diescribed, but these issues are typically contributory part of root causes of the issues covered in the other MACs. The description of each issue commences with a general **'Problem Statement'**, which outlines the broad generic nature of the issue. This is followed by the results of the **'National Scoping'** exercise, which examines the relevance of the issue and presents the evidence at the national level. These descriptions are based primarily on the text of the final draft MEDA documents, and only draw on additional literature only where necessary. Finally, the **'Transboundary Scoping'** is presented, which presents the key results of the prioritisation exercises completed during the National CCA Meetings.

9.2 MAC01 WATER QUALITY DEGRADATION

Water quality within the ASCLMEs is being degraded by a combination of factors associated with changes in the quality, quantity and timing of river flows, and due to contamination of ground and surface waters and coastal and marine waters from land- and marine-based sources. The issue categories identified from the MEDA and included in this Main Area of Concern are described below:

1.1. Alteration of natural river flow and changes in freshwater input and sediment load

Problem Statement

The interaction between river catchment and drainage basins and the coastal and marine environment is an issue of concern affecting all of the countries within the ASCLMEs. The natural river flow in many of the drainage basins in the ASCLME has been altered to some degree through a drop in water quality, quantity or timing of flow, which influence salinity levels in estuarine habitats and introduce contaminants into coastal and marine habitats. Furthermore, there have also been changes in the sediment load carried by rivers and estuaries, which can have significant impacts on coastal sediment transport dynamics, affecting shoreline configuration and siltation of coastal habitats, and contaminant levels.

National Scope

Comoros: The islands have very variable drainage systems; there no permanent water systems in Grande Comore because of the high permeability of the soils, but there are complex and dense drainage systems on Anjouan, Mayotte and Moheli. There has been a reduction in quantity and quality of flow in these rivers and streams over the past two decades. This has resulted in difficulties in the provision of water for domestic uses and irrigation, hydroelectric generation and increased prevalence of water- and vector-borne diseases (as a result of stagnation) (Comoros MEDA, 2012).

Kenya: There are two major river systems, the Tana and Athi-Sabaki rivers, which drain into the Indian Ocean in the northern region of the Kenya coast, and numerous other small semi-perennial rivers draining into the Indian Ocean (Ramisi, Umba, Mwache, Mkurumuji, Rare and Kombeni). Modification of freshwater river flow and sediment transport budgets, have impacted creeks, deltas and estuaries and contributed towards the degradation of coastal habitats and coral reef associated ecosystems (Kenya MEDA, 2012).

Madagascar: There are numerous rivers and streams that flow into the sea on the east (Mananara and Mangoro, Maningory, and the Bemarivo, Ivondro and Mananjary) and west

coast (Sambirano, Mahajamba, Betsiboka, Mania, south and north Mahavavy, Mangoky and Onilahy) (Madagascar MEDA, 2012). The largest river on the island is the Ikopa river, which crosses Antananarivo and feeds into Betsiboka river in the east. Flows in the Mandrare in the south, which is the driest part of the island, are intermittent. Flood flows of these rivers are usually very high because of the steep topography and sedimentation is common. In the Betsiboka estuary, huge quantities of reddish orange silt are transported and deposited in large quantities as the flow slows when the river meets the sea. Changes in sediment transport patterns have contributed towards both the modification of shorelines and silting of reef flats and mangrove forests (Bemiasa 2009, Madagascar MEDA, 2012).

Mauritius: On Mauritius there are 25 major river basins and 21 minor ones, whereas on Rodrigues there are 20 major river basins and 10 minor ones. Almost all rivers on both islands are perennial with most of the streams having their sources in the central higher areas. On both islands, base flow rates of these rivers is typically low due to low levels of infiltration, due to the low retention capacity of the soil and porous basaltic rock. Flows rates can however increase from a few litres per second to more than 500 m^3/s during floods. During floods sediments are carried out to a distance of over 5 km to sea.

Mozambique: There are 100 principal river basins and a number of international rivers (Rovuma, Zambezi, Save, Limpopo and Imcomati). River runoff has decreased and there has been modification of stream flow leading to freshwater shortage/reduction or excessive runoff and flooding in certain periods of the year. The rivers are the main source of sediments and dissolved inorganic nutrients in coastal zones. Shoreline stability in the estuaries and adjacent coast is mostly dependent on the input of sediments from rivers. Freshwater shortages and reduced river flows has led a reduction in sediment transport and resulted in coastal erosion.

Seychelles: There are several freshwater sources on Mahé (38 catchments), Praslin (11 catchments) and La Digue (8 catchments), and the catchments interconnect with numerous rivers and streams. The rivers are typically ephemeral with very few perennial ones. The islands steep topography and the low retention capacity of the soil means that stream are typically swift flowing, during the rainy season and low flow volumes during the drought season. Although rainfall is high (average 2,362mm/yr over the last 37 years), only a small percentage is retained (2%). Despite this river run-off and siltation of drainage systems has increased due to increased development (areas of hard standing and houses). The siltation of drainage systems has reduced their capacity and resulted in flooding in coastal areas during heavy rains. This situation is likely to worsen if rainfall increases with climate change (Seychelles MEDA, 2012).

Somalia: The country is semi arid but there are two major rivers contributing to perennial surface flow in southern Somalia: the Juba and the Shabelle, which originate from Ethiopian Highlands. The rest of the country is crossed by ephemeral streams, which remain dry for most of the year except during major rainfall events. About two-thirds of the Juba Shabelle catchments lie outside Somalia, mostly in Ethiopia, and part of the Juba catchment lies in northern Kenya. The Laag Dheera catchment, is another transboundary catchment, three-quarters of which is in Kenya. This joins the Juba catchment in the lower reaches through a natural depression. In the central and northern regions of Somalia, there is very little surface runoff since most of rainwater either evaporates or infiltrates into the porous soil. Most of the other rivers only flow after flash floods during rainy seasons. Siltation of the rivers as a result of poor land use practices has led to the modification in the configuration of coastal habitats, shifting accretion and erosion patterns and associated ecosystems are changing (UNEP 2009).

South Africa: There are numerous rivers and estuaries that feed into the coast of South Africa. These rivers deliver large sediment loads to the coast. Modified river flows have however resulted in changes in estuarine mouth dynamics, with negative consequences for mangroves and salt marshes and fisheries. Increased sediment loads have also caused the estuaries to

become shallower and has altered the characteristics of river mouths (South Africa MEDA, 2012).

Tanzania: The coastal region of Tanzania has several rivers that discharge into the Indian Ocean, with a drainage system which covers about 20% of the country. The Rufiji is the largest river, which contributes 50% of the total fresh water discharges to the sea. Other important rivers include the Ruvuma, the Wami, the Ruvu and the Pangani. Other rivers such as the Matandu, Mbwemkuru and Lukuledi are considered to be relatively less important in terms of freshwater discharges to the Indian Ocean. River flows have reduced over the years, and the quality of water has also reduced, with subsequent environment and socio-economic impacts including social conflicts in some regions (Tanzania MEDA, 2012).

Transboundary Scope

Many of the major rivers and their catchments within the ASCLMEs cross international boundaries and are therefore transboundary. Modification of river flows and changes in the quality, quantity and timing of flows and sediment loads is also a transboundary issue where the rivers enter the Indian Ocean close to the borders with adjacent countries. Within the ASCLMEs, all countries identified the issue as being 'Relevant' so this issue is also a shared transboundary issue as well. From the Level 1 prioritisation 6 countries ranked the issues as being 'High' importance, and in the Level 2 prioritisation 7 countries allocated 'Overall ranking' scores which were above average compared with the other issues in MAC01.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	✓	✓	✓	✓	9
Importance	H	H	H	L	H	M	M	H	H	6
Overall ranking	15	17	15	13	19	18	12	19	20	7

1.2. Degradation of ground and surface water quality

Problem Statement

The status of ground water and surface waters within the ASCLMEs has declined over the years as a result of pollution arising from agriculture, municipal and industrial effluents and run-off, siltation and from saltwater intrusion. Contamination and saltwater intrusion into groundwater supplies is another common concern among the countries of the ASCLMEs. Degradation of groundwater supplies affects the availability of potable freshwater and as well as soils, with consequences for human health and agriculture. Contaminated ground and surface waters can also impact upon coastal waters through surface run-off, especially during heavy rains, and groundwater seepage. The relative contribution of ground and surface waters is however seldom accounted for as it is more difficult to measure diffuse inputs than point sources.

National Scope

Comoros: In Grande Comore, the total absence of surface water means that potable water comes from groundwater and cisterns. Groundwater is however being affected by salt water intrusion and at risk of pollution due to high soil porosity (Comoros MEDA, 2012). Other water sources are located in the mountains of the Grid and Mbadjini, while these have low water storage capacity, they provide good quality potable water. The crater lakes at high altitude, fill with fresh water, but those located near the shores are contaminated with salt water. In Moheli, there has been groundwater depletion in the dry season (Comoros MEDA, 2012).

Kenya: There are various lakes found in the coastal region of Kenya include oxbow lakes such as Lake Bilisa and Lake Shakababo in the Tana Delta. Some of these lakes are threatened by heavy discharge of sediments from rivers draining into it, while others relatively clean with low levels of pollution (Kenya MEDA, 2012).

Madagascar: Salinisation of soils is already one of the main problems encountered.

Somalia: Salinisation is a serious problem in the irrigated areas along the Jubba and Shabelle river valleys. Both rivers have high salt content even during periods of high flows (Markakis 1998), which limits the extent to which the waters can be used for irrigation. Changes in land-use patterns in the Ethiopian Highlands can interfere with the flow of the two rivers, which severely impacts Somalia. River embankments are used for agriculture which causes frequent flooding (FAO – SWALIM 2009). The major flood channels that the former Government used to maintain have also fallen into disrepair during the civil war increasing the possibility of flooding especially in the lower and middle Shabelle valleys (FAO – SWALIM 2009). People are also settling in flood prone areas due to increased population pressure. This is increasing the vulnerability of the local communities to flooding with high possibility for loss of life and property during flood events (FAO – SWALIM 2009). Little research has however been carried out on the hydrology of Jubba and Shebelle rivers and as such there is very limited data and information on the ground water aquifers.

Mauritius: Pollution of ground and surface water is a concern in Mauritius. There are five main groundwater basins in Mauritius, with coastal aquifers at the terminal part of the aquifers. The water table in the aquifers normally corresponds to the sea level, and coastal groundwater is normally brackish due to sea water intrusion. The extent of seawater intrusion depends on the structural context of coastal aquifers (Giorgi et al., 1999). In Rodrigues, there are also several aquifers and reservoirs, the volume of which has reduced over the years due to siltation. There is groundwater seepage around the islands as freshwater percolates through the volcanic rock into the sea (Mauritius MEDA 2012).

Mozambique: There is little information on the quality of surface and groundwater in Mozambique. There has however been an increase in the frequency of extreme events such as floods and droughts in Mozambique. Heavy rainfall in the central part of the country which is low-lying causes flooding (Mozambique MEDA 2012).

Seychelles: Rainfall is high (average 2,362mm/yr over the last 37 years), but only a small percentage is retained (2%), so the volume that seeps into groundwater aquifers and rivers and streams is generally low (Seychelles MEDA 2012). There are catchments that are exploited on each of the islands. Freshwater shortages are now a common issue. Sea-level rise is expected to result in saltwater intrusion in rivers, marshes and wetlands adversely affecting the habitats of certain species of fish; it would also impede the ability of coastal shellfish to relocate.

Somalia: While there are short streams which flow throughout the year due to subsurface flows and groundwater recharge, most freshwater in Somalia is obtained from boreholes or shallow wells which are often polluted due to bad water systems (Somalia MEDA 2012).

Transboundary Scope

Degradation of groundwater and surface water quality is a transboundary issue where there are shared catchments, aquifers or international rivers. Within the ASCLME, this is also a shared transboundary issue common to all of the countries. It was considered to be 'Relevant' by all the countries, and was ranked as a 'High' priority by 6 out of the 9 countries in the Level 1 prioritisation, and allocated an above average score by 5 out of the 9 countries for the 'Overall ranking'. It is likely that this issue will intensify in future, posing an even greater risk to society and the economy unless the sectors that contribute to the problem take measures to address it.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓f	✓	✓	✓	✓	✓	✓	✓	✓	9
Importance	H	H	H	L	H	M	M	H	H	6
Overall ranking	12	12	19	13	15	16	14	19	18	5

1.3. Degradation of coastal and marine water quality

Degradation of coastal and marine water quality as a result of inputs from various point and non-point sources, from municipal and industrial discharges, surface run-off leechates, dumping of solid wastes are widespread issues of concern throughout the ASCLME. There are a suite of specific issues within this category.

1.3.1 Microbiological contamination from land-based (domestic, industrial, agriculture and livestock) and marine (mariculture, shipping) sources

Problem Statement

Most of the countries in the ASCLMEs identified microbial contamination of their coastal waters as an issue of concern. Microbial contamination refers to the presence of pathogenic organisms (protozoa, bacteria and viruses) of either human or animal origin in the aquatic environment. Usually these occur as a result of inappropriate disposal of un- or under treated municipal wastewater, contaminated surface and sub-surface runoff from populated areas, contaminated runoff from agricultural areas used for livestock rearing, and industrial effluents (often food processing) (UNEP/Nairobi Convention Secretariat, CSIR and WIOMSA, 2009). Microbial contamination of coastal waters can have serious socio-economic impacts, and presents a risk to human health through direct contact (recreation) or ingestion of contaminated seafood. These consequences can affect local communities, tourists, industry and aquaculture operations. The reduced quality (and economic value) of seafood, whether cultured or wild harvested can have serious economic consequences The loss of the recreational value of coastal waters, due to high levels of faecal bacteria (typically used as indicators of microbial contamination), is evident throughout the coastal zone of the WIO region (UNEP/Nairobi Convention Secretariat, CSIR and WIOMSA, 2009). Concentrations are often higher in proximity to larger urban centres. In many areas the situation is accompanied by unpleasant aesthetics and bad odours, also a consequence of inappropriate waste and wastewater management.

National Scope

Comoros: There is no sewerage, drainage or wastewater treatment in the Comoros (Comoros MEDA, 2012). Households typically use pit latrines which can leak and contaminate groundwater and coastal and marine environments. The entire rural population, more than two thirds of the population, relies on rain, surface and ground water supplies. No water quality monitoring and control mechanisms exist, and only a few occasional salinity tests are done. Some islands, such as Ngazidja, there is a massive risk of groundwater pollution by septic tanks and their seepage.

Kenya: Microbial water quality studies have now been completed in a number of locations (Mwangi 1997, Mwanguni 2002, UNEP/Nairobi Convention Secretariat, CSIR and WIOMSA, 2009, Kenya MEDA 2012). In Mombasa, microbial pollution levels near urban centres were several orders of magnitude higher than in coastal waters in rural areas (Mwanguni 2002). Over 50% of all reported diseases in Kenya have been attributed to poor water quality associated with inadequate wastewater management, although the source of the microbial contamination,

whether from drinking contaminated water or coastal recreational, was not always clear (Mwanguni 2002, Kenya MEDA 2012).

Madagascar: Studies conducted around Taolagnaro measured high *E. coli* counts (13300 counts/100 ml) in coastal waters. High counts of enterococci and total coliforms were reported from Mahajanga and Nosy Bé. The high levels of faecal contamination were attributed to defecation on the beaches as well as inappropriate treatment of municipal wastewater (Mong et al. 2009). Over a 5 year period (1993 and 1998) there were 18 cases of human illness caused by ingestion of contaminated seafood (Mong et al. 2009), which included illness resulting from eating marine turtles (seven cases), sharks (eight cases), fish (one case) and molluscs (two cases). WIO-LaB water and sediment quality monitoring surveys confirmed that microbial pollution is an ongoing problem in some Madagascan coastal areas (UNEP/Nairobi Convention Secretariat, CSIR and WIOMSA, 2009).

Mauritius: At present, 73% of the households uses cesspits or septic tanks whilst 2% use pit latrines; so most of the effluents are discharged directly to the sea or are carried to the sea by runoff and rivers with higher potential for microbial pollution, particularly after heavy rains (Mauritius MEDA 2012). Total and faecal coliforms are monitored monthly at public beaches at Flic en Flac, Albion, Pointe aux Sables, Trou aux Biches, Mon Choisy, Le Goulet, Grand Baie and Blue Bay (UNEP/Nairobi Convention Secretariat, CSIR and WIOMSA, 2009). The Ministry of Fisheries reported that waters at most beaches were within recommended guidelines for contact recreation in Mauritius in 2004 (counts of total coliforms < 1000 per 100 ml and faecal coliforms < 200 per 100 ml). Good water quality was confirmed by quarterly monitoring of waters in 2007 through the WIO-LaB project. The highest levels of faecal and total coliforms were recorded at Pointe aux Sables, near Port Louis, where the beach is closed to swimming (Dulymamode et al. 2006, UNEP/Nairobi Convention Secretariat, CSIR and WIOMSA, 2009).

Mozambique: There is only one sewage treatment plant in Mozambique, located in Maputo City, which treats about 50 % of the city's sewage (Mozambique MEDA 2012). Faecal coliform, faecal streptococci and *E. coli* were detected both in marine waters and shellfish tissues in Maputo Bay. Some places in Maputo Bay, particularly where the discharge of sewage takes place, such as Miramar at the entrance of the Maputo Estuary, are not safe for swimming. Faecal coliform counts in the water within the channel near the Infulene River were high (460,000 bacteria counts per 100 ml) and values exceeded 2,400 bacteria counts per 100 ml in the river mouth. The bacteria *Vibrio parahaemolyticus* and *V. mimicus* have been found in clams at the Incomati River mouth and near Matola in the Maputo estuary. *Vibrio* spp. cause of severe gastro-intestinal illnesses (Fernandes 1996). High levels of microbial pollution have also been found at Beira and Nacala Bays, although the concentrations are low as compared to those observed in Maputo Bay (Motta *et al*., 1998).

Seychelles: Coastal waters of Seychelles are generally good quality, except during the rainy season, when areas with significant river inflows have higher microbial quantities. Effluent from wastewater treatment plants discharged directly into the ocean was found to contain between 2000 and 5000 total coliform counts per 100 ml, far above the recommended standards of 500 per 100 ml (Antoine et al. 2008). During a monitoring survey conducted during 2007, high microbial counts were recorded at Beau Vallon Bay during the rainy season. These were mostly associated with runoff from non-point sources such as rivers and small streams (Antoine et al. 2008). Outbreaks of water- and insect-borne diseases usually occur during the rainy season and are mainly associated with defective on-site wastewater disposal systems (UNEP/Nairobi Convention Secretariat, CSIR and WIOMSA, 2009).

Somalia: Only one part of Mogadishu has a sewerage system. All other towns and cities in Somalia typically use septic tanks are the most common mode of human waste disposal. Coastal municipalities also lack the capacity to treat wastes. Sewage and solid wastes containing organic

materials, nutrients, suspended solids, parasitic worms and benign and pathogenic bacteria and viruses are discarded directly into the ocean (Somalia MEDA 2012).

South Africa: Since about 1985, the design of offshore sewage outfalls in South Africa has followed the receiving water quality objectives approach where effluent quantities and composition must be within limits that meet site-specific Environmental Quality Objectives, as recommended in the South African Water Quality Guidelines for Coastal Marine Waters (South Africa MEDA 2012). Long-term environmental monitoring programmes at these outfalls have indicated no detrimental impact related to chemical and microbiological contamination on the marine environment or its beneficial uses. There is however a rapid increase in discharges to less dynamic and sensitive areas such as surf zones and estuaries, where effluents from malfunctioning or overloaded treatment facilities are adversely affecting the marine environment and its beneficial use, albeit in a localised manner (RSA DWAF 2004a,b,c). In Cape Town (South Africa) an extensive monitoring programme for microbiological contamination (using *E. coli* as an indicator organism) found that 80% of stations sampled complied with the South African guidelines for contact recreation. The stations that did not comply (*E. coli* exceeded 200 counts per 100ml in 80% of samples in one, and 2000 counts per 100 ml in 95% of samples in the other) were in highly developed and urbanised sections of the coastline (City of Cape Town 2005).

Tanzania: Raw sewage is directly released into estuaries and other coastal habitats and away from coastal towns. High counts of faecal coliform and total coliform bacteria of up to several thousand per ml of seawater were also recorded in Zanzibar, Tanzania (Mohammed 2001). High counts have prompted health concerns and warnings of health risks to swimmers, and some beaches on Zanzibar and the mainland in Dar es Salaam (e.g. Ocean Road and Banda beaches) have been closed for swimming and other recreational activities due to microbial contamination (Mohammed et al. 2008). WIO-LaB monitoring conducted in 2007 showed contamination of waters around Dar es Salaam as well as Stone Town.

Transboundary Scope

Microbial contamination can originate from point and non-point sources, and immediate area of impact may be localised around the source, depending on the amount mixing and current. All nine countries identified the issue as being 'Relevant', so it is a shared issue of concern amongst the countries. While only 2 of the countries identified the issue as being of 'High' importance in the Level 1 prioritisation, 5 countries ranked the issues as being of 'Medium' importance because the impacts were often geographically localised. In the Level 2 prioritisation, 5 of the countries allocated the issue with an above average score for the 'Overall ranking' within MAC01, suggesting that it is a priority issue of concern for the countries within the ASCLMEs. It is likely that the problem will intensify in future, posing an even greater socio-economic risks to society, unless the sectors that contribute to the problem take measures to address it.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	✓	✓	✓	✓	9
Importance	M	M	H	L	M	M	L	H	M	2
Overall ranking	16	10	24	14	15	14	16	10	15	5

1.3.2 Nutrient enrichment from land-based (domestic, industrial, agriculture, livestock) and marine (mariculture) sources

Problem Statement

Nutrients such as nitrate, nitrite, phosphates and silicate are necessary for the growth of phytoplankton. These inorganic substances are constantly lost from marine surface waters as they are taken up by phytoplankton during primary production, and also because of gravitational sinking. Nutrients are naturally brought up to surface by upwelling, when cold nutrient-rich deep waters are advected upwards. Coastal waters are however also enriched by nutrients as a result of land-based sources, and this was raised as an issue of concern by the majority of countries. Elevated nutrient levels in coastal waters can generate artificially enhanced primary production (e.g. algal and phytoplankton growth) and increase in the amount or organic material in the water column. Nutrient enrichment can also promote rapid growth of certain benthic species (e.g. macroalgae), and cause shifts in community composition (e.g. phase-shifts). Changes in the composition of benthic communities that can occur as a result of nutrient enrichment include shifts from coral to algal dominated habitats, and shifts from seagrass to algal dominated habitats. Nutrient enrichment usually occurs as a result of inappropriate disposal of municipal wastewater near to urban areas, from nutrient-enriched agricultural surface run-off or return flows from agricultural areas where there is a high usage of fertilizers, or livestock, or from atmospheric sources. Wastewater containing high levels of inorganic nutrients (e.g. nitrogen and phosphate) or a high organic content (with high biological or chemical oxygen demand, BOD or COD) can also contribute towards eutrophication and the creation of 'dead zones', although such areas have not yet been reported in the ASCLMEs. Harmful or nuisance algal blooms, which can but not always, occur as a result of nutrient enrichment, can be problematic in some areas, but these are dealt with under a separate issue category in MAC02.

National Scope

Comoros: The islands are situated in one the most prolific "upwelling" regions of the Western Indian Ocean which naturally enhances nutrient levels and drive strong bloom of phytoplankton. Nutrient patterns have yet to be determined in the waters around Comoros (Comoros MEDA 2012).

Kenya: Coastal waters in Kenya receive nutrient inputs from agricultural run-off (fertilizers), untreated waste water or sewage and from atmospheric sources from the burning of fossil fuels. Nutrient enrichment events have been reported to trigger massive algal blooms. Along the Kenya coast, studies have reported an increase growth of epiphytic algae on seagrass and the dominance of the green algae (*Ulva* and *Enteromorpha* sp.), and in areas adjacent to dense tourism developments epiphytic cover reached 60 % (Uku 1995, 2005, Uku and Björk,2005, UNEP/Nairobi Convention Secretariat, CSIR and WIOMSA, 2009). This is a common impact of nutrient enrichment on seagrass beds which can lead to a phase-shift, as the algae smothers the blades of the seagrass, blocking the light necessary for the seagrass to photosynthesize, and ultimately resulting in mortality or a shift in species composition.

Madagascar: The rivers draining the Madagascan Highlands are important sources of nutrients brought to the coast, and some lagoons have variable but high concentrations of nutrients (ammonium, nitrate and nitrite) throughout the year (Lope 2009). Nutrient enrichment is due to the use of fertilizers in agriculture and accelerated soil erosion within the river basins due to deforestation (Mozambique MEDA 2012). Flooding of the Ifaho River in Madagascar results in a peak in nitrate concentrations, 200 - 400 times higher than the minimum values in the lagoons (Mozambique MEDA 2012). The periodic draining of wastewater ponds in fish farms in Madagascar is another source of nutrient enrichment as this water is rich in phosphates, nitrates

and organic matters and may also contain pathogens, antibiotics and pesticides, and can cause eutrophication and harmful algal blooms (HABs) (Mozambique MEDA 2012).

Mauritius: Over use of fertilizers in agricultural practices (both intensive and small scale market gardening, and livestock rearing), poses a serious threat to coastal ecosystems and give rise to algal blooms and red tides. Mass fish mortality events have become quite common in recent years and this has been attributed to discharge of untreated effluents as well as pesticides and uncontrolled use of fertilizers from coastal agricultural activities. High nitrate concentrations introduced into lagoon systems through agricultural return flows have been associated with algal proliferation in the lagoons of Belle Mare/Palmar, and many hotels have had to remove algal deposits from the shoreline on a weekly basis (Dulymamode et al. 2002). At Flic en Flac, black anoxic sands, smelling of hydrogen sulphide, have been observed at the low water mark and are associated with organic enrichment from wastewater discharges (Prayag et al. 1995). High levels of nitrate and phosphate and associated proliferation of algal growth have been recorded at both Belle Mare and Flic en Flac (Prayag et al. 1995, Botte 2001). Nutrient enrichment of lagoon waters also results in increased algal growth over corals, affecting their biology and the coral reef ecosystem as a whole (Botte 2001). High concentrations of phosphates (relative to other WIO countries) were confirmed from sampling conducted as part of the WIO-LaB project (UNEP/Nairobi Convention Secretariat, CSIR and WIOMSA, 2009).

Mozambique: The main sources of the dissolved inorganic nutrients in coastal zones of Mozambique are the rivers (Hoguane, 2007; Gammelsrød and Hoguane, 1987, 1996 and Sætre and Silva, 1979). The Sofala Bank, which is influenced by the discharges from Zambezi, Pungué, Buzí and Save rivers, and it is one of the most productive shelf regions of Mozambique (Lutjeharms 2006, Barlow, 2007, 2008). However agricultural activities within the coastal region and in the hinterland areas also contribute contamination of the coastal and marine environment, through sediments and use of pesticides and fertilizers. High levels of BOD and COD, and low content of dissolved oxygen have been detected downstream of the factories and the presence of water hyacinth and *Pistia* is a clear evidence of nutrient rich water (Mozambique MEDA 2012).

Seychelles: The coastal waters of Seychelles are generally low in nutrients, with the exception of areas which receive significant inputs from food processing factories in the vicinity of Port Victoria (Seychelles MEDA 2012). In the rainy season, areas where there are significant river inflows influence the microbial quality and community structure in the coastal waters. Department of Environment (DoE) has a nutrient monitoring programme. There is however a significant gap with regards understanding the effects of rapid coastal and upland development on nutrient loading, including the implications for water quality and coastal habitats (see Littler et al., 1991; Grandcourt, 1995, Seychelles MEDA 2012).

Somalia: The coastal waters of Somalia are subject to intense upwelling during the south-west monsoon as the 'Southern Gyre' and 'Great Whirl' moves northwards up the coast. Nutrient enriched waters brought to the surface with the upwelling increases primary and secondary productivity and is the main driver in terms of the fisheries productivity along this coast. In addition to this the rivers also contribute large amounts of nutrients and fresh water (Ngasaru et al., 2004). Phosphorous and other nutrients are introduced to the ocean from the Juba and Shebelle rivers during the rainy season and phosphorous concentrations show a peak just after the start of the Southeast monsoon (Somalia MEDA 2012). Coastal municipalities lack the capacity to process wastes and human activities related to food and energy production have greatly increased the amount of nutrient pollution entering the marine environment, causing localised eutrophication of coastal waters and degradation of fisheries habitats. Increasing levels of fertilizers used along river courses also result in eutrophication of lower reaches and excess nutrients being released into the oceans (Somalia MEDA 2012).

South Africa: Riverine input of nutrients peaks in mid- to late austral summer, and is maximal in the north-east of the country (South Africa MEDA 2012). Estuaries act as nutrient-purifying systems, where nutrients from catchments are absorbed, resulting in cleaner water entering the sea. This is particularly evident during low flow periods (dry seasons) when river runoff entering the estuaries may have higher nutrients levels due to agricultural irrigation return flows. High nutrients levels in estuaries can also result from longer residence times during weak neap tides when tidal exchange is reduced (Taljaard et al. 2006). Urban estuaries on the KwaZulu-Natal coast are increasingly showing signs of excess nutrient and organic loading from surface drainage and, possibly, malfunctioning sewage reticulation systems. This has contributed to recent fish kills in several estuaries in the Thekwini municipality and the Port of Durban (UNEP/Nairobi Convention Secretariat, CSIR and WIOMSA, 2009).

Tanzania: Raw sewage is directly released into estuaries and other coastal habitats and away from coastal towns, nutrients also enter the marine environment as fertilizer run-off from areas of intensive farming through mouths of major rivers and streams (Tanzania MEDA 2012). In the Tanga area of Tanzania, macroalgae has profilerated due to nutrient loading from municipal wastewater and industrial discharges, particularly from a fertiliser factory (Munissi 1998). Munissi (2000) also demonstrated the association of *Ulva* spp. and *Enteromorpha* spp. with nutrient input from sewage pipes. In Zanzibar, the release of inorganic nutrients from domestic sewage, has been identified as one of the main causes for a decrease in coralline algae which are sensitive to phosphate and are disappearing from phosphate-enriched areas (Björk et al. 1996, Tanzania MEDA 2012).

Transboundary Scope

Nutrient enrichment as a result of anthropogenic inputs from agricultural, municipal and industrial and other sources, may have a localised impact but it can be a transboundary issue if common between the 9 countries. All 9 of the countries within the ASCLMEs identified the issue as being 'Relevant' although Mozambique considered the issue to be more of a future relevant issue due to the expansion of the sugar and bio-fuel sectors. Only 4 out of the 9 countries identified nutrient enrichment as being of 'High' importance, a further 2 countries ranked it as 'Medium' importance, and 3 ranked is as being of 'Low' importance. Only two countries assigned an above average score for the 'Overall ranking' in the Level 2 prioritisation; one of which had identified the issue as being of 'Low' importance in the Level 1 prioritiation. This is therefore not considered to be a priority issue of concern for the countries within the ASCLMEs at this time.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓f	✓	✓	✓	✓	9
Importance	L	H	H	L	H	M	L	M	H	4
Overall ranking	11	15	15	11	12	17	15	10	12	2

1.3.3 Chemical contamination (excluding oil spills) from land-based (domestic, industrial and agricultural) and marine (shipping, dumping at sea) sources

Problem Statement

Chemical contaminants are defined here as compounds that are toxic, persistent and/or bio-accumulating, which can be grouped in three categories: heavy metals and persistent organic compounds (e.g. pesticides), and hydrocarbons. This issue covers the first two categories and hydrocarbons are dealt with below under issue 1.3.6. Chemical pollution can cause

discolouration of coastal waters, chronic (e.g. affecting growth and reproduction) and acute effects on marine biota and, modifcation of species compositions in marine biological communities. Sources of chemical contamination in the WIO region are typically linked to agrochemical discharges (e.g. persistent organic pollutants), dredging in ports and harbours (thereby releasing sediment-bound heavy metals and hydrocarbons), atmospheric emissions (containing heavy metals) and leachates from solid waste dump sites.

National Scope

Comoros: Two types of Persistent Organic Pollutants (POPs) were reported in 2006: polychlorinated biphenyls (PCBs) and dioxins/furans. PCBs were used as heat exchange fluids and insulators (dielectric) in electrical transformers used by power companies. Although only 6% of transformers on Comoros had PCBs, 84 % were contaminated with PCB (National Implementation Plan of the Union of Comoros, PNM, 2004). Dioxins and furans are produced during incomplete combustion or some industrial processes. Over 77% of dioxins and furans emissions come from uncontrolled combustion processes, and on Comoros these originate primarily from the uncontrolled burning of household waste. The national contribution to the global emissions of dioxins and furans in 2006 amounted to 24.196 g TEC/year. (PNM, 2004). No quantitative study has yet been made of persistent inorganic pollutants, but it is known that this pollution consists of plastic bags, batteries, electronic waste, glass, motor oil and metals that most often end up in the sea (UNEP/Nairobi Convention Secretariat, CSIR and WIOMSA, 2009).

Kenya: Some significant concentrations of pesticide residues have been reported in Kenya (Sabaki and Ramisi River) (Wandiga 2005; Wandiga et al., 2002) and from fish samples (Tana, Athi-Sabaki rivers and estuaries) (Lalah et al., 2003; Mugachia et al., 1992; Munga, 1985). Studies also found elevated levels of copper, cadmium, iron and zinc heavy metals (in Kilindini and Makupa Creeks Mombasa, Kenya) although the levels were substantially lower than those recorded in other polluted coastal areas (Kamau 2001). Monitoring of sediment concentrations of cadmium, copper, lead and zinc in the Sabaki estuary/Malindi Bay complex and Kilindini/Port Reitz Creek were found to be above recommended WIO guidelines (United Nations Environment Programme/Nairobi Convention Secretariat and CSIR 2009).

Madagascar: Chemical contamination occurs due to industrial, agricultural, port and mining activities. Most pollutants are biodegradable but there are also persistent organic pollutants including highly toxic insecticides such as DDT and phenols from wood industries (Madagascar MEDA 2012). Effluents from the oil refinery at Toamasina and the shipyard at Antsiranana contain naphthenic pollutants, sulphides and thiophenols and pollutants from mining zones (mica, quartz, iron, chromium, and graphite) are made up of solid waste and sludge mineral suspensions (Madagascar MEDA 2012). WIO-Lab surveys found that sediment heavy metals concentrations were the highest reported for the WIO region (United Nations Environment Programme/Nairobi Convention Secretariat and CSIR 2009). The highest levels were generally reported in closest proximity to sewage outfall points (Mong 2008).

Mauritius: Historically, steel mills, galvanizing, electroplating and battery factories, released their wastes directly into rivers (Grand River North West and St. Louis River) which empty into marine systems. Estuarine habitats such as Tombeau Bay and Poudre d'Or Estuary have been exposed to untreated industrial wastes since the 1980s (Ramessur 2002). Today chemical pollution in Mauritius arises from the use of pesticides and fertilizers, the textile industry and port activities. Heavy metals, particularly chromium (from textile industries), zinc and lead (from industrial effluent, sewage sludge and landfill leaches) are potentially problematic (Ramessur 2002). Despite this, coastal systems in Mauritius appear relatively unpolluted compared with more industrialised countries (Ramessur 2004, Anon Mauritius 2007). Heavy metals (copper, zinc, lead, cadmium, mercury) and the pesticides atrazine, diuron and hexazinone were not detected in water samples taken from the river mouths (Grand River North West, Pointe Roches

Noires, Grand River South East, Mahebourg, l'Escalier, Baie du Cap, Tamarin and Rivière Lataniers), and chromium, lead and zinc in sediments were well below contamination levels quoted by Van Veen and Stortelder (1988, 24% clay and 10% organic matter) (United Nations Environment Programme/Nairobi Convention Secretariat and CSIR 2009). There are however, indications of elevated levels of zinc and lead in urban estuaries, and this is cause for growing concern (Ramessur 2004, United Nations Environment Programme/Nairobi Convention Secretariat and CSIR 2009).

Mozambique: Sources of pollution are land-based, particularly those associated with domestic and industrial waste from coastal cities and from the activities such as agriculture, industries, mining and operation in Ports. Most industries are concentrated around the coastal cities of such as Maputo, Matola and Beira. The industries discharge un- or undertreated effluents directly into the tidal channels or in coastal waters (Mozambique MEDA 2012). Heavy metals particularly lead have been found within the Port of Maputo, in the mouths of Matola and Maputo rivers and in Nacala Bay (Fernandes 1995, Anon Mozambique 2007). Agricultural activities within the coastal region also contribute towards chemical pollution through the use of pesticides and fertilizers. Pesticides found included 2,4,5-TCB, p,p'-DDT, p,p'-DDE, p,p'-DDD, lindane and HCB. Even though DDT is officially banned, it is still used in Mozambique and neighbouring countries (Massinga and Hatton 1997). While concentrations of DDT were found to be low, very high concentrations of HCH, likely from the use of the pesticide lindane, were recorded (Ogata et al. 2009, United Nations Environment Programme/Nairobi Convention Secretariat and CSIR 2009).

Seychelles: Port Victoria in Seychelles has been affected by industrial pressure, especially with the fishing industry, the tuna canning factory and the loading, unloading and transhipment of goods (Seychelles MEDA 2012). Analysis of heavy metals in coastal sediments in Seychelles has however shown that concentrations are quite low, with the exception of chromium, copper, lead and zinc, specifically in Port Victoria (Radegonde, 2008). Similarly, agricultural activities in Seychelles are generally small scale, so pollution from pesticides and fertilizers are minimal. DTT was historically used as a pesticide, but POPs such as DDT and Aldrin were banned in Seychelles. Stockpiles of these chemicals were disposed of, but there is a possibility of leaching from landfill sites. The analysis of coastal sediments for chlorinated pesticides such as Aldrin, Lindane, Dieldrin, pp'- DDT and the breakdown products of DDT (pp'-DDD and pp'-DDE), has shown that the concentrations of these chemicals are very low in Seychelles (United Nations Environment Programme/Nairobi Convention Secretariat and CSIR 2009).

Somalia: Fish factories, tanneries and slaughterhouses contribute to pollution of the marine environment in Somalia. Maritime activities also contribute to pollution through the release of (oil and ballast waters and) soluble PCBs (UNEP 2009). Noxious oils, organic and inorganic chemical wastes are also dumped into the sea on a regular basis and seepage from dump sites contain significant amounts of dissolved toxic metals and organic chemicals (Somalia MEDA 2012). The leachates from municipal waste disposal sites pose a serious pollution problem during the rainy season (UNEP 2009).

South Africa: Municipal and industrial wastewater discharges are regulated and licensed, and monitoring and assessment studies conducted in and around the offshore outfalls appear to indicate that these systems are helping to reduce the amount of contaminants entering marine waters (CSIR 2004, McClurg et al. 2007). Persistent organic and inorganic pollutants have however been measured in fish (e.g. Grobler et al. 1996), sharks (e.g. Watling et al. 1981), seals (e.g. Stewardson et al. 1999, Vetter et al. 1999), dolphins (e.g. Cockroft et al. 1991; de Kock et al. 1994, Vetter et al. 1999) and birds (e.g. Evans and Bouwman 2000) from South African coastal waters (South Africa MEDA 2012). Persistent organic pollutants have been found in the tissue of mussels collected near stormwater discharges and pose a potential human health risk (e.g. CSIR 2008a).

Tanzania: Alarming levels of PCBs were found in the Dar es Salaam harbour areas (Machiwa 1992 and Mwevura et al. 2002). Heavy metals such as lead (Pb), zinc (Zn), cadmium (Cd), chromium (Cr), mercury (Hg) and copper (Cu) have also been found in sediments samples and associated biota from waters within Dar es Salaam harbour and nearby coastal areas (Machiwa, 1992; Kondoro 1997; Muzuka, 1997). Concentrations were three-fold higher than in other areas. Monitoring conducted as part of the WIO-LaB project in 2007 found high concentrations of copper in sediments (United Nations Environment Programme/Nairobi Convention Secretariat and CSIR 2009).

Transboundary Scope

Chemical contamination can be transported with currents and in sediments, and is a typical transboundary issue, although there is no direct evidence of this occurring from within the ASCLMEs. All 9 countries identified the issue as being 'Relevant', only 2 of the countries ranked the issues as being of 'High' importance in the Level 1 prioritisation, a further 5 ranked it as being of 'Medium importance, and 2 ranked it as being of 'Low' importance. Only one country allocated an 'Overall ranking' score that was above average compared with the scores for the other issues within the MAC01. These results suggest that this issue is not considered to be a priority issue of concern for the countries within the ASCLMEs at this time

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	✓	✓	✓	✓	9
Importance	H	M	M	L	L	M	H	M	M	2
Overall ranking	12	11	18	12	12	15	17	7	11	1

1.3.4 Suspended solids in coastal waters due to human activities on land and in the coastal zone

Problem Statement

High concentrations of suspended solids enter the coastal waters of the ASCLMEs from municipal and industrial wastewater discharges, river discharges and surface runoff, particularly during the rainy seasons. Deforestation, poor agricultural practices, mining and dredging activities (usually associated with ports and harbours) can significantly contribute to this transboundary problem. High suspended solids have both chronic and acute effects on marine biota: they block the penetration of light through the water column affecting photosynthetic organisms, and when they settle they can smother organisms, clogging gills and feeding apparatuses of filter feeding marine organisms. Sedimentation can result in mortality of some species and therefore lead to shifts in community compositions. The loss of critical habitats such as mangroves, corals or seagrasses due to sediment loading may also have negative impacts on fisheries.

National Scope

Comoros: Erosion of the catchment areas, due to deforestation, has increased the sediment load entering coastal waters. This has led to sedimentation and siltation of the reefs, smothering the corals, especially on the reef flat. The high sediment influx into the lagoon coupled with the effects of global changes (ENSO 1994 and 1998), also resulted in the disappearance of *Thalassodendron ciliatum* seagrass beds (Comoros MEDA, 2012).

Kenya: Increased discharge of sediment loads in Malindi Bay (GOK 2008) affected the coral reefs in the Malindi National Park and Reserve (McClanahan and Obura 1997, Kazungu *et al.* 2002,

Kitheka et al. 2003a) and resulted in a decrease in the number of seagrass species, from four to two species (Wakibia 1995). Poor land use practices and an increase in development activities in the Athi-Sabaki River Basin resulted in higher sediment fluxes and a reduction in the depth of the photic zone and productivity in coastal water. High sediment loads in the Athi-Sabaki and Tana estuaries have led to very high turbidity of waters in Ungwana Bay (Kitheka et al. 2003a,b, Kitheka et al. 2005). Sedimentation has resulted in significant impacts on mangrove areas, smothering the root systems of trees and causing die-back of these forests (Kitheka, et al. 2005). Heavy sedimentation in Mwache Estuary has also led to degradation of a large expanse of mangrove forest located in the estuary (Kitheka et al. 2003b). Sediment deposition and beach accretion (e.g. in Malindi Bay) have resulted in the loss of beach frontage from some hotel and resort developments in Kenya, with a consequent loss of tourism revenue and employment (Kazungu et al. 2002, Kitheka et al. 2003a, b). The Port of Mombasa requires regular dredging of the navigational channel to maintain the depth required for shipping activities contributing further to high loads of suspended solids (Kazungu et al. 2002).

Madagascar: Sediment loads from river catchments are recognised as a major concern. The major source of suspended solids originate from the Ifaho River, and particle charge and turbidity decrease depending on the distance from the mouth. Discharge of suspended solids from the Toliara Water Basin has been estimated at approximately 6 million tons per year (Musyoki and Mwandotto 1999 cited in Payet and Obura 2004). Sedimentation has resulted in significant impact on mangrove areas, smothering the root systems of trees and causing die-back of these forests (Mong et al. 2009). Mining activities also contribute to an increase in suspended solids through the discharge of sludge mineral suspensions (Anonymous 2003).

Mauritius: Coastal waters around Mauritius are normally crystal clear apart from during heavy rains when river flooding is a common occurrence. Large amounts of debris and soil are discharged into the lagoons leading to seawater turning from blue to red brown (Mauritius MEDA 2012). High sedimentation and associated high turbidity have also been reported in the lagoon at Rodrigues, some of the bays are silted and channels have been constructed to facilitate the movement of boats (Mauritius MEDA 2012).

Mozambique: The excessive inflow of sediments in the coastal and marine environments of Mozambique are due to bad land-use practices which, among others, include poor farming practices and deforestation in the coastal and hinterland areas. Shoreline stability in the estuaries and adjacent coast is mostly dependent on the input of sediments from rivers. Given that sediment dynamics is governed by the river runoff, freshwater shortages lead to a sediment deficit, and coastal erosion. In Maputo and Beira harbour the siltation is further aggravated by the systematic dredging of the navigational channels (FAO 1999).

Seychelles: Construction and development activities in the upper regions of Seychelles has also resulted in disturbances of soil materials, which are deposited into the lower areas, where the flow of water slows down. This has resulted in excessive silting of the lower part of rivers occurs (Seychelles MEDA 2012).

Somalia: Poor farming practices upstream increase in the siltation of the rivers (UNEP 2009). Destruction of mangrove forests is also leading to heavy offshore siltation and alteration of nutrients pathways for offshore species. Municipal wastes containing organic materials and suspended solids and other contaminants are released directly into the sea as there is no capacity to treat wastes in the coastal municipalities. Mining and dredging also increase in siltation of the rivers in Somalia. Limestone mining of fossil coral reefs (beach rock) occurs in the south, in towns such as Marka and Barawe. The lime is used in house construction, whitewashing and decoration. The mining for limestone degrades the coastal landscape and leads to coastal inundation, sedimentation and erosion. The main threats to coral reefs and seagrass include smothering due to siltation (Somalia MEDA 2012).

South Africa: Sand mining activities in South Africa modify flows, produce high suspended solid loading and destruct riparian and in stream habitats (South Africa MEDA 2012).

Tanzania: Seagrass beds and coral reefs in Tanzania are threatened by various natural and human activities including excessive sedimentation, increasing turbidity and reducing light penetration and shoreline dynamics involving sand deposition and removal (Whitney et al. 2003, Wells et al., 2004, Tanzania MEDA 2012).

Transboundary Scope

Increased sediment loads in coastal waters and increased sedimentation affect transboundary waters, habitats and associated living marine resources within the ASCLMEs. All 9 of the countries recognised the issue as being 'Relevant'. Only 4 of the 9 countries considered the issue to be 'High' priority, another 4 recognised the issue as being of 'Medium' importance, with only one country ranking the issues as being of 'Low' importance. The 'Overall ranking' scores were above average for only 2 countries, indicating that is not considered to be a priority issue by the countries of the ASCLMEs at this time.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	✓	✓	✓	✓	9
Importance	H	H	H	L	H	M	M	M	M	4
Overall ranking	11	13	17	12	15	17	10	8	17	2

1.3.5 Solid wastes / marine debris (plastics etc.) from marine and land-based-sources

Problem Statement

Solid waste materials that are introduced into the marine environment are also often referred to as marine litter. Marine litter typically originates from the inappropriate disposal of waste from urban centres (ports, industrial and commercial areas, informal settlements and tourism developments) or from vessels or industries such as mining. Solid wastes may be dumped on land and transported by rivers into the sea; dumped on the shore and carried out to sea by waves and currents or dumped directly into the sea.

National Scope

Comoros: Due to the lack of an effective waste collection, processing and disposal system the population indiscriminately dispose of their garbage along the road, in the sea along the coast, in a river or near their homes (Comoros MEDA 2012). This results in an accumulation of garbage and degradation of urban and coastal and marine habitats. With the rapid population growth, uncontrolled urbanization, household waste production, as well as other potentially more dangerous medical waste, will continue to increase. Uncontrolled open air waste incineration causes toxic fumes, which include dioxins and furans emissions, and foul odours that in turn cause allergies and lung diseases. These conditions are unhealthy for the local communities and a deterrent for tourism (Comoros MEDA 2012).

Kenya: Dumping of solid wastes in Kenya occurs around urban areas and tourism centres (Kenya MEDA 2012). High population concentration along the coast is leading to increased generation of waste and waste management is a major challenge for most of the main urban coastal centres. Garbage collection services only cover only 50% of the population. Dumpsites are located and managed poorly. Municipalities do not have adequate budgets hence the available staff are poorly paid and not motivated to work, and garbage collection vehicles are not

adequate. The private sector operates on a localised scale, while small-scale solid waste management groups lack means of transport. Solid waste on the public beach is now a major problem, even in areas where there are official waste bins (Kenya MEDA 2012).

Madagascar: There are inadequate collection systems and safe modes of disposal or litter treatment systems. Incinerators, treatment equipment are run-down and insufficient. There is a widespread use of traditional techniques/technologies such as garbage embankment fills, burial of hospital litter, open-air burning and open dumpsites. About 10% of household waste is disposed at authorised sites; while 40% goes to inadequately managed sites and 50–70% is illegally dumped. Mining activities also contribute to an increase in solid waste. There is concern that marine wastes such as plastic bags are a threat to turtles which feed on jellyfish (Hirama and Witherington 2006) and abandoned fishing gear such as cast nets can also trap and drown all species of turtles. Seabirds can also be affected by marine debris and can become be entangled in nets and other discarded fishing gear. Population pressure has increased the number of settlements in the vicinity of mangrove forests, and led to dumping of garbage and other waste into mangrove forests leading to their degradation (Madagascar MEDA 2012).

Mauritius: The waste disposal infrastructure is adequate and facilities exist for collection and disposal. Waste is collected and brought directly through the four transfer stations to a landfill site. Solid waste and marine litter in the marine environment does however need to be better addressed (Mauritius MEDA 2012). Garbage from fishing boats is one of the main sources of pollution in Port Louis harbour waters (Mauritius MEDA 2012).

Mozambique: The municipalities do some waste removal, but this needs improvement (Mozambique MEDA 2012). Tourism operators and environmental non-governmental organisations do almost all of the beach clean-ups with limited support from the municipalities or government institutions. Efforts at the central level currently need to be directed towards the creation of and upgrading of waste reception facilities at the main ports (Mozambique MEDA 2012).

Seychelles: Over 90% of the solid waste stream is collected, treated and disposed of in an environmentally acceptable manner (Seychelles MEDA 2012). There are also regular and frequent cleaning programmes for all the rivers and beaches in the Seychelles, and also in the sea and yacht basin. On the outer islands, debris and marine litter from the sea is the main cause of pollution (Department of Environment 2009) and there have been various instances where marine debris has been swallowed by turtles or found entangled around the animals (Seychelles MEDA 2012).

Somalia: The expansion of urban areas has increased solid waste generation and dumping of garbage directly onto the sea shore. Due to lack of regulation, almost all the coastal cities and towns use the beaches as garbage dumping sites. Over the years, a huge volume of garbage has accumulated on the beaches, and plastics are a major concern on turtle beaches in Somalia (Somalia MEDA 2012).

South Africa: Port reception facilities are adequate in the commercial ports, but not in fishing and recreation harbours (South Africa MEDA 2012). On land, solid waste collection services and disposal sites are currently largely adequate, except for informal settlements. Compacting, landfill and incineration are used, but this is not sustainable and pressure is mounting to reduce the waste stream. Effective storm water screening devices have been developed and tested but not yet installed in most places (South Africa MEDA 2012).

Tanzania: There is insufficient equipment for the collection of waste, and for covering waste dumpsites (Tanzania MEDA 2012). All dumpsites are open, no treatment is done, and hence litter is easily blown by the wind and transported by water to stormwater drains and rivers and eventually into the ocean. Most recyclable items, such as plastic bottles, containers and bags,

are scavenged from the waste collection points and dumpsites. Tourist hotels generate large quantities of solid wastes (Tanzania MEDA 2012).

Transboundary Scope

Marine litter and solid waste is a transboundary issue affecting all 9 countries within the ASCLMEs. Furthermore, 6 of the 9 countries ranked the issue as being of 'High' importance at the national level in the Level 1 prioritisation and; 7 of the 9 countries allocated above average scores for the 'Overall ranking'. This suggests that solid wastes is considered to be a high priority transboundary issue by the countries within the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	✓	✓	✓	✓	9
Importance	H	H	H	L	H	M	H	M	H	6
Overall ranking	15	18	16	14	17	19	16	10	18	7

1.3.6 Oil spills (drilling, exploitation, transport, processing, storage, shipping).

Problem Statement

Oil spills may occur as a result of drilling, exploitation, transport, processing, storage and shipping. All countries in the region have downstream oil storage facilities, and some but not all have processing facilities. While some countries have started offshore exploration, only a few have commenced drilling, therefore the most common cause of spills at present is from transportation and shipping. Pollution from shipping can occur as a result of the release of oily bilge water and oil sludge from engine rooms, accidental oil spills from damaged tankers, and blasting and cleaning operations. All marine traffic calling at ports or in transit within the ASCLMEs pose a risk oil pollution resulting from collisions, groundings, oil cargo and bunker transfers, structural failure or any other number of maritime emergencies or accidents. The Mozambique Channel is a major route for large oil tankers, with an estimated 450 million tonnes of hydrocarbon products transported by large crude oil carriers every year. The risk of oil spills is therefore high, and there have already been a number of medium sized oil spills with serious impacts on biodiversity and critical habitats within the region. Offshore installations pose an additional newer risk, but no major spills have yet occurred from an offshore installation in ASCLMEs. New port developments, increased shipping traffic and an increase in oil operations in the region will increase the risk of oil spills in the future.

National Scope

Comoros: Over 30% of the world's oil production passes the Comoros, representing more than 5000 tanker trips per year, and the risk of accidents increases during the cyclone season. To date only one accidents has occurred, when the *Taurus* boat caught fire in March 2007 near the port of Moroni with 60 tonnes of diesel on board. There have been smaller spills when ships empty their ballast water at sea, or during the transhipment of oil products in ports and oil depots (Comoros MEDA 2012).

Kenya: Kenya has a downstream oil industry, and East Africa's only refinery, which produces 1.6 million tonnes annually in Mombasa. Spillage from the British tanker *Cavalier* caused considerable damage to mangrove forests in Mombasa in 1972. This coastline has since been subject to a further five severe spills, resulting in mangrove dieback, especially in Mida Creek where the effects of oil spills were still evident 10 years after the last oil spill incident (Abuodha and Kairo 2001). A spill in Makupa Creek during 1988 caused massive death of mangroves.

Seagrass habitats have also been impacted (Abuodha and Kairo 2001). Dispersants commonly used to clean up oil spills contain toxic solvents which penetrate the protective waxy cuticles of seagrass blades. This affects the biological functioning of cellular membranes and chloroplasts, thereby causing plant loss and as well as harmful effects in other benthic biota (Ellison and Farnsworth 1996, Abuodha and Kairo 2001). Kenya has demarcated 17 blocks for petroleum rights negotiations, all offshore exploration is currently being undertaken by the private-sector. The current expansion of Kilindini Port and the development of Lamu as a free port bring increased risks of oil pollution and consequent impacts (Kenya MEDA 2012).

Mozambique: More than 16,000 tonnes of heavy fuel-oil were spilled by the *Katina P* tanker in 1992 threatening the coastal and marine ecosystems, and extensive areas of mangrove forest near Maputo were destroyed (Munga 1993). The port of Beira has the largest petroleum refinery (with a capacity of nearly 110,000 m^3) and a pipeline which pumps 1 to 1.5 million tons of petroleum to Zimbabwe every year. There are more ports in the country with oil storage facilities from or to which oil is pumped with associate risks for oil spills during the course of the operation. The prevailing winds (South-easterly trade winds) make the Mozambican coast vulnerable to spills in the Mozambique Channel, as evidenced during the *Katina-P* oil spill in 1992 near Maputo Bay (Massinga and Hatton 1997, Mozambique MEDA 2012) .

Seychelles: There has not been a major oil spill reported in the Seychelles and, although there are incidents or minor spills, understanding of diffuse and non-point sources in the marine environment is limited (Seychelles MEDA 2012). The downstream oil sector is a vital component of the Seychelles economy, with fuel and liquefied petroleum gas accounting for over 25% of total imports in the country. Oil sector activities include importation and distribution of refined oil and liquid petroleum gas, storage and marketing of petroleum products, marine bunkering, aviation refuelling, bulk storage and transhipment and transportation of petroleum products by tankers. Oil exploration efforts commenced in 1969, but significant reserves have yet to be discovered. The government of Seychelles is keen to encourage foreign oil companies to partake in further hydrocarbon exploration survey through the Petroleum Mining Act of 1976 (Seychelles Investment Bureau 2009). The potential side-effects of offshore oil exploration, particularly on marine ecosystems has also been highlighted as a threat in the future (Seychelles MEDA 2012).

Somalia: In the vicinity of coastal cities, municipal waste, noxious oils, organic and inorganic chemical wastes is dumped into the sea on a regular basis. Maritime activities also contribute to pollution through the release of oil and ballast waters and soluble PCBs from these products (UNEP 2009). The coast has not yet been subject to extensive oil and gas exploration and several areas with world-class potential remain to be tested. Prior to the onset of the civil war in December of 1990, several concessions were held by major international petroleum companies and at least three key wells were scheduled to be drilled. Some large multinational oil companies were interested in exploring different sedimentary basins of Somalia. However, due to political instability and war, no further work in this area has been done despite the high potential for discovery of deposits (Somalia MEDA 2012).

South Africa: There have already been a number of spills in South African waters. The *Kapodistrias* ran aground off Cape Recife, Eastern Cape in 1985 (Randall and Randall 1986) and at least 137 penguins died from oiling and 1,043 oiled penguins were rescued for rehabilitation. After the *Treasure* oil spill of 2000, more than 40,000 African penguins were caught for rehabilitation, relocation (to Cape Recife) or captive rearing during (Crawford et al. 2000). Oil and gas exploration commenced in 1967 and about 300 petroleum wells have been drilled (Broad et al. 2006) centred on the commercial oil fields of the Outeniqua Basin with the Transkei, Zululand and Durban Basins receiving considerably less attention. The petroleum industry contributes 2% to GDP. The country produces 35,000 bbl/d of oil, with proven reserves estimated to be 15 million barrels, and also produced 115 billion cubic feet of gas in 2008, with

reserves estimated to be 320 billion cubic feet. South Africa also has Africa's second largest oil refinery system, comprised of four refineries and two synfuel plants producing 692,000 barrels per day (bbl/d) in 2008. Around 19 million tons of crude oil is imported into South Africa annually, while approximately 120 million tons pass South African coasts bound for world markets, hence there is a significant risk of an oil spill incident. Furthermore, the increase in shipping traffic due to the piracy taking place off the Somalia coast, and port expansions now pose a new concern (South Africa MEDA 2012).

Tanzania: An increase in oil operations (drilling, exploitation, transport, processing, storage, etc) in Tanzania is predicted to increase oil spill risks. Oil and gas production commenced recently in the Songo Songo archipelago, off the southern Rufiji delta, and Mnazi Bay, and both pose a threat to marine biodiversity due to general disturbance (e.g. pipe laying) and oil/gas leaks. Numerous companies are currently exploring potential oil reserves, and 13 offshore blocks are expected to be conceded in the near future. The old refinery in Dar es Salaam was closed in 1999, but this is still the centre for downstream activity, as it handles imports of liquid petroleum gas (LPG), stores oil products, receives gas from the 230 km pipeline connected to Songo Songo, supplies Burundi, Uganda, Rwanda and Eastern Conco and transports crude oil through a pipeline to the Indeni oil refinery in Zambia. There are also plans to construct a new oil refinery in Dar es Salaam, as well as upgrading of oil storage capacity in Dar es Salaam and increasing of capacity at the Songo Songo gas field, all of which should be conducive to growth in the sector. However there are concerns as the country has weak petroleum regulations, human capacity constraints, and an inconsistent EIA framework. Increases in oil operations, both upstream and downstream, will intensify the risk of spills and accidents (Tanzania MEDA 2012).

Transboundary Scope

Oil spills in the marine environment can have devastating transboundary impacts, and all countries recognised the issue as 'Relevant'. Furthermore 6 of the 9 countries ranked the issue as being of 'High' importance at the national level. Only 4 of the 9 countries allocated the issue an above average score for the 'Overall ranking' suggesting that the countries do not consider this to be a priority transboundary issue within the ASCLMEs at this time.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	✓	✓	✓	✓	9
Importance	H	H	H	M	H	L	H	H	M	6
Overall ranking	15	12	20	12	8	22	17	9	12	4

9.3 MAC02 HABITAT AND COMMUNITY MODIFICATION

The ASCLMEs hosts a huge diversity and complex array of different coastal and marine habitats including some of the world's critical habitats (seagrass, coral reefs and mangroves), that are important not only for the biodiversity that they support, but also for carbon retention, food production and natural shoreline protection. Coastal and marine habitats are under increasing pressure from the intensification of human activities in the coastal and marine environment. As coastal populations continue to grow, in part fuelled by rural poverty, and as people move to the coast to seek employment, these pressures will continue to grow. Inadequately or completely unplanned coastal developments, destructive fishing techniques, and the expsnion of the extractive industries will continue to contribute towards the degradation, disturbance, fragmentation, or complete removal of habitats. The loss of these natural habitats will affect the flora and fauna that depend on these for different life stages. The issue categories identified from the MEDA and included in this Main Area of Concern are described below:

2.1. Shoreline change, due to modification, land reclamation and coastal erosion

Problem Statement

Shoreline changes (erosion and accretion) can occur as a result changes in environmental processes that control sediment transport patterns or as a result of direct anthropogenic interventions and construction. Changes in environmental processes may occur as a result of shifts in wind and wave patterns and sea level rise, arising from shifts in the climate related processes. Changes in land use can result in shifts in sediment loads entering from rivers. Direct anthropogenic interventions, such as flat-land reclamation schemes or the construction of coastal defences other coastal development works, dredging, and sand mining can also all contribute towards the modification of shorelines. Coastal erosion is a major environmental concern within the ASCLMEs and leads to shifting coastal features such as dunes, beaches and shoreline, loss of coastal vegetation and coastal flooding.

National Scope

Comoros: There are no official and reliable data sources on the extent of coastal erosion in the Comoros other than the observations (Comoros MEDA 2012).

Kenya: Shoreline changes (erosion and accretion) have occurred due to changes in sediment loads from rivers, increased wave climate and coastal development. Erosion as a result of sand and coral mining could also become problematic in Kenya if not attended to. Vulnerability assessments have been used as a tool to identify and map areas that need management attention against occurrences of floods, erosion and oil spill (Kenya MEDA 2012).

Madagascar: Coastal erosion is particularly noticeable at Morondava, Manakara and Mahajanga (Madagascar MEDA 2012). Morondava and neighbouring areas on the west coast have long been affected by high rates of coastal erosion, and breakwaters were constructed on the beach,. In the cases of Manakara and Mahajanga, coastal erosion is a more recent phenomenon (Madagascar MEDA 2012). The east coast of Madagascar has also been affected, and the avenue bordering the beach of Toamasina city has been destroyed. Ports, cultural and historical sites located along the coast and tourist beaches are exposed to higher risks of loss due to coastal erosion (Tsangandrazana 2007). Coastal retreat due to wave erosion was estimated between 5.71 m and 6.54 m in 1997, and estimated to reach approximately 225 m by year 2100 (Madagascar MEDA 2012).

Mauritius: Enhanced coastal erosion due to human activities only become noticeable a few decades ago. Hard structures placed too near the shoreline gave rise to localized erosion. Seawalls built to contain the erosion gave rise to further erosion downstream and other protection measures were taken (Mauritius MEDA 2012). Cyclonic waves are however also a

contributory factor responsible for removing large quantities of sand from the beach and lagoons (Mauritius MEDA 2012). Tropical cyclones will most likely become more intense and higher waves will be formed and as a consequence, coastal erosion will be enhanced. Coastal erosion also occurs due to waves, "raz de marée" (tidal surges) in the winter and transitional months, which can result in coastal flooding. Accelerated sea level rise has been recorded in Mauritius, Rodrigues and other islands in the West Indian Ocean (Ragoonaden 2006). This is a matter of serious concern in the event that the trend continues. Coastal erosion is expected to worsen threatening more coastal infrastructure and settlement (Mauritius MEDA 2012).

Mozambique: Coastal erosion is recognised as an important issue. More than 90 % of the coastline erosion is due to natural processes that occur as a consequence of tropical cyclones and sea level rise, resulting in retreat of the coastline (Mozambique MEDA 2012). The instability of the coastline in Mozambique is however thought to be due to the deposition of materials brought by rivers currents, as well as erosion due to the strong currents toward the mouths of the rivers especially during floods. The maximum erosion values occur in the southern border beach-dune system (Ponta do Ouro) due to disturbance of the dune systems from construction by the recent tourism activities in the region (Mozambique MEDA 2012).

Seychelles: Major reclamation works were carried out off the east coast of Mahé in Seychelles to meet flatland demands for additional development and urbanization (Bijoux et al. 2008, Seychelles MEDA 2012). These resulted in the loss of coral reefs and shoreline change. Coral rubble was used as fill during the reclamation, and this resulted in erosion on one side and accretion on the other, damage to the benthic habitat and altered the coastal and nearshore hydrodynamics (Pulfrich et al. 2006). Other contributory factors include changes in wind and wave patterns during the monsoons as well as unregulated coastal development. Synergistic interactions of spring tide and surges further exacerbate coastal erosion. The prevalence of coastal erosion is more likely to follow the existing trend and further escalate as a consequence of global and local natural and anthropogenic changes (Seychelles MEDA 2012).

Somalia: Most of the Somali coastline has been seriously affected by coastal erosion, especially in the eastern and southern regions (Somalia MEDA 2012). Coastal erosion is an issue of major concern in view of its impacts on valuable land, loss of vegetation in addition to destruction of infrastructural facilities and properties. Poor farming practices upstream cause an increase in the siltation of the rivers in addition to mining, urban development and dredging. As a consequence, the coastal configuration, accretion and erosion patterns and associated ecosystems are changing (UNEP 2009). Sand mining is very popular in all coastal towns and fishing villages. It is mixed with cement, coastal soil and gravel to make bricks. This destabilizes the coastal sand dunes, which already caused severe coastal erosion (Somalia MEDA 2012).

South Africa: Bridges and causeways for coastal roads and railway lines have disrupted estuarine floodplains in many areas, aggravating floods, increasing sedimentation and limiting seawater exchange, which has a range of ecological impacts including coastal erosion. The Durban harbour, Africa's busiest port, interrupted the natural northerly pattern of sediment drift and affected wave refraction, resulting in beach erosion to the north. Durban's beaches are therefore artificially maintained by a sand-pumping scheme that replenishes some 280,000 cubic metres of sand every year (South Africa MEDA 2012). The harbour development at Richards Bay has also interrupted the natural sediment drift pattern, causing sand to accumulate against the southern breakwater (South Africa MEDA 2012). It has also destroyed the dune-field where much of the northward-moving windblown sand would have naturally accumulated (South Africa MEDA 2012). Estuaries and rivers are exploited by a number of sand-winning operations.

Tanzania: The problem of shoreline changes, particularly coastal erosion has increasingly become one of the major issues of concern and has been a recurrent problem in many coastal

areas, including the islands of Zanzibar (Tanzania MEDA 2012). Coastal erosion problems are mainly caused by wave action on the shoreline. Between 1981 and 2002, between 2.04 ha and 2.60 ha of the beach near Dar es Salaam were eroded by wave action (Makota et al. 2004). Recently, Almström and Larsson (2008) concluded wave generated longshore transport is the governing process for moving sediments along the Kunduchi beach area. Lwiza (1994) also recognised the influence of waves on coastal erosion in Tanzania (Tanzania MEDA 2012).

Transboundary Scope

All 9 countries identified shoreline change and coastal erosion as 'Relevant' and 6 of the 9 countries ranked the issue as being of 'High' importance, with the exceptions being Comoros and South Africa (although this may be due to a lack of data in the Comoros). In the Level 2 prioritisation, 7 of the 9 countries assigned the issue an 'Overall ranking' score that was above average, indicating that the countries consider this to be a priority transboundary issue of concern in the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	✓	✓	✓	✓	9
Importance	M	H	H	H	H	H	L	M	H	6
Overall ranking	17	18	12	22	22	24	13	14	22	7

2.2. Disturbance, damage and loss of coastal, watershed and upland habitats

The ASCLME hosts a diversity of different coastal and waterhsed habitats, which support a range of different biodiversity. For these purposes, upland watershed habitats are those inland habitats, above 10 m elevation, whereas coastal habitats are those from high water mark to < 10 m.

2.2.1. Disturbance, damage and loss of upland / watershed habitats (>10 m elevation)

Problem Statement

Disturbance to upland and watershed habitats occurs throughout the countries of the ASCLMEs. Changes in land use and poor land management practices, including the removal of natural vegetation from watersheds, can destabilise soil structures, and result in the loss of top soil, which is transported and into the coastal and marine environment via watercourses or in surface run-off. The degradation of upland watershed habitats can impact shorelines through causing shifts in coastal sediment budgets, and result in siltation, changes in erosion and accretion patterns and coastal flooding. Marine water quality may decrease due to increased turbidity, and critical habitats may be impacted by increased sedimentation and nutrient enrichment, particularly during heavy rains or floods.

National Scope

Comoros: Due to the high population density (300 inhabitants/km²), the lack of land use planning and the land tenure policy, there is uncontrolled land clearing and deforestation for agricultural purposes, and logging. Deforestation has led to increased siltation and a reduction in groundwater supplies. To control deforestation, different projects have focussed on sustainable techniques for forest restoration and better agricultural practices have been undertaken. However, the migration of farmers between islands is increasing and necessitates the expansion of farming areas.

Kenya: Land use change has had significant impacts on the coastal and marine environment (UNEP/Nairobi Convention, 2010). Construction activities, poor agricultural practices and deforestation in the river basins have intensified habitat destruction and soil erosion resulting in high sediment load into the coastal water. This has the effect of reducing the depth of the photic zone thus limiting productivity of the marine ecosystems (Kenya MEDA 2012). Poor land use practices in the Athi- Sabaki River Basin for instance, has resulted in the increased discharge of huge volume of sediments in Malindi Bay with far reaching ecological and socio-economic consequences. Massive sedimentation interferes with growth of mangroves and also smothers coral reefs and sea-grass beds (GOK , 2008).

Madagascar: The destruction and burning of vegetation in the Highlands of Madagascar causes massive erosion and an estimated 40 to 50 million tons of topsoil are carried to the seas every year (Rabesandratana 1984). This results in hyper-sedimentation in coastal zones. For example, poor cultivation techniques used by rice growers along the river banks resulted hypersedimentation around the Onilahy river mouth in the 1990s. The proliferation of invasive insects, leading in turn to the reduced variety of insects, following bush fires and deforestation, were considered to be factors which contributed to the high erosion rates (CNRE/CNRIT/IHSM 2000) (Madagascar MEDA, 2012).

Mauritius: Upland watershed habitats were drastically modified by the early settlers. The first settlers on Mauritius exploited the ebony forests and introduced alien species, which severely damaged the islands ecosystems and indigenous species through over- grazing and predation. Cheke (1987) described the ecological history of the Mascarene islands, and documented deforestation and change in land use. On Mauritius, natural vegetation cover reduced to less than 1% of original cover, with most clearance having taken place between 1773 and 1835, and a similar pattern of change in natural vegetation occurred later on Rodrigues. On Reunion, however, the rugged volcanic topography preserved more of the natural vegetation. Sugar cultivation on Mauritius and Reunion began under French governance in the 1720s and this period was characterized by establishment of the agricultural economy and motivation to sustain and increase productivity of the land, using slave labour (Turner and Klaus 2005). Free-roaming livestock and poor agricultural practices continue on Rodrigues, contributing to degradation of terraces, increases soil erosion.

Seychelles: Early settlers caused considerable damage to the natural vegetation cover on some of the inner islands of the Seychelles. Since then due to both the inner islands' geomorphologic features (mountainous with coastal plateaus) and the protection plan (mountainous parts normally falling into National Parks), much of the development for local residences or rural expansions are taking place along the coast. The participants at the National CCA Meeting therefore identified this issue as 'Not Relevant'. The MEDA goes onto discuss how, this albeit, non urban and controlled expansion should still be taken into account for it could cause additional stress on the coastal areas if not monitored and controlled accordingly (Ministry of National Development 2009). Increases in urban development have been shown to cause an increase in the volume of water flowing into the lower drains, with the potential for coastal flooding. Furthermore the introduction of invasive plants also causes habitat modification in Seychelles. For example, populations of *Sterna fuscata* (Sooty Tern) have suffered declines due to the replacement of indigenous vegetation on the islands where they breed with copra plantations, for the coconut *Cocos nucifera* (Feare et al 1997).

Somalia: Floodplains are being urbanised as population pressure increases (FAO – SWALIM 2009). Heavy rains are intensifying catchment soil erosion and desertification is increasing due to increased frequency of extreme droughts (Somalia MEDA 2012).

South Africa: Land degradation and erosion in inland areas, associated with unsustainable intensive commercial land uses (i.e. forestry, sugarcane and livestock) and in the poverty-

stricken communal areas, heavy grazing pressures and poor land use management practices, result in high levels of land degradation and erosion.

Transboundary Scope

Eight of the 9 countries identified degradation of upland / watershed habitats as 'Relevant', with the exception being Seychelles due to the majority of upland areas on these islands being protected as 'National Parks. Furthermore, 7 of the 9 countries ranked the issue as being of 'High' importance, with the exception Mauritius. In the Level 2 prioritisation, 6 of the 9 countries assigned the issue an 'Overall ranking' score that was above average, indicating that this is an priority transboundary issue of concern to the countries in the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	NR	✓	✓	✓	8
Importance	H	H	H	M	H	NR	H	H	H	7
Overall ranking	17	24	18	12	21	NR	17	18	18	6

2.2.2. Disturbance, damage and loss of coastal forest habitats

Problem Statement

Coastal forests cover an area of roughly 620,000 ha [Lucy do you have a better estimate of coastal forest coverage] (excluding the islands) along the mainland East African coast and extend from southern Somalia to southern Mozambique. These forests are composed of a large number of remnant forest and thicket patches, which are typically small and fragmented. Despite this they tend to support high levels of biodiversity and exceptionally high levels of endemism, often varying dramatically from one forest patch to the next. There are different types of closed canopy forests within the region including: dry forest, scrub forest, Brachystegia forest, riverine forest, groundwater forest, swamp forest, and coastal/afromontane transition forest. Endemism is particularly high within the remaining closed canopy forest patches. The forest patches are surrounded by coastal woodlands, wetlands, grasslands and farmlands that are much less biologically distinctive, but still support additional endemic species. Coastal forests provide a wide range of wood and non-wood products for local use, and support the livelihoods of an estimated 20 million people who live along the eastern African coast in Somalia, Kenya, Tanzania and Mozambique. The forests are increasingly threatened by expanding agriculture, charcoal production, uncontrolled fires, unsustainable logging and the expansion of settlements. Disturbance to coastal forests impacts on the marine environment through clearing of buffer vegetation in environmentally sensitive areas close to shorelines, resulting in increased erosion and sedimentation.

National Scope

Comoros: Poor agricultural and forestry practices such as burning, clearing of the forest, are an issue of concern (Comoros MEDA 2012).

Kenya: Coastal forests in Kenya cover 139,000 ha and important areas include Arabuko Sokoke, Diani, Shimba hills (Kenya MEDA 2012). These unique lowland tropical forests are known locally as Kayas. The Kaya forests are distributed in few remaining patches along the coast which have a high cultural significance to the local Mijikenda community who have traditionally used them for religious and spiritual rituals (Blackett, 1994). The sacred values associated with these forests have contributed to their conservation and growth of forest tourism in the coast region.

However, cultural belief associated with the Kayas is progressively being eroded which is threatening the traditional management and conservation of these important indigenous forests. Coastal populations are highly dependent on forest resources for their daily needs (food, medicines, and general livelihoods). Degradation of coastal forests impact upon these communities and the marine environment through clearing of buffer vegetation in environmentally sensitive areas close to shorelines, resulting in increased erosion and sedimentation (Kenya MEDA 2012).

Madagascar: Heavy dependence on subsistence agriculture, and particularly traditional tavy agriculture, has caused massive deforestation and threatens to continue to do so due to high poverty levels, rising population growth and limited non-agricultural income-generating opportunities. Madagascar has also lost much of its forests due to illicit logging and agriculture, which has had a serious impact on adjacent ecosystems. The degradation is particularly severe near Toliara, where forest land was largely eliminated. Continental forests along the coast are rapidly declining and as a result, and now mangroves are also being increasingly exploited for its timber and energy resources as a result (Madagascar MEDA).

Mauritius: Although there are still small pockets of forest (40 km^2) on Mauritius and Rodrigues, very little of the native forests remain. The first settlers on Mauritius exploited the ebony forests and introduced alien species, which severely damaged the islands ecosystems and indigenous species through over- grazing and predation (Turner and Klaus 2005). In Rodrigues, clearance by fires for agriculture and introduction of cattle began in the early 1800s and continued through the 1900s (Turner and Klaus 2005). Replantation work by the Mauritian Wildlife Foundation, has been attempting to re-introduce native species and improve forest cover. At the National CCA Meeting, participants identified this issue as 'Not relevant'.

Mozambique: The utilization of cropping, as well as firewood and charcoal production, to supply urban centres has resulted in extensive deforestation of coastal forests. The forestry sector is estimated to contribute between two and three percent to total GDP in Mozambique (Suich 2006). In excess of 70% of the value added of forestry and forestry products is thought to be accounted for by subsistence production with the remainder consisting of market fuelwood production, industrial roundwood and processed wood production (Suich 2006), only part which will be from activities within the coastal zone.

Seychelles: Much of the upper mountainous slopes of the inner Seychelles are protected. There are few land-based opportunities in Seychelles, thus, agriculture and forestry contributes far less economically than the more dominant tourism and fisheries sectors. Subsistence agriculture and forestry does however, contribute 6% to GDP and agriculture alone employed nearly 6% of the labour force in 1995. Traditional exports of cinnamon and copra have also recently been revived, as the government continues to provide incentives to the sector to increase productivity.

Somalia: The MEDA does not discuss coastal forests.

South Africa: The southern Cape has remnants of Afromontane forest, while the Eastern Cape has large areas of subtropical thicket. The high-lying interior is dominated by grasslands, while KwaZulu-Natal has lush subtropical forests interspersed with savannah, which also occurs in the far north of the country. Coastal habitats, including coastal forests, are vulnerable to the increasing pressure of increased population density and the associated development, mining, agriculture and afforestation, habitat fragmentation and alien plant invasion (South Africa MEDA, 2012).

Tanzania: Coastal forest are now recognised as a key resource under threat by the Government. Fuelwood and charcoal are the main sources of energy for most people in the coastal region of Tanzania. The lack of an alternative energy for cooking, has resulted in unsustainable harvesting and imposed severe demands on forest resources. In addition there is a major threat posed by

the demand for land for export oriented production, including bio-fuels, which without careful management, will be detrimental rather than being beneficial to coastal livelihoods. The promotion of participatory forest management by the government and international NGOs such as WWF have focused on the empowerment of local communities to manage their own resources. Likewise, alternative sources of income generation, such as beekeeping, honey production, and tree nursery management have highlighted potential substitutes in this sector (Tanzania MEDA 2012).

Transboundary Scope

The coastal forests spanning the mainland east African coastline, even though fragmented, are transboundary in nature. Furthermore, 7 of the 9 countries, including some of the islands, identified this issue as 'Relevant' at the national. This suggests that the issue is a shared transboundary issue. From the Level 1 Prioritisation, 5 of the 9 countries ranked the issues as being of 'High' importance at the national level. From the Level 2 Prioritisation, the 'Overall ranking scores for 6 of the 9 countries were above average, indicating that the countries consider this to be a priority transboundary issue of concern within the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	NR	NR	✓	✓	✓	✓	7
Importance	M	H	H	NR	NR	M	H	H	H	5
Overall ranking	13	19	21	NR	NR	7	16	18	21	6

2.2.3. Disturbance, damage and loss of coastal habitats (beaches, dunes, coastal vegetation and flood plain habitats to 10 m elevation)

Problem Statement

Disturbance of coastal habitats occurs throughout the ASCLMEs as a result of urban expansion, uncontrolled tourism development, sand mining and wind and wave action and may be exacerbated by global climate change. Degradation of beaches as well as noise and light pollution threaten turtle populations in Kenya, Madagascar, Mozambique, Somalia, Tanzania and Mauritius. Disturbance of coastal areas may also have adverse impacts for seabirds and shorebirds utilizing the coastal environment.

National Scope

Comoros: Many natural beaches are currently degraded due to the removal of sand and dumping of garbage (Comoros MEDA 2012).

Kenya: The sand beaches of Kenya are a major tourist attraction. Other coastal habitats include fossil reef intertidal flats and as backshore raised reef limestone, forming cliffs which are 12- 15 m high, sand dunes, mud-flats, and rocky shores bordered by cliffs (Kenya MEDA 2012). In the last decade, there has been rapid and unmanaged transformation of the coast land with a consequent loss of critical coastal habitats. Most settlements, commercial developments and tourist beach hotels are found within a few hundred metres from the sea. This makes such developments vulnerable to sea-level rise (UNEP/FAO/PAP/CDA, 2000) but also contributes towards the degradation of these habitats. Other impacts include increased sediment loads from the major rivers have resulted in accretion of beaches in Malindi and Ungwana bays (GOK, 2008). Loss of bird habitats emanating from unsustainable human activities threatens the

Kenyan avifauna and, populations of shorebirds and seabirds have undergone a general decline along the coast over the past decade.

Mozambique: The accelerated growth of the tourist industry along the coast promotes very high disturbance levels and represents a serious threat to the status of these habitats and the conservation of shore birds. Exploitation of littoral organisms by the local population, a very common activity along the Mozambican coast, also represents a potential threat to their conservation (Mozambique MEDA 2012).

Mauritius: Coastal habitats include sand beaches, rocky shores, and fossil reef beach rock. Most of the pristine coastal sites, often adjacent to expansive sand beaches, have been exploited and now hotel planners are examining areas less touched by the imprint of change. Urban development in floodplains areas, which are actually below mean sea level (e.g. Flic en Flac) have created drainage problems. In Mauritius, cyclonic waves are responsible for removing large quantity of sand from the beach and lagoons. Mauritius also suggests that ocean acidification threatens coral reef growth around the island and may therefore reduce the supply of sand to the lagoon and beaches.

Madagascar: Coastal habitats include sandy beaches, coastal dune systems, pebble beaches and rocky outcrops. Climate change related intensification of winds could result in dune systems becoming more dynamic and significant, leading to the silting of back mangroves and shallow ecosystems such as lagoons and reef. Recent observations in the Southwest suggest that many ancient turtle nesting beaches identified by Rakotonirina (1989) are no longer in use. This reduction may be due to increased light disturbance due to the increased number of beach hotels, as the presence of lights on the beach can induce females to leave without laying eggs and affect new hatches, inducing them to approach the light instead of moving toward the horizon to the sea.

Seychelles: The most threatened habitats are found around the inner islands which are the most populated. Various development pressures along the coast, especially for tourism purposes are currently posing threats to diverse marine habitats. The inner islands' geomorphologic features (mountainous with coastal plateaus) and the protection plan (mountainous parts normally falling into National Parks), are such that the majority of the developments for local residences or rural expansions are taking place along the coast. This albeit, non urban and controlled expansion should still be taken into account for it could cause additional stress on the coastal areas if not monitored and controlled accordingly (Ministry of National Development 2009). Increases in urban development have been shown to cause an increase in the volume of water flowing into the lower drains, with the potential for coastal flooding.

Somalia: The expansion of urban development in the coastal zone and the expansion of the cities increase garbage dumping on the sea shore. Due to lack of environmental governance, almost all the coastal cities and towns use the beaches as rubbish dumping site. Sand mining is also very popular in all coastal towns and fishing villages in Somalia. It is mixed with cement, coastal soil and gravel to make bricks. This destabilizes the coastal sand dunes, which already caused severe coastal erosion.

South Africa: Coastal development in South Africa includes development activities such as infrastructure (harbours and launch sites, cities, towns, housing, roads and tourism), as well as dredging activities and the disposal of sediments. These developments pose a major threat to many components of the marine environment, owing to their cumulative effects, which are often not taken into account by impact assessments. Five types of mining are currently considered to threaten marine biodiversity: sand-winning; mining for titanium; diamonds; fossil fuels; and phosphate.

Tanzania: Coastal habitats found include sand beaches, intertidal mudflats and rocky cliffs and intertidal beach ridges and marine terraces. Beach ridges and marine terraces are among the most prominent backshore features along the coast of Tanzania. A wide variety of coastal birds and seabirds are found particularly in mangrove forests, intertidal flats and on rocky cliffs. Waders and shorebirds visit Tanzania in large numbers each year between August and May to feed on intertidal flats during low tides. 10 Important Bird Areas (IBAs) have been designated by Birdlife International along the coast of Tanzania. Loss of bird habitats emanating from unsustainable human activities threatens the existence of the Tanzanian avifauna, populations of shorebirds and seabirds have undergone a general decline along the coast over the past decade.

Transboundary Scope

All 9 countries identified this issue as 'Relevant' and of 'High' priority in the Level 1 prioritisation. The 'Overall ranking' from the Level 2 prioritisation, revealed that 7 of the 9 countries allocated above average scores indicating that the countries consider this to be a priority transboundary issue within the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	✓	✓	✓	✓	9
Importance	H	H	H	H	H	H	H	H	H	9
Overall ranking	17	19	11	19	23	11	13	19	23	7

2.2.4. Disturbance, damage and loss of wetland habitats

Problem Statement

Wetlands can be temporarily or permanently wet ecosystems dominated by emergent vegetation (Harpa and Mavuti, 1996). The wetlands in the ASCLMEs region can be broadly divided into two categories, seasonal and permanent, both of which form as a result of impeded drainage and are communities at the edge of dry lands and open water (Harper and Mavuti, 1996).

National Scope

Comoros: The participants at the National CCA Meetings identified this issue as being 'Not Relevant'.

Kenya: The largest and most important coastal wetlands in Kenya is the Tana Delta. The Tana river is the largest and longest river in Kenya (nearly 1,014 km long), the Delta covers about 130,000 ha and supports 100,000 people, consisting mostly of farmers, pastoralist & fishermen. The Tana Delta presents true features of a typical delta, characterised by several distributaries that discharges turbid water into Ungwana Bay. While there are some important coastal lakes, some of the oxbow lakes are also wetlands (e.g. Lake Mahe in Umba flood plain, and Ziwa la Chakamba and Ziwa la Ndovu in Tana flood plain see also Kitheka, 2002). The shores of both deltas and estuaries are characterized by the presence of mangrove forest ecosystem (Kokwaro, 1985). The Tana river volume has fallen by 20% in 10 years. The Kenya MEDA (2012) recognised that climate change and natural variability is already influencing rainfall patterns and the flow patterns of rivers, impacting on floodplains, deltas and coastal ecosystems and; that there was limited knowledge and information on the hydrological functions of coastal wetlands.

Madagascar: The west coast of Madagascar is particularly important for wetland birds. Coastal wetlands are being impacted by both human and natural factors (Madagascar MEDA 2012).

Mauritius: Mauritius has an extremely rich coastal zone consisting of near shore wetlands and mangroves, lagoon coral, fringing coral reef. The Rivulet Terre Rouge Bird Sanctuary in Mauritius is the largest estuarine delta covering about 26 hectares and is an important wintering ground and refuge for migratory birds escaping the rigorous winter months of the northern hemisphere.

Mozambique: There are four coastal regions identified which include the coral reef coast, the mangrove coast, the delta coast, and the parabolic sand dune coast. The second coastal habitat is dealt with under a seperate issue. The delta coast is very restricted and only occurs at the mouth of the Zambezi and Save rivers (Mozambique MEDA 2012). The Mozambique MEDA does not however specifically discuss issues related to wetlands.

Seychelles: On the inner granitic islands the ever growing human population coupled with the tourism industry (Rocamora and Skerrett, 2001) leads to land clearing and drainage of wetlands for developments such as housing. This can be exacerbated by the additional threat from global warming and sea level rise which can particularly affect the outer low-lying coralline islands.

Somalia: Six main types of wetlands in Somalia have been described (Hughes and Hughes 1992): (i) Tidal wetlands in bays in the East of the country and in the Gulf of Aden where they form a continuous salt-marsh developed on sediment washed down from the Ogo Mountains. (ii) Wetlands of the Shabelle-Jubba Rivers, where the whole sub-coastal valley of the Shabelle is characterized by the presence of swamps with peripheral floodplains. The river divides into three channels and crosses a swamp which spans 25 km and stretches 150 km along the coast, covering an estimated 300,000 ha. Where the two rivers meet there is a floodplain after which they cross marshy land and drain into a mangrove fringed estuary at Jumba. (iii) Wetlands of the Lachs District: occur where temporary large water courses (*lachs*) drain into southern Somalia, and become floodplains during rainy seasons. (iv) Bullehs, Tugs and Dholos: A bulleh is a small endorheic depression filled by runoff after a storm; these have distinct soil types which retain moisture and as a result have richer vegetation than surrounding areas. Tugs are small temporary watercourses with low gradient, which flood and spread over a wide area causing broad alluvium deposits. Tugs often end in inland deltas which are known as dholos. (v) The Central Districts: where there are sink holes and a small lake. Several large pans also exist towards the coast which seldom hold water and when they do it is only for brief period. (vi) Artificial Impoundments: 240 reservoirs have been constructed to water livestock (Somalia MEDA 2012).

South Africa: Saltmarshes occur mainly in temperate areas, so in South Africa they are found in suitable estuarine habitat along the Cape's west coast, south coast and south-east coast. Further up the east coast, in the sub-tropical parts of the Wild Coast and KwaZulu-Natal, they are replaced by mangroves. True salt marshes are found in approximately 70 of the Cape's 155 estuaries, the most extensive in the ASCLME region being the 1,800 ha in the Knysna Lagoon on the south coast. Common species include the cordgrass *Spartina maritima*, the glasswort *Sarcocornia perennis* and the marsh samphire *Salicornia meyeriana*.

Tanzania: The Rufiji-Mafia-Kilwa Marine RAMSAR Site is located across the three named districts, within the coastal and Lindi regions of southeast Tanzania. It has an area of 596,908 ha (URT 2009). According to the Directory of Wetlands of International Importance, this site is a representative wetland of East Africa as it contains a large diversity of wetland types, which are ecologically interlinked, and includes the threatened estuarine, coastal and marine wetland habitats (Directory of Wetlands of International Importance 2004).

Transboundary Scope

Eight of the 9 ASCLMEs countries recognised wetlands as a 'Relevant' issues, and 5 of the 9 countries considered the issue to be of 'High' importance. Only 3 of the 9 countries gave the issue an above average score for the 'Overall ranking' suggesting that the issue is perhaps not a priority issue within the region now.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	NR	✓	✓	✓	✓	✓	✓	✓	✓	8
Importance	NR	H	M	H	M	M	H	H	H	5
Overall ranking	NR	21	14	16	19	12	13	19	18	3

2.2.5. Disturbance, damage and loss of estuarine habitats

Problem Statement

An estuary is defined as '*a semi-enclosed coastal body of water which has a free connection with the open sea and within which sea water is measurably diluted with fresh water derived from land'* (Pritchard 1967). There are several very large estuaries along the mainland coast of the ASCLMEs, notably in Tanzania (Rufiji) and Mozambique (Zambezi). Disturbance of estuaries as a result of poor agricultural practices, deforestation, urban and industrial development, pollution and sand mining threatens coastal wildlife, especially shorebirds and may also lead to coastal flooding.

National Scope

Comoros: During the National CCA Meetings, attendees identified this issue as 'Not Relevant'.

Kenya: One of the biggest estuaries is the Athi-Sabaki Estuary in Malindi; the distributaries within the Tana Delta such as Kipini and Mto Kilifi are also estuaries in their own right (Kitheka, et al., 2003). Other estuaries include those at the mouths of Mwache, Kombeni, Ramisi and Umba. The shores of estuaries are characterized by the presence of mangrove forest ecosystem (Kokwaro, 1985). Changes in land and water-use practices, poor agricultural practices, deforestation in the catchment areas, are leading to alteration of river freshwater flow and increased soil erosion, increasing sediment loads in creek, deltas and estuaries, causing the degradation of mangrove forests, coral reefs and seagrass beds. The Athi-Sabaki estuary is characterised by highly turbid water that limits primary productivity and resulted in accretion of beaches in Malindi and Ungwana bays (GOK, 2008). Fish samples in the Athi-Sabaki rivers and estuaries have also been found to have residue concentrations of pesticides (Lalah et al., 2003; Mugachia et al., 1992; Munga, 1985). There is however limited monitoring of estuaries and a limited knowledge of the flora and fauna (Kenya MEDA 2012).

Madagascar: The most spectacular areas of shoreline change are due to sedimentation often observed in estuaries and mouths of major rivers. The Bay of Betsiboka is an example of an estuary with serious sedimentation problems. The river carries huge quantities of silt which is deposited in large quantities at the bay. In the Southwest, the same heavy sedimentation occurs at the mouth of the river Fiherenana, resulting in smothering of reef flats and mangrove forests (Bemiasa 2009). Gill nets and fish barriers are used across rivers and estuaries (Madagascar MEDA 2012).

Mauritius: Small estuaries and deltas are observed in a few places mainly at Grand River North West, Grande Riviére Noire in the west and Baie du Cap in the south. During the National CCA Meetings, attendees identified this issue as 'Not Relevant'.

Mozambique: The estuaries of big rivers such as the Zambezi, Púnguè, Buzi and Save are all in the central part of Mozambique. These provide important habitat for mangroves; the Zambezi delta mangroves extend 50km inland. These areas are also important fishing grounds, where small pelagic and demersal fish and crustaceans of estuarine waters are dominant. The semi-industrial prawn fishing areas are located along the navigation channels of Maputo Bay and in the estuaries of the Maputo and Nkomati rivers (at depth between 10 and 20 meters). Estuaries are often centres for development. For example, due to the low lying coastal plain, most of the ports (with exception to Pemba and Nacala) have been developed in shallow bays and estuaries and this poses a problem for handling large modern ocean-going vessels. The high costs of maintenance dredging are constraints in port development. There is a gap in the understanding of the coupled river basin and coastal systems, including the main drivers of ecological, hydrodynamics and morphodynamic changes in the estuaries (and coastal waters) and a gap in knowledge on the influence of nutrients inputs through rivers and rainfall in the biogeochemical processes in estuaries (and coastal waters).

Seychelles: During the National CCA Meetings, participants identified this issue as 'Not Relevant'.

Somalia: Where the Shabelle and Jumba rivers meet there is a floodplain, after which they cross marshy land and drain into a mangrove fringed estuary (Hughes and Hughes 1992). The Shebelle river mouth is one of the priority seascapes mentioned in the Eastern Africa Marine Ecoregion. The area has been proposed for protection as it is not only the most northern estuary in eastern Africa, but it is also the largest estuarine-offshore 'mud ecosystem' and the only permanent estuarine system in Somalia. Sea level rise could cause flooding of estuaries, placing most coastal cities at risk (Somalia MEDA 2012).

South Africa: South Africa's estuaries are relatively small and mean annual runoff for the country's rivers is variable. These characteristics, coupled with extreme environmental conditions, such as droughts, has led to a number of different definitions for South African estuaries (Day 1980; Heydorn 1989). Depending on the definition used, there are more than 258 systems with total coverage of 75 000 ha of which about 60 000 ha, more than 80%, occur in the ACMLE (Van Niekerk unpublished data). River inflow to the estuaries is determined by the different climatic conditions in different parts of the coast, as well as the size and shape of the catchment. Poorly regulated activities upstream have destroyed many estuarine habitats. Infra-structural development such as mouth stabilisation, low lying developments, canalisation, land reclamation, harbour development, pollution and dredging. The degradation of such intertidal estuarine habitats is particularly problematic for over-wintering Palaearctic migrant bird species and could result in a drastic reduction in the numbers and even extinction (South Africa MEDA 2012)

Tanzania: Rivers such as Pangani, Wami, Ruvu, Rufiji, Matandu, Mbemkuru, Lukuledi and Ruvuma all flow to the Indian Ocean. The mouths of most of these rivers are characterized by productive brackish water environments in estuaries, deltas and mangrove forests (Francis and Bryceson, 2001). Tidal inlets, estuaries and creeks are characteristically sites of urban and port development, for example Tanga and Dar es Salaam, which can lead to nutrient enrichment and other forms of pollution. Sand mining in estuaries also causes direct impacts resulting in loss of aesthetic value and ecosystem degradation, as well as secondary threats to the long-term sustainability of the coastal sand resource and stability. Increased economic activities and expanding populations in the growing coastal towns have resulted in production of large

amount of waste, and raw domestic sewage and industrial effluents are directly released into the nearby estuaries (Tanzania MEDA 2012).

Transboundary Scope

Degradation of estuarine habitats was only recognised as 'Relevant' by 6 of the 9 countries. Only 4 of those considered the issue to be of 'High' importance. Furthermore, only one country (South Africa) allocated the issue an above average score for the 'Overall ranking' suggesting that the countries do not consider this to be a priority transboundary issue within the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	NR	✓	✓	NR	✓	NR	✓	✓	✓	6
Importance	NR	H	H	NR	H	NR	H	H	M	4
Overall ranking	NR	1	10	NR	17	NR	10	19	16	1

2.2.6. Disturbance, damage and loss of mangrove habitats

Problem Statement

Mangrove forests are found in the inter-tidal zone, from mean sea level to highest spring tide, in the tropical and subtropical regions of the world, where they survive harsh environmental conditions (high salinity, high temperature, extreme tides, high sedimentation and muddy anaerobic soils). Their global distribution is believed to be delimited by major ocean currents and the 20° C isotherm of seawater in winter (Alongi, 2009). The ASCLME supports an estimated 7,900 km^2 of mangroves, which is 5% of the world's total estimated area coverage (13,776,000 ha in 118 countries) (Giri et al., 2011). This is however already less than half of what it once was (Spalding *et al*., 1997; Spiers, 1999). Only 15 countries host approximately 75 % of world's remaining mangroves, two of which are within the ASCLMEs (Madagascar and Mozambique).

Mangrove forests in the ASCLMEs typically form narrow fringing communities along the shores or small patches in estuaries, along seasonal creeks or in lagoons. The trees do not usually grow to more than 10 m in height, with a minimum height of 1–2 m in South Africa. Madagascar (especially the northwest region), Mozambique and Tanzania represent the few exceptions. The extensive deltas and estuaries found in these countries allow for the development of well extended communities, with tree heights reaching 25–30 m. The Messalo and Zambezi river deltas (Mozambique) are home to some of the most extensive mangrove forests in the region.

There are 14 true mangrove species known to occur in the region, which is higher than the 7 species found in West Africa. The highest species richness is found in Mozambique (10 species), Kenya (9 species) and Seychelles (9 species). A few species, such as *Avicennia marina* and *Rhizophora mucronata*, are wide-spread, whereas other species grow only in one or a few countries, for example *Bruguiera cylindrica* (found in Mozambique) and *Ceriops somalensis* (endemic to Somalia).

Mangrove forests are among of the most productive and biologically important ecosystems of the world and they provide important and unique ecosystem goods and services. The forests help stabilize shorelines and reduce the impact of natural disasters (e.g. tsunamis and cyclones). They also provide breeding and nursing grounds for marine and pelagic species, and food, medicine, fuel and building materials for local communities. Mangroves, and associated soils, are thought to sequester approximately 22.8 million metric tons of carbon each year. Covering only 0.1% of the earth's continental surface, the forests account for 11% of the total input of

terrestrial carbon into the ocean (Jennerjahn & Ittekot, 2002) and 10% of the terrestrial dissolved organic carbon (DOC) exported to the ocean (Dittmar *et al.*, 2006).

Mangroves represent a subset of the species found in the West Pacific region, isolated by the expanse of the Indian Ocean and the arid coastlines of the Middle East. They may thus represent a distinct subregion of the Indo-West Pacific mangrove fauna and flora. however only 6.9% are protected under the existing protected areas network (IUCN I-IV) (Giri et al., 2011).

The mangrove forests of the ASCLMEs have been heavily impacted by human activities land degradation, agriculture, aquaculture, tourism, urban development, pollution, and overexploitation throughout the region. Relative sea-level rise could be the greatest threat to mangroves (Gilman et al., 2008). Predictions suggest that 30–40% of coastal wetlands (IPCC, 2007) and 100% of mangrove forests (Duke et al., 2007) could be lost in the next 100 years if the present rate of loss continues. As a consequence, important ecosystem goods and services (e.g. natural barrier, carbon sequestration, biodiversity) provided by mangrove forests will be diminished or lost (Duke et al., 2007).

National Scope

Comoros: Mangroves are found throughout the archipelago, covering an estimated 115 to 117 ha (FAO 2007), with more significant coverage on Mohéli (91 ha), with less on Grande Comoro (18 ha) and Anjouan (8 ha) (Comoros MEDA, 2012). There are 5 mangrove species known to occur, the most common of which are: *Sonneratia alba, Avicennia marina* and *Rhizophora mucronata*. The forests are mostly situated on the south side of the islands, due to exposure patterns and rainfall distribution. At the water's edge other species such as: *Pandanus sp, Hibiscus tillaceus, Ipomea pescaprae*, *Rhizophora mucronata*, *Bruguiera gymnorrhiza, Avicennia.sp.* and *Lumnizera sp.*

Kenya: Mangrove forests in Kenya are estimated to cover 50,000 ha (FAO 2007) with nine mangrove species that include *Rhizophora mucronata* and *Ceriops tagal* which are the dominant species represented in almost all mangrove formations (Kenya MEDA 2012). The rare species include *Heritiera littoralis* and *Xylocarpus moluccensis*. Mangroves have been impacted by human activities particularly through removal of wood products, conversion to other uses and pollution. Recent estimates suggest a 20% decline in mangrove cover over the last two decades (Kenya MEDA 2012), although this is higher than the 10% estimated loss from FAO (2007). Reduction in river flow has increased erosion of the delta mouth, and through increased salt-water intrusion, lead to a reduction of downstream habitats for mangroves and other species. Conversion of mangrove areas has also contributed to mangrove degradation in Kenya, for example more than 5000 ha of mangroves at Ungwana Bay have been cleared to pave way for solar salt works and aquaculture (Abuodha and Kairo, 2001).

Madagascar: Mangrove coverage is the second highest after Mozambique: estimates range from 278,078 ha (Giri et al., 2011) to 300,000 to 400,000 ha (FAO 2007, Mozambique MEDA 2007). There are reportedly 8 (9) species found including: *Acrostichum aureum, Avicennia marina, Ceriops tagal, Heritiera littoralis, Lumnitzera racemosa, Rhizophora mucronata, Sonneratia alba* and *Xylocarpus granatum* (and possibly *Bruguiera gymnorrhiza*) (FAO 2007). Mangrove resources were traditionally used for timber for house and boat construction, in traditional medicine against stomach ulcers, for the collection of crabs and fish and for firewood. Rapid population growth in coastal areas has resulted in increased exploitation for urban fuelwood, charcoal and timber. Fishing in mangroves is mainly artisanal but fishing companies operating in the northern areas tend to be industrial and shrimp aquaculture in mangrove areas is being encouraged in certain areas. Increased sediment loads, due to deforestation upland and changes in rainfall patterns is resulting in hypersedimentation and smothering of mangroves. Sedimentation at the mouth of the river Fiherenana, for example, is silting the nearby

mangrove. Overharvesting of the mangrove crab *Scylla serrata,* is common in the mangrove areas near coastal cities, while more remote areas still support fishable stocks.

Mauritius: Mauritius only hosts two species of mangrove, namely *Rhizopora mucronata* and *Bruguiera gymnorhiza,* and as such is the most species poor country in the ASCLMEs. The mangroves form a narrow fringe, and the extent of mangrove cover around the islands has significantly decreased (2000 ha in 1987 to 1400 ha in 1994) due to overcutting for firewood, construction purposes and for clearing boat passages. The figures reported in the MEDA are an order of magnitude larger than those reported by FAO (2007) which reported a coverage of 45 ha in 1980 and 120 ha in 2005. Furthermore, the total area of mangrove cover in Mauritius now is reported to be 23 ha (Mauritius MEDA 2012). In response to the decline in mangrove habitat, the Fisheries and Marine Resources Act of 1998, makes provision for the protection and the conservation of mangroves. A Mangrove Propagation Programme was initiated in 1995, with an objective of restoring denuded areas with mangroves. Since 1995, a total of 214,800 of mangrove seedlings were planted in an area of 12.95 ha, with an overall survival rate of 78 % (Mauritius MEDA 2012).

Mozambique: Mangroves occur along almost the entire coast of Mozambique mostly in sheltered shorelines and estuaries, covering an estimated 396,080 ha (Barbosa et al., 2001) to 390,200 (FAO 2007), which is the largest area coverage for all the countries in the region. Mozambique also hosts the highest species richness, with a total 10 species of mangrove, including *Bruguiera cylindrica,* which is only found in Mozambique. Mangroves are being depleted at a rate of 4 % (Mozambique MEDA, 2012). The growth of population in coastal regions, associated with the developing tourism has increased the depletion rate and between 12,300 ha (FAO 2007) and 15,000 ha (Mozambique MEDA 2012) has been degraded across 7 provinces. The northern sector has numerous islands (mainly Quirimbas archipelago) which help to provide protection to mangroves. The central sector, also known as the 'Mangrove coast', has the most extensive and well established mangroves because of the alluvium and freshwater discharge in the estuaries of the Zambezi, Púnguè, Buzi and Save rivers. The mangroves of Zambezi delta extend 50 km inland. This mangrove zone is continuous from the south up to Quelimane covering close to 180 km of coastline. This zone is one of the largest extents of mangrove forests in Africa representing close to 50 % of Mozambique mangroves (Barbosa et al., 2001). The southern sector has extensive mangroves in Morrumbene estuary, Inhambane bay, Maputo bay and Inhaca Island. Maputo bay with its four main rivers inlets in the bay is one of the major mangrove areas in southern Mozambique (Barbosa et al., 2001). Some of the major threats to mangroves in Mozambique include: uncontrolled exploitation for firewood, charcoal and pole production; clearance for agriculture and salt production; uncontrolled influx of people from mainland to the coast leading to increased overexploitation of mangroves and pollution. Degradation of mangroves is also caused by changes in river flow rates, and particularly by a reduction of freshwater flow to mangroves due to dam construction (Barbosa e*t al*., 2001).

Seychelles: Mangrove forest are found within the inner granitic and outer islands. They occupy a total surface area of 2,900 ha (Seychelles MEDA, 2012) to 2,500 (FAO 2007) and there are a total of eight species, namely *Rhizophora mucronata, Bruiguiera gymnorhiza, Ceriops tagal, Sonneratia alba, Lumnitzera racemosa, Avicennia marina, Xylocarpus granatum* and *Xylocarpus mulocuensis* (Seychelles MEDA, 2012). There is some discrepancy between this list and the species reported in FAO (2007), which lists 9 species, including *Pemphis acidula,* which is reported to only be found in the Seychelles, and *Acrostichum aureum* but which does not include *Xylcocarpus mulocuensis*. At Port Launay in Mahé, all eight species of mangroves are found in an area that has been designated a RAMSAR site. The Seychelles reported that on Curieuse there is a problem with insufficient sewage and waste water treatment which leads to pollution of the mangroves and the beaches.

Somalia: Mangroves are mainly found along the south-west coast although isolated pockets of *Avicennia marina* grow on the northern coast behind sand spits and along the Gulf of Aden (Carbone and Accordi 2000; Khalil 2004). Tree growth is reportedly restricted due to cold upwelling waters (Taylor *et al*., 2003), although salinity is also another factor known to stunt growth in some regions. Coverage was reported to be 10,000 ha in 1975 (FAO 2007) and is currently estimated to be between 7300 ha, representing a loss of 2,200 ha. Somalia reported six mangrove species: *Avicennia marina, Bruguiera gymnorrhiza*, *Ceriops tagal*, *Lumnitzera racemosa, Rhizophora mucronata,* and *Sonneratia alba* (Somalia MEDA 2012). *B. gymnorrhiza*, *C. tagal*, *L. racemosa* and *R. mucronata* are common along the Indian Ocean coast, *Sonneratia alba* occurs in some estuaries in the south, and *Avicennia* and *Rhizophora* grow on intertidal flats facing the channels. FAO (2007) reported the presence of 8 species, including *Xylocarpus granatum* and *Ceriops somalensis*, the latter of which is an endemic species (although it is not entirely clear if these species are found on the Indian Ocean coast). Mangroves are found in the intertidal zone of the coast south of Kisimayo and extensive mangrove forests are found in the creeks of Istambul, Kudha and Burgavo and on the sheltered side of the barrier islands (Carbone and Accordi 2000). The Shebelle river mouth, which includes the area where the Juba and Shebelle meet, is one of the priority seascapes mentioned in the Eastern Africa Marine Ecoregion and should also be considered for protection as it is not only the most northern estuary in eastern Africa, but it is also the largest estuarine-offshore 'mud ecosystem' and the only permanent estuarine system in Somalia. In this area there is mangrove fringed estuary at Jumba (Hughes and Hughes 1992). There is systematic over-harvesting of mangrove wood for building, charcoal, firewood and trade purposes, as well as conversion of mangrove habitat for agricultural, residential use and salt and lime production. Destruction of mangrove forests is also leading to heavy offshore siltation and alteration of nutrients pathways for offshore species with concomitant reduction in fish catches. This is contributing towards the decline in artisanal fishery resources including the giant mangrove mud crab *Scylla serrata*.

South Africa: Mangroves occur in estuaries along the east coast of South Africa from Kosi Bay in the north to Nahoon River at East London. Two species, the Tagal mangrove *Ceriops tagal* and Kosi mangrove *Lumnitzera racemosa*, extend no further south than the Kosi system, while the red mangrove *Rhizophora mucronata* and black mangrove *Bruguiera gymnorrhiza* reach their limits on the Wild Coast, together with the mangrove associate *Acrostichum aureum*, a halophytic fern. The white mangrove *Avicennia marina* extends to East London (Steinke 1995). Mangroves cover some 2.20 km2, within the Kosi Bay system supporting the three most common South African species (*Avicennia marina, Brugueira gymnorrhiza* and *Rhizophora mucronata)* as well as two species at the southernmost limit of their distribution (*Ceriops tagal* and *Lumnitzera racemosa)*. Mangrove trees (white, red and black mangrove) are harvested for their wood, which is very durable. Mangrove cutting is considered a problem in many of the Wild Coast estuaries Mngazana, Mtata, Xora and Mntafufu (Sink et al. 2004). At Kosi Bay mangroves are harvested for building materials and for construction of fish traps, and there is some harvesting in Richards Bay.

Tanzania: Mangroves are found in various locations including the mouths characterized by the presence of deltas, estuaries and mangrove forests, covering an estimated 127,200 ha, the third largest coverage within the ASCLMEs. The Rufiji delta is home to the largest estuarine mangrove forest in East Africa, with an estimated surface area of 53,200 ha it consistutes approximately 46% of total mangrove forest cover in Tanzania (Tanzania MEDA 2012). A total of 8 species of mangrove are found in mainland Tanzania (*Avicennia marina, Bruguiera gymnorrhiza, Ceriops tagal, Heritiera littoralis, Lumnitzera racemosa, Rhizophora mucronata, Sonneratia alba* and *Xylocarpus granatum*) and *Xylocarpus mulluccensis* occurs in Zanzibar (Ngusaru et al, 2001). This is contrary to FAO (2007) which only reported the presence of 5 species (*Acrostichum aureaum, Avicennia marina, Ceriops tagal, Lumnitzera racemosa and Rhizophora mucronata*). *Xylocarpus mulluccensis* is not a species reported to be found in the WIO. The mangrove ecosystem in

Tanzania is under huge pressure due to high demand for mangrove products (firewood, charcoal, building and boat making), as well as commercial cutting and over harvesting, coral burning, lime production, salt making, clear-cutting for building sites, solar salt pans, clear cutting for construction and agriculture,), and for paddy farming and illegal harvesting (Shunula and Whittick, 1996; Francis et al., 2001; Sallema, 2003; Wagner, 2003). In the Rufiji delta, the mangrove forests have declined slightly from 49,799 ha in 1990 to 49,032 ha in 2000, in part due to flooding of Rufiji River (Wang et al. 2003). In Zanzibar, mangrove threats also include debarking of *Rhizophora* sp. for tannin production (Wells et al. 2004). The other main threats to the mangroves include coastal erosion and pollution. The use of DDT and other pesticides on rice farms and the construction of dams and major irrigation schemes upriver are also posing a threat to the mangroves (Semesi and Mzava, 1991).

Transboundary Scope

Mangrove forests are present throughout the ASCLMEs region. All 9 of the countries considered the issue as 'Relevant' and 6 of the 9 countries considered it an issue of 'High' importance. The 'Overall ranking' was above average for 8 of the 9 countries, indicating that this is a priority transboundary issue of shared concern within the ASCLMEs'.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	✓	✓	✓	✓	9
Importance	L	H	H	H	H	L	H	L	H	6
Overall ranking	10	22	24	20	23	17	16	17	24	8

2.3. Disturbance, damage and loss of subtidal benthic habitats

2.3.1. Disturbance, damage and loss of coral reef habitats

Problem Statement

The majority of the East coast of Africa is edged by well-developed fringing reefs that occur along the fairly narrow continental shelf of Somalia, Kenya, Tanzania, Mozambique and around the offshore islands between latitude 5°N and 15°S. Breaks in the reef occur where there are major rivers or estuaries. A variety of other geomorphological reef types have been described by Andrefouet et al., (2009). Coral reefs and coral dominated habitats within the region are threatened by a combination of coastal development, overfishing and destructive fishing practices, sedimentation, coral harvesting, pollution, corallivores, coral bleaching and other climate related impacts leading to loss of biodiversity and a decline in reef fish populations. Coral bleaching affected many of the coral habitats in the western Indian Ocean, with many being severely affected during the 1997–1998 coral bleaching event. The increase in emissions of carbon dioxide into the atmosphere is expected to result in increased dissolved CO_2 concentration in ocean water causing a decrease in pH value of the sea water, known as ocean acidification. Under the current forecast of CO_2 levels in the atmosphere, in 2100, the growth rate of scleractinian corals will be significantly compromised (Kleypas et al. 2006). The importance of these potential effects is unknown, but the hypothesis is that the acidification will contribute to the decline of coral reefs and other species with carbonate skeletons or shells.

National Scope

Comoros: Fringing reefs form a narrow platform without a lagoon. Coral cover is dominated by branching and tabular colonies (*Acropora, Pocillopora* and *Pavona* genera), massive colonies (*Favia* and *Porites* genera) as well as encrusting and foliaceous colonies (*Montipora* and

Turbinaria genera). Reefs occupy about 60% of Grande Comoro's coast, 80% of the Anjouan coast and 100% of Mohéli's coast. The lack of a continental shelf has resulted in weak reef development around Grande Comoro. Currently, the status of the Comorian coral reefs is poor, consist of 60% dead coral and 40% live coral. In some sites, the proportion of dead coral reaches between 80 and 90%. Repeated coral bleaching has been observed, probably due to seawater temperature. Other pressures include: the use of dynamite, uncontrolled anchoring, trampling, global warming observed in all oceans, fishing pressure, the dumping of garbage directly into the sea and terrigenous deposits linked to land erosion.

Kenya: The coral reefs of Kenya are estimated to cover 63,000 ha and host 220 coral species (GOK 2008). Dominant species in Kenya include *Porites lutea, Galaxea astreata*, and a broad diversity of species in the genera *Acropora, Pocillopora, Favia, Favites* and others (Hamilton and Brakel, 1984). The best reef development is found in the fringing reefs in the southern part of Kenya at Diani-Chale and Kisite- Mpunguti MPA. Reduced reef development in the northern part of the Kenya coast is attributed to the large areas of loose sediment and significant fresh water inputs from Tana and Athi-Sabaki rivers (Spalding, et al., 1997). Fringing reefs are also found off Lamu Archipelago and along many of the barrier islands to the north. Coral reefs support artisanal fishery dominated by local and migrant fishers. Currently it is estimated that over 10,000 fishermen are directly engaged in artisanal fishing in the Kenyan coast (Ochiewo, 2004). The landing from artisanal fisheries ranges from 5,000 - 8,000 tonnes per year which is about 95% of the total marine catch.

Madagascar: Coral reefs extend along the coast with an estimated surface area of 240,000 ha (Cook et al., 2000) and host approximately 323 species (McKenna et al., 2003), and 8 species of antipatharian (Pichon 1978, Vasseur 1981, Randriamanantsoa and Brand 2000). Coral reefs are currently under severe pressure due overfishing, trampling, sedimentation, pollution, coral mining (for lime and coral blocks), coral harvesting for the jewellery trade, as well as cyclones and coral bleaching. The majority of most accessible coral reefs are already damaged (Maharavo, 2009) but there are a few areas with higher coral cover, usually in deeper waters (20 m). Trampling during collection of *Eucheuma* algae during low tides can have a large impact, with an estimated 36 persons per km^2 (Randriamanantsoa 1997). Silting of reef flats, causes high mortality of species (Bemiasa 2009). Coral bleaching in 1998 had devastating effects in the south-west (Maharavo 2010). Overfishing is thought to cause an imbalance in the functioning of the reef ecosystem as a whole, for example when herbivores, that play an important role in controlling the proliferation of algae, are removed resulting in the smothering of corals with algae (Anonymous 2009). It is thought that simultaneous effects of ocean warming and overexploitation/physical damage will probably result in the gradual disappearance of many reef areas in Madagascar (Anonymous 2009).

Mauritius: There are five types of reef around Mauritius: fringing reefs, patch reefs, atolls, reef flats and barrier reefs. The 1998 coral bleaching event caused approximately 50% of the corals in Mauritius to bleach although mortality as a result of this event was not severe (Turner et al., 2000). In 2009 there was more extensive bleaching which resulted in extensive mortality of the corals around Mauritius (Pascal-Quod pers comm.; Bhaghooli and Sheppard 2012). Impacts on coral reefs include climate change and over-exploitation and destructive fishing practices, sedimentation, contamination from land-based sources and outbreaks of Crown-of-Thorns starfish (Turner and Klaus 2005).

Mozambique: The coastal fringing reef is only intercepted by large river outflows and are more extensive where the shelf broadens around islands. Fringing reefs extend from the northern coast and extend south to Mocambo Bay. From Moma southwards to the South African border, rocky reefs with scattered coral are extensive but at only few places are they attached to islands or the mainland. Most of them occur offshore at 3-30 m depth. The largest gap in coral distribution is in the Sofala Bank, with its widest shallow continental shelf and turbid waters

associated with the discharge of Zambezi River. Inhaca Island is reported to be the southernmost coral reef of the African mainland, although coral communities extend southwards into South Africa. Mozambique corals are were subject to extensive coral bleaching due to an increase in temperature during the 1997-1998 El Nino (Schleyer *et al*., 1999, Motta *et al*., 2002). Other threats to reefs include coral mining (for house building), sedimentation, flooding, beach seining, fishing nets, trampling and more recently inappropriate development of the tourism industry. COTS outbreaks also occurred in 1995-1996 and extensive reef damage was found at Bazaruto (80%) and Inhambane (95-98%).

Seychelles: Coral reefs cover approximately 1,690 km² of which only 40 km² are found within the inner islands. The reefs around the inner islands are usually relatively narrow as compared to those found in the outer islands. The reefs can be classified into 2 main types: (i) granitic reefs, which consist of corals growing over large granite boulders, and (ii) carbonate reefs which are further divided into fringing reefs, atolls and platform reefs (Stoddart, 1984). The main threats to the reefs in the Seychelles are from climate related changes such as increases in sea water temperature. During the 1997/1998 event the degree of coral bleaching was highly variable with the inner islands being much more affected by the bleaching event than the outlying islands (Spencer et al. 2000; Turner et al. 2000). Live coral cover was reduced by 90% in the inner islands (Turner *et al.,* 2000). This warming also significantly affected reefs in the outer islands, although to a lesser extent (Spencer et al. 2000; Bijoux *et al.*, 2008). Other impacts include destructive fishing practices, coastal development activities, dredging and flat-land reclamation.

Somalia: Coral reefs are widely distributed along the Indian Ocean coastline between Adale and the Somalia-Kenya border and around the Bajuni Archipelago. Coral communities are well developed and consist of 27 genera and 63 species. The main threats to coral reefs are the use of destructive fishing practices, over-fishing, global warming, and smothering due to sedimentation and pollution. Limestone (coral reef) mining exists mainly in southern towns such as Marka and Barawe, where it is used for house building as well as for whitewashing and house decoration. The coral reefs of the northern coast east of Berbera suffered extensive coral bleaching, with some reefs suffering almost total mortality (Schleyer and Baldwin 1999).

South Africa: Coral reefs occur as far south as Cape St Lucia, while some of the southernmost corals in the world are found on the Aliwal Shoal. The main area of coral reefs occur in the northern KwaZulu-Natal. North of the St Lucia estuary there are three major reef areas: the northern complex of relatively unexplored reefs off Kosi, the central complex just north of Sodwana Bay, and the southern complex of Red Sands Reef and Leadsman Shoal in the marine sanctuary between Cape Vidal and Sodwana Bay. The corals do not form their own reefs, but are Indo- Pacific species that have colonised a submerged outcrop from the late Pleistocene (Ramsay & Mason 1990). Corals were less affected by the 1998 bleaching event, however monitoring studies at Sodwana Bay during 2000 and 2001 showed that bleaching had increased from <1% in 1998 to 5-10% in 2002. Aliwal Shoal is subject to periodic turbidity due to riverine input (Schleyer 1995b) and discharges from the SAPPI-SAICCOR pipeline, which cause discoloured plumes of water to drift over the Shoal.

Tanzania: The use of destructive methods such as dynamite and seine nets pose a threat to coral reefs. Dynamite fishing in Tanzania has degraded the coral reefs to such an extent that only two of the eight coral reef sites recommended for marine parks in 1968 had intact coral reefs (Salm, 1983); the rest of the reefs have been reduced to rubble. Pollutants destroy sensitive ecosystems including coral reefs, and pollution is also one of the main threats to coral reefs in Tanzania. A great deal of damage to the intertidal and near shore areas is caused by ambulatory fishers collecting shells or octopus or algae. They trample the seabed, break corals and overturn rocks and stones. Significant coral bleaching was documented between March and September 1998 when live coral cover was reduced from 52% before bleaching to 27% after the

event (Wells et al. 2004). Outbreaks of Crown-of-Thorns starfish (COTS) have also affected coral reefs in Tanzania.

Transboundary Scope

All 9 countries identified coral reefs as 'Relevant' and 8 of the 9 countries ranked the issues as being of 'High' importance, with the exception being South Africa. In the Level 2 prioritisation, 8 of the countries assigned the issue an 'Overall ranking' score that was above average, indicating that this is a priority transboundary issue of concern in the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	✓	✓	✓	✓	9
Importance	H	H	H	H	H	H	H	M	H	8
Overall ranking	20	22	19	21	17	24	19	16	23	8

2.3.2. Disturbance, damage and loss of seagrass habitats

Problem Statement

Seagrass degradation occurs throughout the ASCLME as a result of: physical dragging of fishing nets and anchoring of boats, pollution, or increased sedimentation from river systems. Seagrass beds are also threatened by changing shoreline dynamics involving sand deposition and removal. The degradation and loss of seagrass habitats results in a loss of habitat for focal species such as dugongs and a reduction in coastal fisheries production. Seagrass are an important functional component of coral reef ecosystems: their rhizomes bind sediment, the blades help to slow water flows and can alter sediment transport patterns. More recent research has shown that seagrass also help to alter the carbonate composition and acidity of seawater, which may be important under future climate change scenarios.

National Scope

Comoros: Relatively little is known about the distribution of seagrass beds within the Comoros. Being located less than 400 kilometers east of the coastline of Mozambique and sharing a similar climate, these islands are likely to support similar seagrass meadows to those of northern Mozambique.

Kenya - Seagrass beds cover a surface are of about 3360 ha, with the most important sites in the region between Lamu and Kiunga, Malindi, Mombasa, Gazi Bay (800 ha), and Mida Creek and Diane- Chale lagoon (450 ha) (Dahdouh-Guebas et al., 1999; Ochieng and Erftemeijer, 2003). Twelve species of seagrass are found, with the most common being *Thalassodendon ciliatum, Halodule wrightii* and *Halophila minor* (see Obura, 2001; Gulstrom et al., 2002). There has been significant loss of seagrass along the coast, which was largely due to increased sediment loading of rivers causes degradation of seagrass habitats through smothering. Another cause of seagrass loss is an increase in the abundance sea urchin populations. In Diane-Chale lagoon for instance, preliminary studies indicate that *T. ciliatum* beds experienced a loss of more than 50 % of cover. These degraded sites were also found to have a density of the sea urchin *Tripneustes gratilla* of more 37 individuals/m², while healthy sites had a density of 4 individuals/m² (Uku, 2006). The degradation of seagrass habitats also has implications for other species that are dependent on these habitats, such as dugong. Dugong populations have declined, and a herd of 500 individuals reported on the south coast in 1967 has been reduced to 8 in 1975, 10 in 1994 and only 6 individuals in 1996.

Madagascar: Little is known about the relative dominance of seagrass species though it is likely that in southwest Madagascar they are similar to the species from the limestone areas of Mozambique with most meadows being dominated by *Thalassodendron ciliatum* and *Thalassia hemprichii* (Bandeira and Gell, 2003). Seaweeds are also a common feature in intertidal and subtidal seagrass areas of Madagascar (Rabesandratana, 1996). Seagrass habitats are heavily used by fishers (beach seines, trampling for the collection of invertebrates shrimp trawling). Trawling, which is mainly practiced on the west, northwest and northeast coasts of Madagascar, and can cause mechanical damage to seagrass beds.

Mauritius: Seagrass beds cover an estimated surface area of 55 ha and 649 ha respectively on Mauritius and Rodrigues (Turner and Klaus, 2005). The most abundant species in Mauritian lagoons is *Syringodium isoetifolium*, with other species present being *Thalassodendron ciliatum, Halophila ovalis, H. stipulacea, Halodule uninervis* and *Cymodocea serrulata* (Montaggioni and Faure, 1980; Database of Marine Organisms of Mauritius, 2007). Seagrass beds are found both as extensive beds of mixed species and monospecific stands constituting natural habitats for a diverse group of organisms in these lagoons. The Saya de Malha bank also support extensive stands of seagrass (REF). Species which depend on seagrass, such as dugongs which were once common in the lagoons, are now extinct.

Mozambique: Seagrass beds are estimated to cover a total surface area of 439 km^2, 25 km^2 around Inhassoro and Bazaruto Island, 30 km^2 at Mecúfi-Pemba and 45 km^2 in the southern Quirimbas Archipelago (Bandeira and Gell, 2003). The largest seagrass beds occur at Fernão Veloso, Quirimbas and Inhaca-Ponta do Ouro (Bandeira and Gell, 2002). Pioneer species observed in Mozambique include *Halophila wrightii, H. ovalis* and *Cymodocea serrulata*. The first two species occur in exposed sandy areas close to the coastline (den Hartog, 1970), whereas *C. serrulata* is a pioneer species in silted channels (Bandeira, 2002). Seagrasses abound in the sandy and limestone areas of Mozambique with the three dominant mixed-seagrass communities on the sandy substrates of southern Mozambique comprised of *Thalassia hemprichii, Halodule wrightii, Zostera capensis*, *Thalassodendron ciliatum* and *C. serrulata* (Bandeira, 1995). In contrast, the seagrass communities of the more northerly limestone areas are quite different, with seagrasses tending to occur intermingled with seaweeds species (Bandeira and António, 1996). Macroalgae such as *Gracilaria salicornia, Halimeda* spp. and *Laurencia papillosa* occur mixed with *T. hemprichii*, and *Sargassum* spp. with *T. ciliatum* (Bandeira and Antonio, 1996; Bandeira, 2000). Elsewhere, *Zostera capensis* and *Halodule wrightii* also form mixed beds (Bandeira, 2000; Bandeira and Björk, 2001; Massingue and Bandeira, 2005). *Enhalus acoroides, Halophila stipulacea* and *H. minor* were only found in northern Mozambique. Sedimentation and degradation of seagrass beds due to farming practices and deforestation is also common in Mozambique. Likewise, in Tanzania, excessive sedimentation increasing turbidity and reducing light penetration threatens seagrass habitats (Wells et al. 2004). Dugong populations in Mozambique, with mixed seagrass species in intertidal areas and subtidal seagrass species dominated by broad-leafed species such as *Thalassodendron ciliatum* (see Bandeira and Gell, 2003).

Seychelles: A total of 8 seagrass species occur in the Seychelles, typically mixed with more than 300 species of macroalgae. The total area covered is not known, but in general, *Cymodocea serrulata, Syringodium isoetifolium* and *Thalassia hemprichii* are dominant (Ingram and Dawson, 2001). The clear waters of Seychelles have supported the deepest known seagrass distribution within WIO, with *Thalassodendron ciliatum* occurring up to 33 meter depth (Titlyanov, 1995). The structure of the Aldabra Atoll differs considerably from some of the other island groups, since its coasts are built primarily of dead consolidated corals and are steeply undercut with overhangs. Four seagrass species (*T. ciliatum, T. hemprichii, H. uninervis* and *S. isoetifolium*) and 119 algal species occur both. However, Mahé Island supports the highest recorded seagrass diversity for the archipelago (seven species), with *C. rotundata* inhabiting a narrow band along

the shore, which is then replaced by *T. ciliatum* occupying the entire area exposed at low waters. The clearing of seagrass beds is neither encouraged nor practiced extensively in the Seychelles. Exceptions have however been made for the removal of small patches of seagrasses to create bathing areas close to a few hotels.

Somalia: Seagrass beds are threatened by fishing methods such as beach seining and shallow water trawling as well as regular anchoring of boats, and drag nets threaten seagrass beds. Dugongs are threatened by seagrass damage from trawlers and seine nets.

South Africa: Seagrass beds are only found along the east coast of South Africa, where they cover about 7 km^2, with the largest concentration in the St. Lucia estuary of 1.81 km^2 (Colloty, 2000). *Zostera capensis* is the most widespread and one of the dominant seagrass species in the country, occuring mostly in estuaries from Kwazulu-Natal to Western Cape region. Other important seagrass habitats are around the rocky headlands of KwaZulu-Natal, where they are mostly dominated by *Thalassodendron ciliatum*, which is well adapted to rocky habitat, and found together with seaweeds (Barnabas, 1991). *Ruppia maritima* is the dominant species within estuaries, especially St Lucia (Short and Coles, 2003).

Tanzania: Major seagrass bed are found around Pemba, Unguja and Mafia Islands (Ochieng and Erftemeijer, 2001). One of the best described Chwaka Bay, Unguja Island, Zanzibar (de la Torre e Castro, 2000; Gultröm et al., 2006). Here, two types of seagrass habitats can be found: shallow beds in marine embayment, far away from coral reefs and adjacent to mangroves and mud flats, and shallow seagrass beds situated on the shallow continental shelf adjacent to coral reefs and far away from mangroves and mud flats (Dorenbosch *et al.*, 2006). Seagrasses are present in most places of the tidal zone, but are more abundant in the western part of the bay. There are about 11 species, the dominant include *T. hemprichii, E. accoroides* and *T. ciliatum* (de la Torre e Castro and Ronnback, 2004; Eklof *et al.*, 2005). Since 1990s, the island have become an important site for seaweed farming, which is being reportedly negatively affecting seagrass beds (de la Torre e Castro and Ronnback, 2004; Eklof et al., 2005).

Transboundary Scope

All 9 countries identified seagrass habitats as 'Relevant' although only 5 of the 9 countries ranked the issues as being of 'High' importance, with the exception being South Africa. In the Level 2 prioritisation, 3 of the 9 countries assigned the issue an 'Overall ranking' score that was above average, indicating that the countries, perhaps do not consider this a priority transboundary issue of concern to the countries in the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	✓	✓	✓	✓	9
Importance	M	H	H	M	H	L	H	L	H	5
Overall ranking	10	9	12	12	20	10	15	13	21	3

2.3.3. Disturbance, damage and loss of macroalgal habitats

Problem Statement

There are over 3,355 species of algae recorded from the Indian Ocean (Silva *et al.,* 1996), and more recent species additions have been described by Coppejans *et al.,* (2000, 2001). Macroalgal communities are an important and often overlooked functional component of nearshore shallow water tropical marine communities. Together with seagrass beds, macroalgae

are one of the most important primary producers, and they form the basis of many foodwebs, providing a food source for a variety of other organisms. Macroalgae can occur in a wide variety of different habitats, in estuaries, on rocky shorelines, coral reefs, mangrove forests or in seagrass beds. Most algae are known to exhibit a distinct preference for a given suite of environmental parameters, and there are species that can be used as indicator of environmental conditions. Some species are known to respond rapidly to nutrient inputs, and can be used as an indicator of pollution. Calcareous species, such as *Halimeda,* are composed of calcified segments which contribute towards sediment processes and the presence or absence or condition of these species may provide an early indication of ocean acidification. Other species such as the corallinaceae species, often found on reef flats, provide more structural function, as they bind together loose rubble and sediments helping to stabilise reef flats and reef slopes. Other species such as *Euchema* and *Gracillaria* have become an increasing important economically due to the chemical compounds that they contain, and such species are now being farmed in several countries in the region.

National Scope

Comoros: Primary production during the monsoon is characterized by an increase in macroalgae such as *Turbinaria* and *Sargassum*, as well as phytoplankton and sea grass beds. Some common species of algae include *Gracillaria Jania, Lithothamnium, Padina, Ulva, Codium, Halimeda,* and *Porolithon*. There were no particular issues identified in the Comoros MEDA (2012).

Kenya: There were no particular issues identified in the Kenya MEDA (2012). There are however exotic marine species reported as occurring in Kenya which include the red algae *Acanthophora spicifera* and *Gracilaria salicornia*. The status of their invasiveness is however unknown.

Madagascar: The Mozambique MEDA (2012) does not discuss macroalgal communities. However there is mention of the exploitation of *Euchema* around Toliara. Large numbers of fishermen (150 000) have destroyed the corals due to trampling during collection of *Eucheuma* algae during low tides (Mozambique MEDA 2012).

Mauritius: Mauritius has a rich algal flora with floristic records dating back to 1875. The Mauritius herbarium has a collection of more than three hundred marine algae. Over 160 genera of marine algae have so far been identified in coastal waters. However species records do not reflect this diversity as only 36 species of algae have been identified from Mauritius and 104 species from Rodrigues. Some species of seaweeds commonly found in Mauritius are *Enteromorpha* sp., *Ulva* spp., *Sargassum* spp*., Caulerpa* spp. *Padina* spp. and *Halimeda* spp. There were no particular issues identified in the Mauritius MEDA (2012).

Mozambique: The Mozambique MEDA does not discuss macroalgal communities. Although there is farming of exotic species (*Kappaphycus alvarezii* and *Eucheuma spinosum*) which were introduced from Zanzibar, Tanzania in the late 1990s (FAO 2006-2009). These species are farmed in Northern Mozambique (Cabo Delgado and Nampula Provinces) in shallow areas close to the shore. In 2008 the total production of seaweed was about 70 tonnes (INAQUA 2008). There were no particular issues identified in the Mozambique MEDA (2012).

Seychelles: The Seychelles MEDA (2012) does not discuss macroalgal communities or macroalgal habitats.

South Africa: Kelps are the largest and fastest-growing algae, and support a rich community of organisms. Four species occur in South Africa – sea bamboo *Ecklonia maxima*, spined kelp *Ecklonia radiata*, split-fan kelp *Laminaria pallida* and bladder kelp *Macrocystis angustifolia*. Of these, only the spined kelp is common in the ASCLME region, as the others occur west of Cape Agulhas. It is found in deep rock pools and gullies, and seldom forms solid stands. Although herbivores such as limpets, abalone and sea urchins are able to graze on kelp, most of the animals in kelp forests are filter-feeders such as mussels, which are in turn eaten by

commercially valuable rock lobster. In South Africa, siltation as a result of poor catchment management causes smothering of benthic algal communities.

Tanzania: Several studies have been conducted on the impacts of heavy metal on flora and fauna in polluted habitats in Dar es Salaam coastal areas (Mwandya, 1996; Wekwe *et al.* 1989). The environmental impacts of Pb, Hg and Cd on calcification rates of the reef building calcareous algae *Amphipora tribulis* have been investigated in Dar es Salaam (Kangwe, 1999). Effluents from a fertilizer factory, municipal sewage and sisal decortications plants have enriched coastal waters causing proliferation of macroalgae in Tanga coastal waters (Munisi, 1999; Shilungushella, 1993).

Transboundary Scope

Only 6 of the 9 countries identified macroalgae habitats as 'Relevant', none of the countries identified this issue as being of 'High' importance and only 5 of the 9 countries ranked the issues as being of 'Medium' importance. In the Level 2 prioritisation, 2 of the 9 countries assigned the issue an 'Overall ranking' score that was above average, indicating that the countries do not consider this to be a priority transboundary issue of concern to the countries in the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	NR	✓	NR	✓	✓	✓	6
Importance	M	L	M	NR	M	NR	M	M	L	0
Overall ranking	6	6		NR	20	NR	8	16	8	2

2.3.4. Disturbance, damage and loss of soft sediment habitats

Problem Statement

The distribution, composition and morphology of soft sediment habitats within the ASCLME region are poorly known. These types of habitats often support rich and highly productive infaunal communities, and support commercially important fish and invertebrate species. Soft sediment habitats are vulnerable to physical disturbances and habitat damage as a result of fishing activities such as: beach seining; trawling for prawns and for horse mackerel and lizard fish. Disturbance also occurs due to sand mining and dredging.

National Scope

Kenya: The continental shelf is relatively narrow and sedimentary in nature, dominated by fine sands, silt and mud derived from terrigenous sources (Obura, 2001). Beyond the shelf, the seabed slopes away to depths in excess of 4,000 m (UNEP, 1998). The physical dragging of fishing nets, trawling for prawn and other species, can disturb these habitats as can dredging for shipping channels. The discharge of sediment laden low salinity water derived from the main estuaries and rivers also influences the quality of nearshore sediment environments. Sediments contaminated with POPs have been recorded in Makupa Creek, Port Reitz and Port Tudor although the distribution and persistence of POPs in the Kenyan environment has not been studied extensively.

Madagascar: Shrimp trawls in mud flats leads to the destruction of bottom micro-habitat, affecting ecological niches and therefore the diversity of fish communities and other species. Trawls have been used in Madagascar since 1967, and this has modified the majority of natural habitats and replaced them with muddy habitats that are poor in biodiversity and a decline in

catches. The creation of closed areas is important in that it would allow assessment of the impacts of trawling.

Mauritius: Following a recognised increased in the severity of coastal erosion, the Government implemented a ban on sand mining in the lagoons, which came into force in October 2003. The abyssal benthic fauna of Mauritius is quite rich and its abundance and distribution follows similar pattern reported earlier from central Indian Ocean and other seas. Polychaetes show continuous distribution and are recorded at all depths. Impacts on soft sediment habitats include dredging.

Mozambique: The beach seine fishery and gillnet fishery are concentrated on sedimentary habitats, as are the shrimp trawling fisheries.

Seychelles: Dredging and reclamation in the marine environment has been and still is a controversial issue. A large part of Victoria is built on reclaimed land and there has been extensive reclamation since the early 1980s on the east coast of Mahé to create flat.

Somalia: There is little mention of soft sediment habitats in the Somalia MEDA (2012).

South Africa: Muddy areas of the continental shelf support sole fisheries and the shelf break on the west and southern Cape coasts support trawl and demersal longline fisheries targeting hake but with a bycatch that includes kingklip, monk, jacopever and angelfish. In other soft sediment habitats, local meiofauna is continuously affected by disturbances such as chemical pollution, dredging and landscape alterations resulting in changes in diversity patterns often accompanied by changes in abundance and biomass. Other impacts on sediment habitats include dredging. For example Durban's harbour is currently being deepened and the entrance widened (scheduled completion date was April 2010), and some 10 million cubic metres of rubble will be moved to a designated deep-water dump site offshore. There is also concern about the impact of trawling on soft sediment habitats and it is thought that all trawlable grounds on the west and south coast have already been damaged.

Tanzania: The information on sea bottom sediment composition, distribution and morphology is generally scarce apart from limited studies conducted in the Zanzibar channel and between Pangani and Wami rivers (Shaghude et al. 1998, Shaghude 2003, 2004a, 2004b). Dredging is a particular concern in Tanzania, where the predominant effect is the burial of the resident fauna.

Transboundary Scope

Eight of the 9 countries identified soft sediment habitats as 'Relevant' but only 3 of the 9 countries ranked the issues as being of 'High' importance, while a further 4 countries ranked the issue as being of 'Medium' importance. In the Level 2 prioritisation, 3 of the 9 countries assigned the issue an 'Overall ranking' score that was above average, indicating that the countries do not consider this to be a priority transboundary issue of concern in the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	NR	✓	✓	✓	✓	✓	✓	✓	✓	8
Importance	NR	M	M	L	H	M	M	H	H	3
Overall ranking	NR	8	9	6	20	8	11	19	20	3

2.3.5. Disturbance, damage and loss of deep water habitats (including sea mounts)

Problem Statement

Deep water habitats may be disturbed by fishing activities, such as deepwater trawling, mining and extractive industries, or from the disposal of solid wastes, marine effluents and dredged spoil. These deepwater habitats can support a rich biodiversity, which have yet to be described, yet which are vulnerable to the impact of heavy deepwater gear. A survey of seamounts in the ASCLMEs, identified XXX seamounts.

National Scope

Madagascar: Exploratory fisheries surveys on shelf and slope in the 1970s and 1980s discovered >50 species (FAO 1998). A new industrial fishery was launched by a South African company using deepwater trawling techniques to catch alfonsino (*Beryx splendens*). This fishery was able to catch 7 tonnes with a single vessel within a period of several months. The fishing site included seamounts to the south of Madagascar (Centre de Surveillance des Pêches 2007). There is concern about the impact of the deepwater gear on these habitats (Madagascar MEDA 2012).

Mauritius: There is interest in the potential for exploiting deep water fisheries resources, which include the deep water shrimp with an estimated Mean Sustainable Yield (MSY) of 200 tonnes (Mauritius MEDA 2012).

South Africa: Shelf habitats include deep reefs, banks that support deepwater coral and sponge communities, and unconsolidated sediments of sand, gravel, mud and various intermediate and mixed sediments (Sink & Attwood 2008). The shelf break is a distinct habitat and is incised by submarine canyons. There are also several seamounts. The deep reefs are the habitat of many commercial linefish species including several endemic and threatened species. Rocky areas of the upper slope support rock lobster trap fisheries and muddy offshore banks on the east coast support a crustacean trawl fishery. Seamounts are productive habitats that support diverse fish communities that include valuable commercial species such as Orange Roughy. The demersal trawl fishery, which is the most valuable fishery, targets deep-water and shallow-water hake. Deepwater trawls targeting the newly found deepwater species have a unique set of biodiversity impacts and significant bycatch. Disposal of deepwater marine effluent and dredged spoils are monitored off the east coast, and although water, sediment and/or biological tissue in these waters is at times contaminated by various metals and persistent organic pollutants, the magnitude and spatial extent of this contamination is usually low and temporally variable (South Africa MEDA 2012).

Tanzania: Exploitation of deep-water lobsters (*Linuparus somniosus* and *Metanephrops andamanicus*) takes place in depths of 250 to 320 m in the southern end of the Zanzibar Channel. Tanzania has formed Deep Sea Authority (DSA), which is a corporate body with powers to regulate and control fishing activities in the country's Exclusive Economic Zone (EEZ) (Tanzania MEDA 2012).

Transboundary Scope

Only 4 of the 9 countries identified deep water habitats as 'Relevant' but 3 of these 4 countries ranked the issues as being of 'High' importance, while one country ranked the issue as being of 'Low' importance. In the Level 2 prioritisation, 1 of the 9 countries assigned the issue an 'Overall ranking' score that was above average, indicating that the countries, perhaps do not consider this a priority transboundary issue of concern to the countries in the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	NR	NR	✓	NR	NR	NR	✓	✓	✓	4
Importance	NR	L	H	NR	NR	NR	L	H	H	3
Overall ranking	NR	8	16	NR	NR	14	9	12	17	1

2.4. Disturbance, damage and degradation of pelagic habitats (nearshore <30 m, neritic 30-200m and oceanic >200m depth)

Problem Statement

Pelagic habitats, as referred to in this issue, includes the water column in the nearshore (<30 m), neritic (30-200 m) and oceanic (>200 m). Many of the impacts to the pelagic habitats have been captured under the issues of concern in MAC01. Impacts to pelagic habitats may include the land-based and ship based sources of contamination including the unregulated discharge of domestic and industrial pollution, run-off of agricultural chemicals, oil spills. The following describes some of the additional impacts in the pelagic environment that have not yet been captured under MAC01, and mainly relate to noise pollution as a result of boat traffic, shipping and transportation, dredging and seismic surveys associated with oil and gas exploration.

National Scope

Kenya: Noise pollution is reported to threaten marine mammals. It disrupts their orientation, feeding and communication ability, causing interference which may lead to strandings and physical damage to the ear of the animals if they are close to the source noise.

Madagascar: Noise pollution is a concern around major ports and specific activities producing underwater noise, particularly industrial shrimp trawling and by seismic and sonar studies undertaken by the oil industry. Sea turtles are sensitive to noise and in Madagascar, during seismic studies turtles were observed to flee 1 to 2 km from the noise source.

Seychelles: There is an increase in the amount of noise pollution in Seychelles associated with the increase in expeditions for oil exploration.

Transboundary Scope

Eight of the 9 countries identified pelagic habitats as 'Relevant' and 6 of these countries ranked the issues as being of 'High' importance. In the Level 2 prioritisation, 7 of the 9 countries assigned the issue an 'Overall ranking' score that was above average, indicating that the countries consider this to be a priority transboundary issue of concern in the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	NR	✓	✓	✓	✓	✓	✓	✓	✓	4
Importance	NR	H	H	H	M	L	H	H	H	6
Overall ranking	3	16	19	17	20	18	16	12	21	7

2.5. Increase in the occurrence of harmful or toxic algal blooms (HABs)

Problem Statement

Harmful algal blooms (HABs) or toxic algal blooms may occur naturally as a result of climatic factors or they may be triggered by anthropogenic impacts causing eutrophication.

National Scope

Comoros: The MEDA does not report incidents of Harmful or Toxic algal blooms.

Kenya: Coastal waters are increasingly being impacted by land-based pollutants, more specifically wastewater (Kenya MEDA 2012). This creates eutrophic conditions, which could promote HABs development and prolong the duration of their occurrence. A first extensive survey carried in Kenya reported a total of 24 species of potentially harmful microalgae. A bloom mostly comprising of *Gymnodinium sp*. was observed in the Kiunga National Marine Reserve in 2004 (IUCN, 2004). The bloom lasted for 10 days causing extensive marine life mortality due to hypoxic conditions that created dead zones (Kenya MEDA 2012).

Madagascar: There is a problem of intoxication from consumption of marine animals due to the proliferation of micro-organisms such as microalgae, bacteria, cyanobacteria or diatoms, mainly in the warm season (Madagascar MEDA 2012).

Mauritius: In 1990 the coastal waters and ecosystems of Port Louis (Mauritius) suffered from severe eutrophication as a result of nutrient-enriched runoff and sewage effluent, as did seagrass beds in Bain des Dames and Point Moyenne (Ramessur 2002). Domestic sewage released to coastal waters from urban areas and poorly planned housing developments on reclaimed wetlands can cause eutrophication/algal blooms that lead to the smothering of coral reefs. Algal blooms are observed annually at Trou aux Biches and isolated cases have been reported at Bain des Dames near Port Louis. Frequent discharge of pollution and nitrates from agriculture and coastal hotels give rise occasionally to algae bloom and red tides. Mauritius is an endemic region of fish toxicity, especially ciguatera, as a result of the presence of potentially toxic benthic dinoflagellates. Anthropogenic eutrophication and industrial development can trigger toxic algal blooms and this is a genuine concern. Introduction of new toxic species from ballast water is also a potential threat and the effect of global warming and associated effects on climate could cause an increase in coral bleaching and mortality thus contributing to favourable habitats for *G. toxicus.* The tourism industry could suffer in the event of an outbreak of ciguatera fish poisoning (Mauritius MEDA 2012)..

Somalia: In January, 2002, a HAB occurred along the East African coast from Mogadishu in Somalia to Lamu in northern Kenya, associated with the strong, upwelling of the Somali current and an unusual strong NE wind (force 5-6) that may have blown it onshore. This bloom lasted for 10 days, with extensive fish mortalities during the first three days, and numerous fish and other marine animals, such as turtles being washed up on the beaches or found floating on the ocean surface (Somalia MEDA 2012)..

Tanzania: Several potentially harmful microalgae have so far been found to exist in Tanzanian coastal waters. They are distributed among three major microalgal groups: the cyanobacteria, mostly dominated by *Trichodesmium* spp; the dinoflagellates, dominated by both *Prorocentrum* spp. and *Gambierdiscus toxicus* and; the diatoms, mostly *Pseudonitzschia* spp. (Tanzania MEDA 2012).

Transboundary Scope

Eight of the 9 countries identified harmful algal blooms as 'Relevant' but only 4 of these countries ranked the issues as being of 'High' importance. In the Level 2 prioritisation, none of the 9 countries assigned the issue an 'Overall ranking' score that was above average, indicating

that the countries, perhaps do not consider this a priority transboundary issue of concern to the countries in the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	NR	✓	✓	✓	8
Importance	H	M	H	H	L	NR	M	H	M	4
Overall ranking	8	15	10	15	15	NR	7	11	13	0

2.6. Introduction of exotic non-native species, invasives and nuisance species

Problem Statement

The introduction of exotic non-native and invasive species causes a loss of biodiversity in the marine and coastal environment due to preying on native species, competition for space with native species, hybridisation causing genetic dilution, changes in ecosystem function and decreased water quality. In the marine environment, international shipping is the principal method for the introduction of exotic species and over 3,000 marine species travel around the world in ships' ballast water on a daily basis. Invasive species of marine algae may impact on marine habitats, reducing coral growth and excluding native algal species. Outbreaks of nuisance species also occur periodically within the ASCLME, and introduced species may also impact on the populations of birds in coastal environments.

National Scope

Comoros: Exotics and invasive species are found throughout the Comoros archipelago. There is no official list of invasive plants in the Comoros, although some of the introduced species are known. These include some fruits, spices and some fast growing multipurpose species. Other species were introduced as part of reforestation and soil erosion control programme in the twentieth century, approximately two thirds of which are trees the remainder being shrubs (e.g. *L. glutinosa*, *L. leucocephala*, *J. curcas*, *G. sepium*, *L. camara*, *C. hirta*, *Senna* sp.). *Acacia* sp. was introduced in the 1970s to control soil erosion have now become naturalized. New invasive or potentially invasive species have been reported. *Clidemia hirta* is probably a new invasive in Anjouan and Mayotte, with devastating effects widely visible on Grande Comore and Moheli. An estimated 16 tree species are highly invasive in the Comoros archipelago: *Acacia mangium*, *Acacia auriculauformis*, *Albizia lebbeck*, *Cinnamomum verum*, *Clidemia hirta*, *Gliricidia sepium*, *Jatropha curcas*, *Lantana camara*, *Leucaena leucocephala*, *Litsea glutinosa*, *Psidium guajava*, *Psidium cattleianum*, *Senna* sp. *Spathodea campanulata*, *Syzygium aromaticum,* and *Syzygium. jambos*. Others are woody species of crops, mainly *S. obtusifolia*, *A. lebbeck*, *S. campanulata*, *P. cattleianum*, *L. glutinosa*, *L. camara* and *C. hirta*. They are typically competitive (e.g. *L. glutinosa* in rainy season), and deeply rooted (e.g. *P. cattleianum*, *S . obtudsifolia*, *A. lebbeck*). Some herbaceous species are also difficult (e.g. *Hibiscus surratensis*, *Mimosa pudica*) or irritating (*Mucuna pruriens*).

Kenya: A recent study found 36 exotic species in Kenya (ISSG 2009) although only *V. cholera* is an invasive in Kenya. The ballast water handling facility at the Kenya Port Authority is not currently operational, posing a major risk of the introduction of new plankton communities. Some seabirds and coastal shorebirds suffer predation of eggs and chicks by introduced brown rats, *Rattus rattus*. Nuisance species such as COTS have also affected coral reefs in Kenya.

Madagascar: On the southwest reefs of Madagascar, *Turbinaria* became an invasive species following reef degradation due to the combination of overfishing and bleaching events

(McClanahan et al. 2009). While the effects of this invasion have not been studied yet, the reduction of light might have negative effects on coral growth. Some seabirds and coastal shorebirds suffer predation of eggs and chicks by introduced brown rats, *Rattus rattus*. Jellyfish blooms also occur in Madagascar and the phenomenon is observed regularly in the region of Toliara during the warm season (P. Vasseur, pers. comm. 1992).

Mauritius: The transfers of alien species of zooplankton in ballast water from one country to another is an on-going problem. There are concerns that *Caulerpa taxifolia* forms dense monoculture beds within the lagoons that prevent the establishment of other seaweeds and excludes almost all marine life.

Mozambique: Exotic seaweeds are farmed in Northern Mozambique (Cabo Delgado and Nampula Provinces) in a system of poles installed in shallow areas close to the shore and this has the potential to cause the introduction of exotic species into the marine environment. During 1995-1996 there was an outbreak of the Crown-of-Thorns starfish (COTS) in Mozambique, which caused extensive reef damage at Bazaruto (80%) and Inhambane (95-98%);

Seychelles: introduced animals such as *Rattus* spp., *Felis catus, Tyto alba* and *Acridotheres tristis*, have caused severe reductions in breeding bird populations through the predation of eggs, chicks and adult birds (Rocamora and Skerrett 2001).

South Africa: 85 alien species have been reported in South Africa (Mead et al. in prep.). The threat from new alien species in the region remains high due to the high volume of shipping processed at Richards Bay and Durban harbours. An assessment of the impacts caused by ballast water in Mozambique has not yet been done, but the country possesses 3 big harbours where large vessels arrive and depart daily.

Tanzania: The Invasive Species Specialist Group (ISSG 2005) of the IUCN Species Survival Commission identified the following invasive species: *Musculista senhousia* (mollusc), *Salmo trutta* (fish), *Tilapia zillii* (fish), *Vibrio cholera* (micro-organism), *Acanthophora spicifera* (algae), *Gracilaria salicornia* (algae), *Tubastraea coccinea* (coral) and *Lutjanus kasmira* (fish). The Indian crow is known to be feeding ferociously on eggs of other bird species thus threatening indigenous populations and their continued existence. COTS outbreaks have also affected coral reefs in Tanzania.

Transboundary Scope

Only 8 of the 9 countries identified deep water habitats as 'Relevant' but only 3 countries ranked the issues as being of 'High' importance. In the Level 2 prioritisation, 3 of the 9 countries assigned the issue an 'Overall ranking' score that was above average, indicating that the countries, perhaps do not consider this a priority transboundary issue of concern to the countries in the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	NR	✓	✓	✓	8
Importance	L	M	H	M	M	NR	L	H	H	3
Overall ranking	7	16	15	18	20	NR	9	14	16	3

9.4 MAC03: DECLINES IN LIVING MARINE RESOURCES

Globally, it is now well established that marine wild capture fisheries are overexploited. The methods used to extract resources may impact on other non-target species, and contribute towards the loss or disturbance of natural habitats, further threatening the long term survival of other species which depend upon these habitats for feeding, breeding or other critical life processes. Populations of many species, including the larger more charismatic marine mammals, seabirds, sea turtles, as well as rarer endemic species, are critically endangered or vulnerable. The issue categories related to declines in living marine resources as identified from the MEDA and included in this Main Area of Concern are described below:

3.1. Decline in populations of focal species

Focal species is an umbrella term, that is usually used to refer to a collection of species of conservation concern, which may include endemics, flagships, indicators, keystones, targets, and vulnerable species. In this context it has been used to group the charismatic flagship and vulnerable species. The commercially important indicator and target species are dealt with in the subsequent section.

3.1.1. Decline in populations of other marine mammals (excluding whales and dolphins)

Problem Statement

There are five marine mammal species other than whales and dolphins found within the ASCLMEs, which include: one species of Sirenidae (*Dugong dugong*) which was found throughout the region, and four species of Pinnepeds (*Arctocephalus pusillus, Arctocephalus tropicalis, Mirounga leonina, Lobodon carcinophagus*), which are mainly found along the South Africa coast, but have also be reported as vagrants from other locations. Dugong are potentially the most threatened and vulnerable species within the ASCLMEs and they now extremely rare. The population is estimated to be less than 500 animals, the majority of which are found in Mozambique (Bazaruto Archipelago). Recent surveys have also found potentially significant populations in northwest Madagascar (Ridoux *et al.*, 2010), and Mayotte (Kiszka *et al.*, 2007) but the viability of these populations remains uncertain. Populations of dugong have declined due to hunting and incidental capture in commercial and artisanal fisheries (gillnets, trawlers and other set nets). Pollution and physical disturbance and damage to marine mammal habitats (particularly seagrass beds) are also thought to have contributed to the decline in *Dugong*. In more recent year, an increase in tourism activities and boat traffic also threatens these marine mammals through noise pollution and boat strikes.

National Scope

Comoros*:* Dugong meat is very popular in Comoros and they are a target species for the artisanal fishery. Mohéli Marine Park used to host a population of several hundred especially during the austral winter months when seagrass beds exhibit the fullest growth. Dugong populations have however declined and sightings are now rarer than before (WWF EAME, 2004; Muir & Kiszka, 2011, Comoros MEDA 2012).

Kenya: Dugong populations in Kenya have declined rapidly from a herd of 500 individuals reported on the south coast in 1967 to 8 in 1975 (Ligon 1976), 10 in 1994 and only 6 in 1996 (WWF EAME 2004; Wamukoya et al. 1996, 1997). The decline in this species was due to hunting and bycatch in gillnets. Currently, dugong are only present in very small numbers, mostly confined to the Tana delta area, the Lamu Archipelago and Kiunga (WWF EAME, 2004).

Mozambique: The largest remaining viable dugong population in eastern Africa, is found in Bazaruto Bay, and this population is now considered to be declining (Muir et al. 2004). Recent aerial surveys conducted between April 2006 and December 2007, estimated 247 animals (Cockcroft *et al*., 2008; Findlay *et al* 2011). In other coastal areas of Mozambique, dugongs

appear relatively rare (WWF EAME, 2004). Entanglements in gillnets appear to be a major cause of dugong mortality (Mozambique MEDA 2012). Dugong is a desired source of meat in parts of Mozambique and targeting has been reported around Inhaca Island (van der Elst, 2012).

Madagascar: The dugong is known to occur in Madagascar but its status remains unclear (WWF EAME, 2004). A dedicated aerial survey in 2009, recorded seven dugong in the northwest region (Ridoux *et al.*, 2010), an area now suspected to be important in the WIO, but more quantitative surveys are needed to confirm this observation. Dugongs are rarely hunted by fishermen around Madagascar anymore, but hunting was very important in the early 1980s until 1990, near Vohémar (Rafomanana and Rasolonjatovo 2004) and Cape St. Andre (WCS unpublished data). There are still reports of hunting in more recent years (van der Elst, 2012). Dugong are also caught incidentally by commercial, artisanal and traditional fisheries. Habitat losses (seagrass beds) due to trawling for shrimp and noise pollution associated with trawling are also a concern.

Mauritius: Dugongs, which were once common in the lagoons around Mauritius and Rodrigues, are now extinct and no sightings have been reported in recent years.

Seychelles: Only a few (3) individuals having been recorded at Aldabra atoll (WWF EAME, 2004). Changes in dugong numbers at Aldabra is unknown (Hermans & Pistorius, 2008).

Somalia: One of the last viable populations of dugong on the eastern African Indian Ocean coast is found in Somalian waters, however the remaining populations are threatened by bad fishing practices, particularly the use of shark gill nets (Van der Elst and Salm 1998, Pilcher and Alsuhaibany 2000) and hunting. Hunting of large mammal has been intense, leading to catastrophic declines and the long-term survival of local populations of some species is unlikely.

South Africa: The South African fur seal (*Arctocephalus pusillus*) is found along the south and southwest coasts of South Africa (Best, 2007). Fishing activities have reduced fish stocks on which seals depend, the reduction in prey resources would have a negative impact on their populations. Furthermore, cape fur seals are often trapped and drowned in nets. Fishermen view seals as a pest that compete with them for fish and destroy their fishing gear in the process. Some fishermen retaliate by killing seals at sea by shooting or clubbing them.

Tanzania: Populations of dugong have declined significantly in recent decades and sightings are now very rare. Small resident populations exists in the Rufiji-Kilwa-Mafia area and at Moa in Tanga region, where there are extensive shallow seagrass beds, and sheltered bays and channels (Muir & Kiszka, 2011). The Pemba-Zanzibar channel in northern Tanzania is also recognized as an important dugong habitat. Numbers are estimated to be no more than 100 individuals. They were a target species, but the introduction of nylon filament nets in the late 1960s posed the greatest threat to dugongs (Amir et al. 2002). Dugongs are also threatened by fishing methods that cause seagrass damage (trawling) and seine nets and by the use of dynamite.

Transboundary Scope

Seven of the 9 countries identified concerns related to marine mammals as 'Relevant', and 5 countries ranked the issues as being of 'High' importance in the Level 1 prioritisation exercise. In the Level 2 prioritisation, only 2 of the 9 countries assigned the issue an 'Overall ranking' score that was above average, indicating that the countries, do not consider this to be a priority transboundary issue of concern within the ASCLMEs at the current time.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	✓	✓	NR	NR	7
Importance	M	H	M	H	H	H	H	NR	NR	5
Overall ranking	18	16	11	15	21	11	13	NR	NR	2

3.1.2. Decline in populations of cetaceans

Problem Statement

Over 30 species of whales and dolphins have been reported from the waters of the ASCLME region, and these included baleen whales, sperm whales, toothed whales and dolphin species. The whole of the Indian Ocean south to 55°S was declared as a whale Sanctuary in 1979. Within the ASCLMEs cetacean populations are declining due mainly to hunting and incidental catches by various fisheries (commercial, artisanal and traditional). Habitat disturbance and loss, collisions and climate variability and change are other factors contributing to the decline in local populations. Noise pollution is an increasing problem which disrupts orientation, feeding and communication ability of cetaceans, causing interference which may lead to strandings and physical damage to the ear of the animals if they are close to the source noise.

National Scope

Comoros: There at least 4 species of dolphin and 12 species of whales that have been reported from around the Comoros and Mayotte. Humpback whales are found around the islands between July and November. They are not targeted by local fishers.

Kenya: There are 6 species of whale and 8 species of dolphins found in Kenyan waters. Threats include artisanal gillnets, trawlers and other set nets, industrial pollution, degradation of habitats, as well as tourism and boat traffic due to noise pollution and boat strikes.

Madagascar: Dolphin species are hunted by fishermen, particularly in the south-west region of Anakao, for consumption and sale of meat. The species targeted include the bottlenosed dolphin (*Tursiops truncates*), the Indo-Pacific humpbacked dolphin, (*Souza chinensis*) and the long-nosed dolphin (*Stenella longirostris*) (Andrianarivelo 2001, Razafindrakoto et al. 2004, 2005 & 2007 and Cerichio *et al.,* 2009). The annual catch at Anakao was estimated to be between 100 to 150 spinner dolphins (*Stenella longirostris*), with smaller catches of large dolphin and Risso's dolphin (*Grampus griseus*) (Razafindrakoto et al. 2008, Cout and Cooke 1994). Incidental catches also occur as a result of various fisheries (commercial, artisanal and traditional) but there is little data on the scale of the problem are available and it is thought that the impact is lower than for hunting. Drift nets and longlines take coastal species of dolphins (bottlenosed dolphin, Indo-Pacific humpbacked dolphin, long-nosed dolphin) (Razafindrakoto et al. in prep) and cetaceans are also accidentally caught by jarifa (shark nets). Noise pollution around major ports and activities, particularly industrial shrimp trawling and seismic and sonar studies undertaken by the oil industry, also create a disturbance for these animals. Collisions between ships and cetaceans and harassment, whether intentional or accidental, is increasing. The humpbacked whale is the main attraction for sightseers between June to October. Dolphins are observed during diving, fishing and marine tours. Seawater temperatures may impact on highly migratory species including cetaceans (Madagascar MEDA 2012).

Mauritius: Seventeen marine mammal species have been recorded in Mauritian waters mostly as they migrate to and from Antarctica to warm tropical waters for calving. Dolphins are encountered more frequently than whales, although more recent studies have found resident

populations of humpback and sperm whales in the waters around Mauritius. Whale and dolphin watching has become a very popular tourist attraction in Mauritius and the number of boats offering this activity has exploded in recent years as fishers have transitioned out of fisheries into the tourism sector (Mautitius MEDA 2012).

Mozambique: Little is known about the cetacean populations in Mozambique's waters. There are thought to be at least three species of whale and ten species of dolphin. Humpback dolphins are a target species in Mozambique (Guissamulo and Cockcroft 1997). Small coastal cetaceans are also vulnerable to accidental capture, particularly as a result of the use of gillnets. There has been a marked decline in coastal dolphin populations was observed in the early 1990's (Mozambique MEDA 2012).

Seychelles: Over 40 species of whale and dolphin have been recorded from Seychelles waters. Cetaceans are not a fisheries target species in the Seychelles but there are several incidents of poaching of dolphins every year but the number of occurrences is on the decrease (Seychelles MEDA 2012). The increase in expeditions for oil exploration, are resulting in an increase in the amount of sound pollution which can pose great danger to the cetaceans (Seychelles MEDA 2012).

Somalia: Purse seines yield a high by catch of cetaceans and shark gill nets also catch non-target species including dolphins and whales (Van der Elst and Salm 1998, Pilcher and Alsuhaibany 2000, Somalia MEDA 2012).

South Africa: The waters along the eastern coast support resident and migratory populations of over 34 species of whales and dolphins. Dolphins, whales and seals are trapped in the anti-shark nets in the KwaZulu-Natal region, and various species have been reported as fisheries by-catch in South Africa waters (South Africa MEDA 2012).

Tanzania: Whales, dolphins and porpoises frequently occur in the marine coastal waters of Tanzania. Eight species of dolphins have been observed in various places including the Rufiji delta, Mtwara, Tanga, Saadan, Latham Island, Menai bay, Nungwi and Matemwe. Humpback Whales have also been observed near the coast of Tanga and Mnazi Bay. Cetaceans have been recorded as bycatch in gillnets in various locations, but most notably by the gillnet fishery in the Zanzibar Channel and along the coast of northern Tanzania (Amir *et al.*, 2002). The level of dolphin bycatch in the artisanal gillnet fishery was high enough to likely be impacting upon small local populations (Amir *et al.*, 2002).

Transboundary Scope

Declines in the populations of these highly migratory species is identified as a 'Relevant' by 6 of the 9 countries, and 5 countries ranked the issue as being of 'High' importance. In the Level 2 prioritisation, only 3 of the 9 countries assigned the issue an 'Overall ranking' score that was above average, indicating that the countries, do not consider this to be a priority transboundary issue of concern in the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	NR	✓	✓	✓	✓	✓	✓	NR	NR	6
Importance	NR	H	H	H	M	H	H	NR	NR	5
Overall ranking	NR	13	16	20	17	17	10	NR	NR	3

3.1.3. Decline in populations of seabirds

Problem Statement

Seabird populations in the ASCLMEs are threatened by hunting and egg collection; accidental bycatch particularly in the longline fishery, but also by gillnets; and habitat destruction or loss as a result of human activities or climate change; the introduction of alien predators such as cats and rats also affect many seabird populations. There are eleven seabird families within the ASCLMEs including, penguins (Spheniscidae), albatrosses (Diomedeidae), petrels and allies (Procellariidae), storm-petrels (Hydrobatidae), diving-petrels (Pelecanoididae), tropicbirds (Phaethonidae), gannets and boobies (Sulidae), cormorants (Phalocrocoracidae), frigatebirds (Fregatidae), skuas (Stercorariidae), gulls and terns (Laridae). Many tropical seabird species forage in association with tunas, which drive prey to the surface and thereby bring them within reach of the seabirds. The Procellariiformes (albatrosses and petrels) are the most susceptible to being caught as bycatch in longline fisheries (Brothers et al. 1999). The depletion of tuna stocks and other small pelagics could also impact these dependent species although these kinds of impacts are difficult to predict.

National Scope

Comoros: The Comoros MEDA (2012) did not identify concerns related to birds.

Kenya: Egg collection by fishermen also significantly affects colonial nesting seabirds in Kenya. In Kisite Island, Whale Island and Kiunga Marine Reserve, many years of egg collection by fishermen has predisposed many birds in the *Sterna* genus to breeding failure (Bennun and Njoroge, 1999). Some seabirds and coastal shorebirds suffer predation of eggs and chicks by introduced brown rats, *Rattus rattus*. The Indian crow is suspected to be feeding ferociously on eggs of other bird species thus threatening indigenous populations and their continued existence. The pelagic long-line fishing in Kenya often kills or injures diving seabirds such as petrels, noddies, albatrosses and tropicbirds, which then form part of the by-catch. It is also suggested that to a significant extent, piscivorous birds suffer reduced food supply resulting from overfishing by artisanal fishermen (GOK, 2008). For example, trawl-fishing in Ungwana Bay has reduced fish food available to pelagic fishing seabirds, and created bird-vessel dependency which leads indirectly to unsustainable feeding relationships. Rising sea levels associated with global warming are also expected to depress suitable feeding and roosting habitat for many shorebirds along the East African coast in the coming few years (Kenya MEDA 2012).

Madagascar: Egg collecting takes place on many continental islands accessible to fishermen, and is considered to be a major factor in the decline of seabirds in coastal waters (ZICOMA 1999), although systematic study on this subject has yet been conducted. Some seabirds and coastal shorebirds suffer predation of eggs and chicks by introduced brown rats, *Rattus rattus*. Albatrosses and giant petrels are sometimes accidentally caught by longlines when these birds dive after the bait on the fish hooks (Madagascar MEDA 2012).

Mozambique: Seabirds are used as protein resources by local people, but harvesting of both eggs and adults may be unsustainable. Exploitation of littoral organisms for human consumption also represents a potential threat to the conservation of the shore bird since birds are dependent on these organisms. The accelerated growth of the tourist industry along the coast also poses a serious threat to the conservation of the shore birds due to the loss or damage caused to essential habitats (Mozambique MEDA 2012).

Seychelles: Although the Sooty tern (*Onychoprion fuscatus)* is the most abundant seabird that breeds in Seychelles (Burger and Lawrence 2003), its eggs are also commercially exploited. Despite enforcement efforts to control the amount of eggs harvested, poaching still remains an issue, especially on the outer islands (Feare et al. 1997; Rocamora and Skerrett, 2001); this is largely due to logistical and economical constraints. Introduced animals such as *Rattus* spp., *Felis*

catus, Tyto alba and *Acridotheres tristis*, have caused severe reductions in breeding bird populations through the predation of eggs, chicks and adult birds (Rocamora and Skerrett 2001). Other species are threatened by habitat destruction and/or loss from land use changes such as coconut plantations. Albatrosses and giant petrels are sometimes accidentally caught by longlines when these birds dive after the bait on the fish hooks. Mitigation measures used within the IOTC to reduce seabird by-catch include night setting with minimum deck lighting, bird-scaring lines (tori lines) and weighted branch lines (IOTC 2009), (Seychelles MEDA 2012).

South Africa: The incidence of bird mortality on tuna-directed longlines is high (seasonally) on the Agulhas Bank. Seabirds feeding on anchovy and sardine compete with purse-seine fisheries for food and some populations have suffered large decreases in the past 50 years (Crawford 2007), (South Africa MEDA 2012).

Tanzania: Introduced species such as the Indian crow is suspected to be feeding ferociously on eggs of other bird species thus threatening indigenous populations and their continued existence (Tanzania MEDA 2012).

Transboundary Scope

Seabirds spend the majority of their life at sea and some species are highly migratory. Eight of the 9 countries identified concerns related to seabirds as 'Relevant', only 3 countries ranked the issues as being of 'High' importance. In the Level 2 prioritisation, only 1 of the 9 countries assigned the issue an 'Overall ranking' score that was above average, indicating that the countries, do not consider this to be a priority transboundary issue of concern in the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	✓	✓	✓	NR	8
Importance	H	L	L	H	M	H	L	M	NR	3
Overall ranking	18	10		17	17	16	8	12	NR	1

3.1.4. Decline in populations of turtles

Problem Statement

There are five species of sea turtle known to frequent the waters of the ASCLMEs (Marquez 1990; Ratsimbazafy 2003; Seminoff 2004) all of which are listed on the IUCN Red List. The species found include two 'Critically Endangered' species, the Hawksbill (*Eretmochelys imbricata*) and Loggerhead turtle (*Caretta caretta*), two 'Endangered' species, the Green turtle (*Chelonia mydas*) and Leatherbacks (*Dermochelys coriacea*), and one 'Vulnerable' species, the Olive Ridley turtle (*Lepidochelys olivacea*). The Green and hawksbill turtles, are the most widely distributed and the Green turtle is the most numerous within the ASCLMEs. Loggerhead and Leatherback turtles are most common in South African waters. Little is known about the distribution and abundance of the Olive Ridley turtle within the western Indian Ocean, and it may be more of a vagrant to the region. The main threats to turtles in the region include disturbance, loss and degradation of nesting beaches; pollution; hunting for meat, eggs and carapaces; and incidental capture in industrial and artisanal fisheries. Hawksbills and Green turtles are the most commonly exploited species in the region (Hughes 2010). Sea turtles may be affected by various forms of pollution, such as marine debris, oil pollution, sedimentation and noise pollution and this is a particular concern in Madagascar, Kenya, Somalia and Tanzania. Female turtles generally spawn at night and can be disturbed by the presence of lights on the beach, inducing them to leave the premises without laying. Electric lights can also affect new

hatches, inducing them to approach the light instead of moving toward the horizon to the sea. Rising sea levels will likely reduce or modify the nesting beaches. Rising temperatures may also affect embryo development, causing sex ratio bias toward females. Water warming could have a negative impact on foraging areas, particularly turtles depending on coral reefs. Finally, the increased influx of terrestrial sediments, due to preview increase in extreme rainfall events, erosion due to poor land use and upstream deforestation could change the shape and characteristics of the sand beaches. This may discourage females from nesting or inhibit young turtles from digging their way out of the nest. Fibropapillomonas affects Green turtles globally. Links to environmental factors such as pollution or global warming are suspected but not proven (Mortimer 2003).Although reporting of bycatch of sea turtles is generally poor, there are reports of catches by purse seiners, longliners, and gillnets. The most common species caught by the purse seiners were Olive Ridley, Green and hawksbill turtles.

National Scope

Comoros: Four species of sea turtle are found including Green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), Loggerhead turtle (*Caretta caretta*), and Leatherback turtle (*Dermochelys coriacea*). Previously all the beaches of the Comoros were sea turtle nesting sites, but now, only the Mohéli Marine Park has sea turtle nesting beaches, and these are some of the most important in the region. The main threats to sea turtles in Comoros include habitat destruction due to sand and stone mining on nesting beaches, discharge of groundwater and runoff on marine turtles habitats (coral reefs, seagrasses, beaches) due to deforestation, and poaching. Despite large public sensitization programs, environmental education in schools and surveillance by coastguards, poaching of Green turtle for its meat and eggs is still prevalent in Comoros. A traditional trade for turtle meat is still active in Anjouan and Moheli. However in some places, such as Itsamia's village, population is well educated on the importance of turtle conservation and the whole community is supporting anti-poaching activities.

Madagascar: Traditional hunting of turtles is performed with harpoon or spearguns. Catches were estimated to be as high as 13,248 turtles per year (*Chelonia mydas* 51%, *Eretmochelys imbricata* 15%, *Caretta caretta* 15% and *Lepidochelys olivacea* 18%) over an 800 km coastline in Southwest (Hughes 1971). Hughes (1973) estimated the national catch of *E. imbricata* at 2,500 individuals and concluded that the species was threatened. So at least *C. mydas* and *E. imbricata*, and probably also *L. olivacea* and *C. caretta* are overexploited which is a major concern. Turtles are also affected by offshore industrial fishing (longline and seine), fishing on the continental shelf, industrial shrimp trawling, fishing nets for shark and traditional fishing with poison. Industrial trawling for shrimp is an important cause of incidental catches of turtles, but has never been scientifically evaluated. In 2000, a trawler captain in Toliara (pers com.) estimated incidental catch at 300 turtles per ship per year. The nesting beaches in Madagascar are also affected by urban development, major construction works such as ports, dams, mining and oil installations and constructions for tourism and development. Light and interference with nesting beaches as a result of increasing tourism also affects turtle populations in Madagascar. Studies confirm that the most important turtle nesting sites are now on small islands in the west of Madagascar (particularly the north west of Madagascar), while nesting is less frequent on mainland beaches, and absent in mainland areas near to coastal towns. Sea turtles are also affected by various forms of pollution, such as marine debris, oil pollution, sedimentation and noise pollution. Noise, especially between 50 and 1000 Hz was found to cause an increase in swimming speed and diving in Madagascar. In the case of seismic campaigns, turtles fled 1 to 2 km from the source. A turtle conservation project in the Maintirano region, found a high incidence of the disease Fibropapillomatosis among sea turtles caught for research purposes around Maroantaly Island, one of Barren Islands. The disease affects approximately 25% of green turtles and can be a significant cause of mortality (Madagascar MEDA 2012).

Mauritius: There are two species of marine turtles which are commonly encountered in coastal waters (Hawksbill *Eretmochelys imbricata* and green *Chelonia mydas*).Population trends of both the species are not known, but believed to be declining (Mauritius MEDA 2012). Both species used to nest on Mauritius and Rodrigues but there is no evidence of nesting in recent times; although there are still nesting beaches on St. Brandon, Agalega and the Mascarene. The hawkbill was traditionally exploited for the carapace and eggs and the green turtle was exploited for meat, eggs, fat and leather (Mauritius MEDA 2012).

Mozambique: Turtle carapaces are still used in the manufacture of tortoiseshell. The artisanal and prawn trawling fisheries of Mozambique have also reported catches of sea turtles with 36 turtles accidentally caught each year between 1932 and 1954 on the Sofala Bank.

Seychelles: There are four species of sea turtles found in Seychelles waters, but only the green turtle (*Chelonia mydas*) and Hawksbill turtle (*Erethmochelys imbticata*) nest on Seychelles beaches. The Seychelles hosts one of the five most significant global populations of Hawksbill turtle, which is particularly significant given that this is a critically endangered species (Mortimer 1985). The numbers of nesting Green turtles appears to have increased significantly during the past 35 years. But there has been a 50 % decline in the number of female nesting Hawksbills in the past 20 years. The most important nesting sites have protected status either as special reserves or as marine national parks. Turtle hunting is also banned, but there are still incidents of poaching, especially of the Greens in the outer islands and the Hawksbill around the inner islands. There have also been instances where marine debris has been swallowed by turtles or entangled the animals. There are concerns that coral reef degradation and seagrass loss could affect the feeding of hawkbill and Greens, respectively. Coastal development constitutes a significant threat, especially tourism related development, where nesting habitats are either being destroyed or there are increasing activities on previously undisturbed beaches. Also, the nesting turtles are disorientated by lights of hotels. Sea level rise also poses a threat to the nesting habitats. Although turtle bycatch rates may be low, it still occurs in many fisheries and there are issues with entanglements in Fish Agregation Devices (FADs).

Somalia: Hunting of nesting and foraging turtles and collection of eggs in also a concern in Somalia. Destruction of turtle nesting beaches through coastal development, dredging, mining and erosion threatens turtle populations in Somalia (Okemwa 1998). Gillnets used in the artisanal and subsistence fisheries pose a major threat to all species of turtles (adult and sub-adult) in Somalia.

South Africa: There is large pressure on conservation areas adjacent to nesting beaches to be developed into lucrative tourism areas. This sometimes results in a conflict between the need to add artificial lights in remote areas for security reasons, and the need for dark beaches for turtle nesting and hatching (Jacobson and Lopez 1994; Witherington and Martin 1996; Wilson and Tisdell 2001). Incidental mortality of turtles is problematic in South Africa and vessels deploy Turtle Excluder devices (TEDs).

Tanzania: Turtles and their eggs have been used for domestic consumption and as a source of income for centuries by local coastal communities in Tanzania. Gillnets used in the artisanal and subsistence fisheries pose a major threat. In 2007, and 16 turtles (Green, Hawksbill and Loggerhead) were caught during a by-catch survey conducted in 2007 in the industrial prawn trawl fishery in Tanzania. There are also concerns about human disturbances and light pollution on nesting beaches (by tourists, seasonal fisher camps) in Tanzania.

Transboundary Scope

All marine sea turtles are listed on the IUCN Red and five of these highly migratory species are found throughout the ASCLMEs. All 9 countries identified concerns related to sea turtles as 'Relevant', and 8 of the 9 countries ranked the issue as being of 'High' importance. In the Level 2

prioritisation, 6 of the 9 countries assigned the issue an 'Overall ranking' score that was above average, indicating that the countries consider this to be a priority transboundary issue of concern in the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	✓	✓	✓	✓	9
Importance	H	H	H	H	H	H	H	M	H	8
Overall ranking	24	16	19	19	22	17	16	15	12	6

3.2. Decline in populations of commercial fish stocks

Globally marine wild capture fisheries are in decline, and this is also true for a number of the commercially important fish stocks within the ASCLMEs. The majority of countries identified a decline or uncertainty related to populations of commercial fish stocks in their MEDAs. The most common cause for the declines is overexploitation, which is raised as an issue of concern by all of the countries throughout the ASCLMEs. Illegal, Unregulated and Unreported (IUU) fishing is also an important consideration in the ASCLME region.

3.2.1. Decline in populations of sharks and rays

Problem Statement

Shark and ray fisheries and bycatch is a global concern and prevalent throughout the ASCLMEs. Due to their slow reproductive rates, elasmobranchs are very vulnerable to overexploitation. Landings have been increasing at a rate of 2 % per annum globally and are now estimated to 700,000 to 850,000 tons of sharks per year (Camhi et al., 2009; Lucifora et al., 2011). This figure is likely to be an underestimate given that it does not account for illegal fin fishing (Clarke et al., 2006). In the western Indian Ocean (FAO fishing area 51), elasmobranch catches peaked in 1996, due partly to higher effort targeting tuna which has since subsided (Smale, 2008). However, in 2009, elasmobranch landings were reported by 33 countries totalling 86 000mt. Little is known on trends in pelagic shark populations of the region. There are 15 species of sharks (belonging to five families) that are regularly caught in the ASCLMEs, the most common species being blue (*Prionace glauca*) and silky sharks (*Carcharhinus falciformis*) (Smale, 2008). While it is known that sharks are taken both as bycatch and target species in several industrial and artisanal fisheries, knowledge on the extent of bycatch and level of exploitation of elasmobranchs are poorly documented. In the IOTC (Indian Ocean Tuna Commission) records, most elasmobranchs landings in the region are not identified to species and are grouped as “sharks”, and there is insufficient data to properly assess the status of stocks. Shark bycatch is commonly associated with the pelagic fisheries including the purse seine fishery, pelagic longline fisheries, targeting other species such as tuna and swordfish, and fisheries associated with FADS. These fisheries mainly affect three main shark families including Lamnidae, Alopiidae and Carcharhinidae. The industrial shrimp fishery with shallow inshore and deeper offshore elements, also catches significant amounts of elasmobranchs (Fennessy 1994).

National Scope

Comoros: The Comoros MEDA does not mention any issues of concern relating to sharks or rays.

Kenya: Sharks are targeted by artisanal fishers, using a variety of different gear: multifilament drift gillnets, monofilament drift gillnets, bottom-set gillnets, longlines and handlines (Kiszka 2012). The sharks caught by the artisanal fishers are sold whole (body and fins) (Kiszka 2012).

Shark fins are however also exported, with a total of 468 t of shark find exported in 2007 worth over 250,000 US dollars per year. Sharks and rays are also caught accidentally as by-catch, by monofilament. and multifilament drift gillnets, bottom-set gillnets, beach seine, longline and handline, although the most impact is due to gillnets (Kiszka 2012).

Madagascar: Approximately 50 species of sharks and rays of neritic and oceanic deep waters of Madagascar are affected by industrial tuna fishing (longline and seine fishing), industrial fish fishing, industrial shrimp fishing, artisanal and traditional fishing. Official statistics on local production and export of meat and fins show an annual mortality of sharks by various forms of fishing from 200,000 to 600,000 individuals. Artisanal and traditional fishermen target sharks using gill nets (100 meters in length, known as jarifa). The prawn trawling fishery and the longline fishery in Madagascar also catch sharks. There is an active export market along the west coast for shark fins, indicating a considerable social and economic importance. In this Toliara region, results from a total of 1,164 catch records, included at least 13 species of elasmobranch, with an estimated total wet weight of over 23 mt. Hammerhead sharks (*Sphyrna* spp.) represent 29 % of sharks caught by number and 24 % of the total wet weight (McVean *et al*., 2006). The scalloped hammerhead shark (*S. lewini*), which is classified as "endangered" on the IUCN Red List, is declining in certain regions including southwest coast of Madagascar (McVean et al., 2006). Sawfish (Pristidae), which are classified as "critically endangered" on the IUCN Red List and on Appendix I of CITES are now very rare in Madagascar probably due to shrimp trawling, use of gill nets across rivers and installation of fish barriers in estuaries (Valakira).

Mauritius: Sharks are both targeted and accidentally caught by sports fishermen and by local artisanal fishermen fishing around FADs. Bottom-set gillnets resulted in a bycatch of both sharks and rays, whereas only sharks were impacted by line (handlining and lining under FADs) and other net fisheries (Kiszka 2012).

Mozambique: Most of the elasmobranchs taken in Mozambique waters are part of a bycatch with shrimp trawlers catching the most significant amount of elasmobranchs, especially over the continental shelf. However, recently, bycatch reduction devices have been tested in prawn trawl fisheries in Mozambique. Over 75% of hauls with grids caught fewer large rays than those without grids while hauls using grids caught no large sharks at all (Mozambique MEDA 2012).

Seychelles: Increased targeting of sharks in recent years has resulted in the stocks of inshore sharks being under threat of overfishing. In 2007, a National Plan of Action (NPOA) for the conservation and management of sharks was produced. The NPOA indicated that the shark fishery is data deficient but that significant historical, anecdotal and fisheries-independent information suggest that inshore populations continue to be severely depleted (Seychelles NPOA Sharks 2007). Stocks of inshore sharks have also been described as being depleted in recent fisheries reports (FAO Fisheries and Aquaculture report No. 899 2009).

Somalia: Elasmobranchs are heavily exploited in both the industrial and artisanal sectors (FAO 2005), and represent 40% of the artisanal catches. The principal groups are hammerheads (Sphyrnidae), grey sharks (Carcharhnidae), mako shark (Lamnidae), houndsharks (Triakidae) and dogfish (Squalidae). Shark populations are also declining due to the unmanaged harvest of shark fins (Pilcher and Alsuhaibany 2000). Sawfish (Pristidae), which are classified as "critically endangered" on the IUCN Red List and on Appendix I of CITES are also caught as bycatch in shark gill nest in Somalia.

South Africa: Shark populations in RSA waters are declining, in particular blue and mako sharks. Shark and ray bycatch is problematic in several of main commercial fisheries: the large pelagic fishery, which targets 4 or 5 species, results in bycatch of sharks; the midwater trawl fishery, which targets horse mackerel (*Trachurus capensis*) also impacts (as bycatch) large pelagic sharks and occasional marine mammals (dolphins and cape fur seals); the line fishery has a bycatch of elasmobranchs. Sports and recreational fishers also target sharks; the shark-nets along the

southern and eastern seaboard to protect bathing beaches also result in mortality. South Africa also offers non-consumptive resource use/tourism sector, in the form of shark cage-diving operations, although this is not thought to be a factor in the decline of shark stocks (South African MEDA 2012).

Tanzania: Fishing for elasmobranchs has occurred for centuries with shark fishing, especially in Zanzibar, being mostly seasonal during austral summer Tanzania MEDA 2012). Sharks are a particularly important fishery in Zanzibar, both as a valuable source of cheap meat when dried, and as a major source of income provided by the fins (Schaeffer, 2004). Long lines and bottom-set gillnets, are used to target sharks and rays, and these vary in length up to 450m, with mesh sizes ranging from 20-40cm (Tanzania MEDA 2012).

Transboundary Scope

While some species of sharks and rays are highly migratory, other species form resident populations, yet relatively little is known about the migration and residency patterns within the ASCLMEs. Only 8 countries identified concerns related to sharks and rays as 'Relevant', and 8 countries ranked the issue as being of 'High' importance. In the Level 2 prioritisation, 7 of the 9 countries assigned the issue an 'Overall ranking' score that was above average, indicating that the countries, consider this a priority transboundary issue of concern in the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	✓	✓	✓	NR	8
Importance	H	H	H	H	H	H	H	H	NR	8
Overall ranking	22	15	14	21	21	21	22	16	NR	7

3.2.2. Decline in populations of large pelagics

Problem Statement

Large pelagics, such as tuna and tuna like species including billfishes, are apex oceanic predators. These species make up nearly 50% of the total landed catches within the ASCLMEs. These species are targeted by small-scale or artisanal fisheries and by sports fisheries in several countries, as well as by national and foreign industrial and semi-industrial fleets. Pelagic landings (excluding foreign fleet data per EEZ) have boomed over the last decade. Factors that have increased the national catches include the deployment of Fish Aggregating Devices (FADS), which have increased landings by artisanal and sports fisheries in the region. Landings in Seychelles waters alone increased four-fold between 1995 and 2005, due to increased investment in the national fleet and the setting up of joint ventures to supply the cannery. Many other countries have not significantly increased their national catches of large pelagics, but there have been significant increases in the landings by foreign vessels. The latest report by the Indian Ocean Tuna Commission (IOTC-SC14, 2011) included stock assessments which indicated that the majority of species are being exploited at or above the Maximum Sustainable Yield (MSY). There is a particular concern about the stock status of yellowfin (*Thunnus albacores*) and big eye (*T. obesus*) tuna. A recent stock assessment conducted by the IOTC working party on Tropical Tuna in 2009, incorporating data obtained from the Regional Tuna Tagging Programme-Indian Ocean (RTTP-IO) revealed that the stock of yellowfin tuna has been over-exploited with catches averaging 343,000t (1992-2002 period). Recommendations have been made to reduce landings to the MSY (250,000 and 300,000t) levels. The Indian Ocean Swordfish (*Xiphias gladius*) are caught mainly using drifting longlines (95%) and gillnets (5%). Landings of swordfish in the

Indian Ocean slowly increased in tandem with the level of coastal state and distant water fishing nation longline effort targeting tunas between 1950 and 1980. Swordfish were mainly a bycatch of industrial longline fisheries before the early 1990's with catches slightly increasing from 1950 to 1990 proportionally to the increase in the catches of target species (tropical and temperate tunas). Data indicates that stocks in the southwest Indian Ocean have been overfished in the past decade and biomass remains below the level that would produce MSY. Other billfishes, such as Indo-Pacific blue marlin (*Makaira mazara*), black marlin (*M. indica*) or Striped marlin (*Tetrapturus audax*) are caught almost exclusively under drifting longlines (~50-98 %) with remaining landings being caught by gillnets, troll and hand lines. These species are usually considered as bycatch by the industrial fisheries. Stock assessments have not been completed for marlin species due to a lack of data,, but landings (nominal CPUE) have all exhibited declines since the fishery commenced. Other factors which may influence the stocks of these highly migratory species include changes in seawater temperatures, but there is currently sufficient data to be able assess its importance (Anon 2008).

National Scope

Comoros: Large pelagic fish account for approximately 75% of the fish consumption in the archipelago and nearly 90% between December and June when fishing can take place outside the lagoons because of favourable sea conditions. The lack of storage and processing facilities prevents catch increases per trip, as prices are very sensitive to the volume of landings. The use of deepwater FADs increased the accessibility of large pelagics to the artisanal fishers.

Kenya: The catch of tuna has been declining since 2004 most likely due to overfishing (Kenya MEDA 2012). Large pelagics, tuna and tuna like species are targeted mainly by Distant Water Fishing Nations (DWFN) and a smaller catch is taken by sports fishers. The number of foreign licensed vessels has increased steadily since 2003. Between 2005 and 2007, an average of 37 purse seiners and 30 long liners operated in Kenya waters, all licensed by the Ministry of Fisheries Development, for an annual license fee of US$ 30,000. In 2007, these foreign vessels transhipped a total of 16,564 metric tonnes of Tuna and Tuna like species through Mombasa (equivalent to a total of USD 1.7 million per year). Sports fishing is seasonal with the low season occurring between May and September and peak season in October to March. Targeted species are mainly billfishes especially sailfish, swordfishes, the marlins, sharks and some tunas.

Madagascar: There is limited information available about the state of stocks of tuna, associated fishes, incidental catches of vulnerable bycatch species. Tuna are subject to industrial seine fishing (under two agreements with Anabac and EU) and longline fishing (under three agreements - the EU, Korea -Dae Young, and Japan- Japan Tuna). Official fisheries statistics indicate that catches are between 10,000 and 11,000 tonnes per year. The development of a semi-industrial fleet in Madagascar since the end of the 1980s boosted production from 5,000 t to 25,000 t today. Only one of the species of Scombridae targeted on Madagascar is 'Critically Endangered', the southern bluefin tuna (*Thunnus maccoyii*). This species may be present in the southern part of the EEZ at 200 miles, where it is targeted by Asian longline fishermen.

Mauritius: In recent years, efforts have been made to encourage the targetting of off lagoon pelagic fishes as a strategy to help alleviate pressure on the lagoon resources. Fish Aggregating Devices (FADs) have been installed for use by artisanal fishermen. Sports fishing is also now an important fishery on Mauritius and has grown in popularity with tourists. The tuna fishery is split into the coastal tuna fishery and the offshore industrial tuna fishery. Tuna and tuna-like species are caught by local fishermen near the coast and mainly around Fish Aggregation Devices (FADs). The total landings from FADs and sport fishermen are estimated at around 650 tonnes annually. Species caught are big eye tuna, skipjack, yellow fin tuna, dorado, wahoo and sharks. Industrial tuna fishing is carried out mainly by long-liners and purse-seiners. These are mostly

licensed foreign fishing vessels that catch about 10,000 tonnes yearly in the EEZ of Mauritius. The species caught are mainly the skipjack tuna and yellow fin tunas.

Seychelles: There is major concern about the stock status of yellowfin (*Thunnus albacores*) and big eye (*T. obesus*) tuna. A recent stock assessment conducted by the IOTC working party on Tropical Tuna in 2009, incorporating recently obtained data from the Regional Tuna Tagging Programme- Indian Ocean (RTTP-IO) revealed that the stock of yellowfin tuna has been over-exploited with catches averaging 343,000t (1992-2002 period). It was recommended that catches should not exceed the MSY (250,000 and 300,000t) levels estimated by the current assessment.

Somalia: Stocks of large pelagic fish (yellowfin tuna (*T. albacares*), bigeye tuna (*T. obesus*), longtail tuna (*T. tonggol*), bonito (*Sarda orientalis*), skipjack tuna (*Katsuwonus pelamis*) and Spanish mackerel (*Scomberomorus commerson*) are heavily exploited by the industrial sector and lightly exploited by the artisanal sector (FAO 2005).

South Africa: Large pelagics (and demersal sharks) are targeted by the longline fisheries and a pole fishery for tuna. The longline catch is dominated by five species (yellowfin tuna, bigeye tuna, blue shark, longfin tuna and mako shark) which make up 75% of landings, although up to 61 species may be retained. Other non-directed bycatch recorded from this fishery include sharks, killer whales (depredation) and marine birds (Grantham *et al*. 2008). While this a relatively small fishing sector, the South African EEZ and surrounding waters are also heavily fished by foreign tuna fleets who access the ports for servicing and fish transhipments. Stocks of Yellowfin tuna are depleted (IOTC assessments), whilst bigeye tuna are considered stable but at risk and the status of swordfish is uncertain.

Tanzania: Large pelagics such as kingfish, tuna, sailfish and marlin, are caught by surface gill nets and trolling lines. Over 95% of the catch is attributed to small-scale artisanal fishing using primitive crafts and gear (Table 11) (Linden and Lundin, 1996). The local supply of tuna, swordfish and marlins has been drastically reduced following the collapse of large pelagics stocks over the last two decades. Catches taken by Tanzania fishermen in Kenya waters are not repatriated, and there are poor transport and conservation facilities

Transboundary Scope

Because of the highly migratory nature of the large pelagic species targeted, this is a transboundary issue as stocks are shared between the EEZ of countries. All 9 countries identified concerns related to large pelagics as 'Relevant', and 7 countries ranked the issue as being of 'High' importance. In the Level 2 prioritisation, 7 of the 9 countries also assigned the issue an 'Overall ranking' score that was above average, indicating that the countries, consider this to be a priority transboundary issue of concern in the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	✓	✓	✓	✓	8
Importance	H	M	H	H	H	H	H	L	H	7
Overall ranking	23	15		23	19	21	22	15	19	7

3.2.3. Decline in populations of small pelagic

Problem Statement

Small pelagic fisheries may target species small tuna-like species including horse mackerel and mackerel, (Scombridae), barracuda (Sphyraeindae), Jacks (Carangidae), sardines (Clupeidae), anchovies (Engraulidae). These species may form large shoals in coastal waters and are often an important food fish for other species, such as seabirds. Declines in pelagic fish species can impact on their predators and

National Scope

Kenya: Small pelagic fish (Stiophoridae, Scombridae) are targeted by the artisanal fishery using bottom-set gill nets. There is limited data available to determine the status of these stocks, although the methods can result in by-catch of turtles, sharks and rays. There has been a noticeably impact of trawl-fishing in Ungwana Bay on the availability of fish food for pelagic fishing seabirds, which has created a bird-vessel dependency that can leads to unsustainable feeding relationships.

Madagascar: There is a significant decline of small pelagic fisheries (Madagascar MEDA 2012). Small pelagic fishes are targeted by shrimp trawlers in all shrimp fishing zones, by artisanal fishing, mainly in the Northwest and by traditional fishing mainly along west coast, in Antongil Bay and in the Southeast. The most common species belonged to Sciaenidae, Leiognathidae, Trichiuridae, and Mullidae families (PNRC 2006). The most affected species by traditional and artisanal fisheries are small Scombridae, often called "small tunas", such as the eastern little tuna, *Euthynnus affinis*, the wahoo, *Acanthocybium solandri*, the narrow-barred Spanish mackerel, *Scomberomorus commerson*, the Indian mackerel, *Rastrelliger kanurgata* and *Auxis* spp., Sphyraeindae, Carangidae, sardines (Clupeidae), anchovies (Engraulidae), Hemirhamphidae, Belonidae and others (Madagascar MEDA 2012).[N.B. This issue was not selected as one of the priority issues by the participants at the national CCA meeting].

Mauritius: Small pelagics are not targeted at present but there is an potential yield of the small pelagic namely horse mackerel estimated in the region of 13,000 to 26,000 tonnes per annum (Mauritius MEDA 2012).

Mozambique: Small pelagics are mainly targeted by the artisanal fishers using beach seine nets. The MEDA did not identify any issues of concern related to this fishery (Mozambique MEDA 2012).

Somalia: The fisheries of the Somali Coastal Current LME are heavily fished and studies show that many stocks are unsustainably overexploited (Kelleher and Everett 1997; Fielding and Mann 1999). Small pelagics including the Indian oil sardine (*Sardinella longiceps*), rainbow sardine (*Dussumieria acuta*), Scads (*Decaptrus* spp.), chub mackerel (*Scomber japonicus*) and horse mackerel (*Trachurus indicus*) are mainly caught off the northeast coast of Somalia by both artisanal and commercial fleets (FAO 2005); anchovies (*Engraulis japonicus, Stolephorus* spp.) also occur but in smaller quantities (Somalia MEDA, 2012).

South Africa: Species mixing between juvenile anchovy (*Engraulis encrasicolus*) and juvenile sardine (*Sardinops sagax*) causes an “early season” fishery problem (before separating into discrete shoals), presenting fishery management issues such as discarding and dumping (South Africa MEDA, 2012). Seabirds which feed on anchovy and sardine must compete with purse-seine fisheries for food and as a result, some have suffered large decreases in the past 50 years (Crawford 2007).

Tanzania: The main commercial marine fish species are small pelagics, including sardine and anchovy, which together form 30-50 % of total fish landings. The small pelagics are caught

mainly using purse seine nets or ring nets, and these fisheries may also include small tuna and mackerel (Tanzania MEDA 2012).

Transboundary Scope

Small pelagic species are not targeted in all countries. Only 7 of the 9 countries identified concerns related to small pelagics as 'Relevant', and 5 countries ranked the issue as being of 'High' importance. In the Level 2 prioritisation, 5 of the 9 countries also assigned the issue an 'Overall ranking' score that was above average, indicating that the countries consider this to be a priority transboundary issue of concern in the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	NR	✓	NR	✓	✓	✓	7
Importance	H	H	H	NR	L	NR	H	L	H	5
Overall ranking	20	16			18		17	14	18	5

3.2.4. Decline in populations of deep demersal fish species

Problem Statement

Exploitation of deepwater species is a relative recent development in the ASCLMEs. Deep waters fisheries may involve dropline/long-line (200-400 m depth) targeting deepwater snappers and other associated fishes; and conventional line fishing (mainly hand-line, less than 200m depth) targeting a range of reef-associated fishes, and deepwater trawling, which could be considered the most concerning due to the associated habitat damage. In the 1990's there was a shift in trawl effort towards deeper water and industrial deep-sea operations targeting deepwater species such as orange roughy (*Hoplostethus atlanticus),* Cardinal (*Epigonus telescopus*), Alfonsino *(Beryx splendens) and* deep water dory (*Allocyttus verrucosus*) and others (FAO 2007, 2009). Rich deepwater resources (mostly demersal species) were discovered, particularly on the South West Indian Ocean Ridge and on deep-sea seamounts. Efforts in or adjacent to the South African EEZ were largely short-lived with few economically commercial stocks identified (Japp and James 2005). The exploitation of this area has been documented in FAO technical reports and by Japp (2006). Nevertheless, most deep-water species have life history strategies that are generally vulnerable to exploitation (slow-growing, aggregating behaviour etc). These fisheries are also associated with hard grounds and sensitive deep-water corals and other benthic flora and fauna. The fishing industry has since attempted to limit the impact of trawling by voluntarily halting trawling in eleven deep-sea areas of the southern Indian Ocean. This will protect and conserve the bottom of the sea floor, or benthos, associated fish fauna and related biodiversity in what is effectively a marine protected area.

Any further information on ABNJ

National Scope

Mauritius: The banks fishery is a mothership-dory fishing operation, which has been operated by a single licenced fishing company since the late 1960s. This fishery targets a single species (*Lethrinus mahsena*) which constitutes 80–90% of the annual catch of 3,000 tonnes. As the fishery only operates to a maximum depth of 50 m, this does not really count as a deepwater fishery, but there is now increased interest in the potential of other deepwater species.

Madagascar: Continental shelf and slope surveys carried out in the 1970s, in the Northwest identified almost 20 species of commercially important deep demersal fish, namely: Lethrinidae

(*Lethrinus coerulues*, until 150m), Denticidae (*Cheimerius nufar*, up to 120m; *Polysteganus coeruleopunctatus* up to 150m), Sparidae (2 *Argyrops* at 150m, 2 *Pterogymnus* between 100 and 300m, 1 *Pagellus* species up to 1 250m), Priacanthidae (2 species at 150 and 250m), Branchiostegidae (1 species captured between 100 and 300m), Triglidae (4 species between 100 and 450 m), Sciaenidae (1 unidentified species between 450 and 475m), Brotulidae (1 species between 400 and 500) and Gadidae (1 *Merluccius* sp. between 600 and 720m). In 2007, a pilot fishing for alfonsino *Beryx splendens*, was launched by a South African company using deep trawling techniques. This fishery caught 7 tonnes with a single vessel in a period of several months. The fishing site consists of seamounts in the south of Madagascar located at approximately 26°S 46°E (Centre de Surveillance des Pêches 2007). The gear used on these trawls are able to deflect rocks weighing several tonnes and destroy large areas of underwater habitat, particularly on seamounts or continental slopes and shelves (CSP 2007).

Mozambique: The line fishery is a multispecies hook and line fishery, comprising more than 200 species, and is conducted over a wide area and mostly at a depth of 30-200 m. It takes place mainly on rocky bottoms that are not suitable for trawling. Some linefish species are also targeted by sportfishers (Torres and Jakobsen 2007). A number of priority species are important components of the linefishery catch.

Seychelles: Demersal fisheries are carried out by both the artisanal and commercial fisheries. Important demersal species include red snappers, groupers, job fish, and emperors (Nageon de Lestang 2011). The two main fishing grounds for the demersal handline fishery are the Mahé Plateau and the Amirantes Plateau at depths from 25 - 70 m. Other fishing areas include the offshore banks and around the southern Group of coralline islands. Experimental drop-line fisheries for certain deepwater species resulted in the rapid removal of stocks (*P. filamentosus)* (Grandcourt 2008).

South Africa: The demersal fishery is the most valuable fishery in South Africa and it targets deep-water and shallow-water hake but also catches many other fish species such as kingklip, horse mackerel, angelfish, snoek and monk as bycatch. The trend in the hake-directed offshore trawl, particularly on the South and East coasts, towards deeper fishing (> 600 m) has resulted in exploitation of a new “deepwater” species regime with a unique set of biodiversity impacts linked to the continental shelf break (500 – 2000 m water depth). In all these fisheries there is a significant problems with bycatch. The demersal longline component is relatively selective compared to the bottom trawl, which catch the full spectrum of size classes of hake (except for the smallest fish generally below 15cm in length). Over-harvesting of deepwater stocks is a particular concern in South Africa, where the deep-water hake stock levels are estimated to be <30% of BMSY (the biomass that can support the Maximum Sustainable Yield, MSY). Impact of heavy deepwater gear on deep water substrate with potential impacts on unknown deepsea biodiversity.

Tanzania: More than 35 captures of Coelacanths have been reported by rural fishers in the fishing villages of Kigombe, Mwarongo and Mwambani, South of Tanga, Mtwara, Lindi and Dar es Salaam using deep-set shark gill nets.

Transboundary Scope

Deepwater demersal fisheries are not targeted in all countries. Only 6 of the 9 countries identified concerns related to deepwater demersal as 'Relevant', and only 4 countries ranked the issue as being of 'High' importance. In the Level 2 prioritisation, 3 of the 9 countries assigned the issue an 'Overall ranking' score that was above average, indicating that the countries do not consider this to be a priority transboundary issue of concern in the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	NR	✓	NR	✓	✓	✓	✓	✓	✓	6
Importance	NR	L	NR	H	L	H	H	L	H	4
Overall ranking	NR	6	NR	24	11	15	9	14	16	3

3.2.5. Decline in populations of reef and demersal fish

Problem Statement

Reef and nearshore demersal fish are heavily exploited throughout the ASCLMEs. These resources are largely exploited by artisanal fisheries as they are typically open-access, and are within relatively easy reach of the shore, thus requiring minimal investment. Population growth and coastal migration have increased pressure on these resource. Increased wealth and the expansion of coastal tourism in some countries has also fuelled the demand for more fresh fish. Many of the preferred reef derived foodfishes are becoming increasingly rare throughout the region, and some species are now recognised as being of international concern for conservation, including some groupers (Serranidae), the humphead wrasse, *Cheilinus undulatus* (Labridae) and the double-headed parrotfish *Bolbometopon muricatum* (Scaridae). Overfishing of reef and demersal fishes may cause an imbalance in the functioning of the wider reef ecosystem. Overfishing of herbivores can result in the smothering of corals with algae, and overfishing of keystone predators can lead to outbreaks of nuisance species (e.g. sea urchins *Diadema* spp.). Overfishing can also have impacts higher up the food chain. As resources become more depleted there has been an increase in the use of more destructive and non-selective fishing methods, involving the use of dynamite, plant derived poisons or smaller mesh size nets, such as mosquito nets.

National Scope

Comoros*:* Reef fishery produce 3000 tons of reef fish per year in the Comoros. Overexploitation has meant that commercially important food fishes including jacks, groupers and parrot fishes are now very rare (Comoros MEDA, 2012). There has been an increase in the use of destructive fishing methods including the use of dynamite and plant poisons (*Thephrosia candida*), which paralyzes and kills fish and the use of small mesh nets. Other destructive fishing techniques have caused further habitat damage and contributed to the decline in species includes reef walking, the creation of retention ponds for use during low tide, damage due to use of paddles, machetes or pitchforks, bow-nets which requires walking on the reef flat, use stone line or bottom line on the reef flat or on the outer edge of the reef flat.

Kenya: The small-scale fisheries in Kenya is an important sector and an estimated 60,000 coastal residents depend on this sub-sector for their livelihood. Population growth, along with high levels of poverty in the coastal region, has contributed to increases in the number small-scale fishers, with a 34% increase in the period between 2004 and 2008. Over-exploitation has been compounded by an increase in the use of destructive fishing methods which has led to a 50% decrease in demersal coral reef fish yields through the 1990s. Rabbit fish and scavengers, which make up nearly 40% of the small-scale fishers' landings, have declined by 40% in the 1990s (Kenya MEDA 2012).

Madagascar: Reef fish, including large carnivorous families such as Serranidae, Lutjanidae and Lethrinidae, and herbivores, Acanthuridae, Scaridae and Siganidae are exploited by traditional fishing in Madagascar (Madagascar MEDA, 2012). Resources are already overexploited beyond

the tolerances of various reef sites (Maharavo, 2009) primarily due to overfishing. Overexploitation of marine resources is likely to continue in the coming decades as human population growth continues. Demand has also increased as an indirect effect of tourism; one study showed that tourists eat five times more by weight of fish than a fisherman villager, increasing local pressure on resources (Tanner 2000).

Mauritius: Reef and demersal fish are exploited by the artisanal and bank fishery. The artisanal fishery provides employment to over 2,000 fishermen on Mauritius (and at least double that on Rodrigues). The main families of fish caught are Lethrinids, Sigganids, mullets, Scarids and groupers. Total production in 2009 was 820 tonnes (Mauritius MEDA, 2012). Reef and demersal fish stocks are over-exploited and no substantial increase in fish production in these areas is expected in future (Madagascar MEDA, 2012). The banks fishery, operates on the banks of the Mascarene Plateau, located between 400 and 800 km north of Mauritius. Twelve fishing vessels are in operation and their total catch which comprises mainly Lethrinids (90%) amounts to around 3,000 tonnes annually. This fishery supplies a substantial quantity of fish consumed in Mauritius.

Mozambique: Demersal fish species in Mozambique are threatened by destructive fishing methods which do not discriminate between species and also kill eggs and larvae, as well as they destroying the habitat. An assessment of the stocks of Sparidae, which account for more than 70% of the catch, did not rule out the possibility of local overfishing (Mozambique MEDA, 2012).

Seychelles: The artisanal fishery is an open access fishery and, the lack of management control poses a threat for the sustainability of demersal fish resources. Emperor red snapper (*Lutjanus sebae*) is the most important commercially exploited demersal species in the Seychelles. It is a popular food fish with locals and tourists, has a good local price and an international market, resulting in increased targeting by the artisanal fishery. Recent assessments of the Emperor red snapper (Lutjanus sebae) stocks showed that the stock is overexploited (Seychelles MEDA, 2012). Moreover, the MSY of 380 tonnes is likely to have been overestimated. Recent artisanal catches is around four times higher than the new maximum sustainable yield (MSY) (Grandcourt et al. 2008). The rabbitfish, *Siganus sutor,* have also been overfished (Fisheries and Aquaculture report No. 899, 2009).

Somalia: Around coral reefs, unsustainable exploitation as a result of increased fishing effort and the use of destructive gear (Somalia MEDA, 2012).

Tanzania: Coastal fisheries in Tanzania are dominated by artisanal fisheries, which contribute more than 96% of the total marine fish catches (Tanzania MEDA, 2012). The catches are dominated by reef and demersal fish including bream, grouper, parrotfish, snapper, rabbit fish, emperors, (and sharks and rays), using traps, hooks and lines, nets and harpoons. Fishing effort is concentrated on coral reefs, sea-grass beds and reef flats areas, and as a result of heavy fishing pressure the fishery is showing signs of over-exploitation (Tarbit, 1984). Destructive fishing practices are used, most notably dynamite fishing, which is particularly common in coastal areas near urban centres such as Dar es Salaam, Tanga and Lindi. Dynamite fishing has contributed to the decline in the productivity and catches of artisanal fishery. Seine net fisheries also result in habitat damage, as the fishers encircle the reef with nets and then scare the fish into the net by breaking the coral heads. This is a destructive form of fishing, but it is also indiscriminate.

Transboundary Scope

Reef and shallow demersal fisheries are targeted in all countries. All 9 countries identified concerns related to reef and demersal fish as 'Relevant', and all 9 countries ranked the issue as being of 'High' importance. In the Level 2 prioritisation, 7 of the 9 countries assigned the issue

an 'Overall ranking' score that was above average, indicating that the countries consider this to be a priority transboundary issue of concern in the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	✓	✓	✓	✓	9
Importance	H	H	H	H	H	H	H	H	H	9
Overall ranking	17	21		24	21	17	20	15	18	7

3.3. Decline in populations of commercial invertebrates

The east and south coasts of South Africa have a high coastal population density relative to the west coast, which results in intense exploitation of nearshore resources by recreational and subsistence fishers. Many coastal invertebrate stocks are overexploited as a result, with significant impacts on both target and non-target species having been recorded.

3.3.1. Decline in populations of molluscs (bivalves, gastropods)

Problem Statement

As with many of the fisheries for invertebrates, mollusc resources are exploited in nearshore habitats, most often by reef walking or snorkeling. Molluscs are often collected opportunistically as additional catch alongside another fishing methods. The main molluscs targeted are the edible and ornamental species. Several gastropod and bivalve mollusc species are listed in Appendix II of CITES, or in Annex 2 of the Nairobi Convention. These include the giant clams (*Tridacna* spp.), pearl oysters (*Pinctada* spp.), the queen conch (*Strombus gigas*), the triton (*Charonia tritonis)* and (*Trochus niloticus*) among others.

National Scope

Comoros: *Charonia tritonis*, which feeds on the corallivorous Crown-of-Thorn starfish (*Acanthaster plancii)*, is now rare in the Comoros. Many tons of mollusc shells are exported to neighbouring countries (Madagascar, Kenya and Tanzania). Even though there is a ministerial decree, which prohibits the collection of shells, licences are regularly given to exporters without any real control over the quantities or species exported. All the places more or less frequented by tourists offer shellfish for sale and the stocks in the luggage of boarding passengers. The rarity of these molluscs is an indication of over-exploitation (Comoros MEDA 2012).

Kenya: There are fisheries for bivalves, including oyster *Crassostrea cucullata* and oyster pearl *Pinctata imbricata,* barnacle *Balanus amphitrite,* and gastropods including *Cerithidea decollata,* Snails *Nerita plicata, N. undata* and *N. textilis* (Prosobranchia: Neritacea) and *Drupella cornus*. The Kenya MEDA (2012), does not indicate the status of these fisheries.

Madagascar: No national legislation exists concerning the exploitation of gastropods and between 1989 and 1991, one Indian exporter from Toliara annually exported 8,000 kg of ornamental shells and 50 tonnes of industrial shellfish (WWF 1993). In 1997, it was reported that 138 species of gastropods were for sale in shellfish markets at Toliara. Among the rarer and more valuable curio species are the spider conch (*Lambis truncata*), the Mauritius island cowry (*Cypraea mauritiana*), the helmets (*Cassis cornuta, Cypraecassis rufa*), the giant triton (*Charonia tritonis*), the shell tun (*Tonna canaliculata*) and various cone shells (*Conus* spp.) (Romaine 1997). These ornamental species have become rare, particularly near cities such as Toliara (e.g. the queen conch, *Strombus gigas,* triton *Charonia tritonis* and *Trochus niloticus*). The turbo (*Turbo marmorata*) and pearl oysters (*Pinctada margaritifera*) are exported for the manufacture of

buttons and other pearly objects. Mangroves are also exploited for mangrove gastropods *Terebralia* (= Pyrazus) *palustris*, whose shells are transformed into lime. Bivalves are also exploited as food species such as clams (*Anadara antiquata*), oysters and mussels. Several species of food bivalves are overharvested (Madagascar MEDA 2012).

Mozambique: Exploitation of littoral organisms by the local population is a very common activity along the coast and this represents a potential threat to the conservation of the shore birds (Mozambique MEDA 2012).

Somalia: The mangrove oyster, *Saccostrea cucullata*, targeted by the artisanal fishery is declining. In Tanzania, most of the shells collected for the curio trade are rare and threatened species (Somalia MEDA 2012).

South Africa: High rural population densities, pervasive poverty, a lack of development and very limited control over natural resource use along the coastal sections of the underdeveloped former homeland areas such as Kwa-Zulu, Transkei and Ciskei, have resulted in the stripping of coastal shellfish and other natural resources for subsistence consumption (South Africa MEDA 2012).

Tanzania: Invertebrate stocks are threatened by both the extraction of wild-caught seed for the mariculture industry but also by collection for the curio trade. Intertidal and near shore areas are damaged by shell collectors through trampling (Tanzania MEDA 2012). Shells such as queen snails (*Turbo marmoratus*), helmet snails (*Cypraecassis rufa*), tiger cowrie (*Cypraea tigris*), money cowrie (*C. moneta*) and the most valuable cowrie (*C.mauritiana*) are collected and exported for curio trade. Most of the curio shells are rare and threatened species. A large proportion of ornamental shells intended for the tourist market was exported by the Tanzania Fisheries Corporation and Zanzibar State Trading Corporation.

Transboundary Scope

Mollusc fisheries are not targeted in all countries. Only 7 of the 9 countries identified concerns related to molluscs as 'Relevant', and only 2 countries ranked the issue as being of 'High' importance. In the Level 2 prioritisation, 2 of the 9 countries assigned the issue an 'Overall ranking' score that was above average, indicating that the countries do not consider this to be a priority transboundary issue of concern in the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	NR	NR	✓	✓	7
Importance	M	H	M	H	L	NR	NR	M	M	2
Overall ranking	14	15		21	14	NR	NR	14	10	2

3.3.2. Decline in populations of abalone

Problem Statement

There are ten abalone (Family Haliotidae) species found in the ASCLMEs. This is a very high value mollusc fishery, and it was identified as being an issue of concern in South Africa.

National Scope

South Africa: Abalone poaching for illegal export to lucrative Asian markets has been a major activity along the South African coastline over the last decade or more. Many of these poachers are well equipped, armed and dangerous. In some cases they use poor local residents to assist

or supply them. While there has been some success in curbing such activities along some parts of the coastline, attempts by conservation authorities to enforce compliance with regulations in many areas have been undermined by capacity constraints and threatening and violent tactics used by poachers.

Transboundary Scope

South Africa is the only country where this species is exploited, and was the only country to identify this issue as 'Relevant'. and they ranked the issue as being of 'High' importance. In the Level 2 prioritisation, the issue 'Overall ranking' score that was below average, indicating that even South Africa did not consider this to be a priority issue of concern.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	NR	NR	NR	NR	NR	NR	NR		NR	1
Importance	NR	NR	NR	NR	NR	NR	NR	H	NR	1
Overall ranking	NR	NR	NR	NR	NR	NR	NR	11	NR	0

3.3.3. Decline in populations of cephalopods

Problem Statement

Cephalopods are members of the Phylum Mollusca. There are over 16 species within the ASCLMEs, which are all active predators, that trap prey using their tentacles. There are fisheries targeting squid, cuttlefish and octopus within the region, the most widespread of which is the artisanal octopus fishery. Declines in octopus fisheries landings were reported by several countries due mainly to overexploitation and habitat damage. The South West Indian Ocean Fisheries Commission (SWIOFC) has classified the octopus fishery as overfished in the SWIO region. Octopus fishing is usually done by walking on the reef flat at low tide. This fishery is usually open access, requires little financial investment, and is often done by young people and women. The most common fishing technique employed throughout the region is to use a long metal spike, or harpoon, with a crook end to lure the octopus from the den in the reef rock, break open the den and to spear the octopus once caught. This method of fishing may be supplemented by the use of oil, to help smooth surface ripples and increase visibility through the water column, or by the use of lime to stun the octopus and make it exit the den. Reef walking causes habitat damage, particularly in coral dominated habitats, and the fishing technique also leads to further breakage of the corals.

National Scope

Comoros: Octopuses are over-exploited as they are easily accessible without owning a canoe, and a popular food species on the islands especially given their low prices compared to that of fish. Octopus are abundant at Mitsamiouli, Chindini, Malé (Grande Comoro), the Nioumachouoi islets, Wallah, Itsamia (Mohéli), Pomoni, Moya and Ouani (Anjouan). As well as reef walking, another technique used to catch octopus on Mohéli, is to spread lime in the octopuses' habitat; which causes the octopus to exit the den blinded and paralyzed. Many people consider the consumption of octopus as taboo, perhaps due to food allergies associated with their consumption. There are no specific regulations for the protection of octopus in the Comoros.

Kenya: Octopus (*Octopus* spp.), squids and cuttlefish are exploited in Kenya waters. The octopus fishery is a valuable exports estimated to be worth nearly 1.5 million USD.

Madagascar: Three species of octopus were caught around Toliara: the day octopus, *Octopus cyanea*, the marbled octopus *Octopus aegina* and the less common long-armed octopus *Octopus macropus* (FAO 1998). The pelagic deep water or common squid (*Loligo*) is also a exploited in Toliara and Nosy Ve. The species, *Sepiatheulis lessoniana* is the most commercially important. The cuttlefish *Sepia* spp. is a less common fishery product and *Sepia zanzibarica* is more common on sandy bottoms around Nosy Be (Laboute and Maharavo 1998). The octopus fishery (for *O. cyanea*) is very important in southwest Madagascar but it is also heavily over exploited. With only 50 tonnes of production, in 1994, the production in Toliara region reached more than 700 tonnes in 2002. Today, the fishing area for octopus stretches 400 km, between Fanambosy and Morombe reefs, and involves some 60 fishing villages. In 2005, the first decrease of catches was seen, a possible sign of overexploitation. Consequently, the Ministry of Fishery announced a closed season between December 15 and January 31 and imposed a minimum size of 350 g. Meanwhile, an initiative of COPEFFRITO and Blue Ventures Conservation showed the advantage of a longer closure period to maximize the size of octopus, taking advantage of international markets that prefer sizes above 500 g (Humber 2006).

Mauritius: There are fisheries targeting both squid and octopus, both of which are important artisanal fisheries, particularly on Rodrigues. The octopus fishery (*Octopus cyanea*) provides a livelihood to over 2000 people but is heavily overfished. Catches have declined by more than 75 % over the past 20 years, from 800 tons in 1994 to approximately 200 tons in 2006 due to overexploitation, habitat degradations and lack of management control.

Mozambique: There are fisheries for both squid and octopus (Mozambique MEDA 2012), and landings appear to be increasing.

Seychelles: The Seychelles MEDA (2012) does not describe a cephalopod fishery, although the issue was identified by the national participants and being a concern.

Somalia: The Somalia MEDA (2012) does not describe a cephalopod fishery, although the issue was identified by the national participants and being a concern.

South Africa: The squid-jigging fishery targets spawning aggregations of chokka squid (*Loligo vulgaris reynaudi)* in sheltered bays on the south coast. There is no major stock issues although annual catches are somewhat variable and dependent on environmental / oceanographic conditions. There are no bycatch issues associated with this fishery. But the significance of squid in ecosystem / trophic structure and the impact of exploitation is poorly understood. There is also an octopus pot fishery (*Octopus vulgaris*), an octopus gleaning fishery, but there were no concerns expressed about this fishery.

Tanzania: Cephalopods represent a significant fishing resource in Tanzania (octopus, cuttlefish and squids). The common octopus, *Octopus vulgaris* is the cephalopod species with the highest landings in Tanzania particularly among the artisanal fleet. Traditionally, this species has been caught by the artisanal fleet using spears, traps and hand collection during low tides. Regulation has been proposed to include a minimum legal capture of an individual octopus weighing not less than 500 g. Production and export data have revealed that catches of octopus are declining rapidly from 430,000 kg in 2000 to 57,000 kg 2007, representing a 87% decrease in 7 years, which is attributed to overfishing stimulated by high prices of octopus in international markets.

Transboundary Scope

Cephalopods fisheries targeting squid, octopus and cuttlefish occur in all countries, and are mainly artisanal in nature with the exception of South Africa. Octopus fishing is a particularly important livelihood in a number of the countries. Only 8 countries identified the issue as being 'Relevant', and from the Level 1 prioritisation 7 countries ranked the issue as being of 'High' importance. In the Level 2 prioritisation only two countries allocated an 'Overall ranking' score

that was above average. This suggests that the countries do not consider this to be a priority transboundary issue of concern within the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	✓	✓	NR	✓	8
Importance	H	H	H	H	M	H	H	NR	H	7
Overall ranking	15	19		17	17	10	12	NR	19	2

3.3.4. Decline in populations of sea cucumbers

Problem Statement

Sea cucumber fishing is not a traditional fishery within the ASCLMEs, but it has rapidly and significant increased in importance given the export value of the product. The fishery spread as a result of foreign demand for sea cucumbers, which grew in tandem with the economic growth in China and the Eastern region**.** Sea cucumbers are typically targeted by fishers using snorkel and mask or SCUBA equipment or collected as bycatch by spear fishermen and other gleaners. The gear and boats may be provided by dealers who purchase the processed product, while the collectors carry out the processing and drying at the landing beaches. Fishers typically target the six highest value species (*Holothuria nobilis, H. fuscogilva, H. scabra, Thelenota ananas* and *Actinopyga mauritiana*). Sea cucumber resources in all countries in the ASCLMEs are presently either over-exploited (at least for the main commercial species) or fully-exploited. Even in the countries where the fishery has recently started or re-started, resources are been depleted rapidly, and the "boom and bust" nature is a characteristic of this fishery, not only within this region but globally.

National Scope

Comoros: Currently, the Comorian sea cucumbers are not subject to any exploitation and there are numerous species found on the reef flats, the outer lagoon and in the mangroves. A Comorian contractor tried to exploit sea cucumbers in 1998, but ceased this following an accident that killed two divers. While there is no formal legislation to protect these species, an awareness raising campaign led to their informal protection by communities. Covert operations are however developing around sea cucumber exploitation through Malagasy and Chinese networks. In a report cited in Conand (2008), the authors expressed "*concern with regards to the present, rather blind, overexploitation of sea cucumbers in the Comoros*" giving a few qualitative observations to support this. The harvesting and processing is controlled by Chinese immigrants

Kenya: There has been a fishery for sea cucumber since the 1990s, and numerous different species are exploited. Overexploitation of sea cucumbers is a concern.

Madagascar: There are about 40 species of sea cucumbers found around Madagascar, and they are an important export product. Sea cucumber fishing is a very common practice (Laroche and Ramananarivo 1995, Rasolofonirina and Conand 1998, McVean et al. 2005) and natural populations are now overexploited (Conand 1998, Conand et al. 1997). The sea cucumbers are not among the species of conservation concern although some species are locally overexploited (Mara *et al.*, 1997).

Mauritius: The exploitation sea cucumber started on a trial basis in late 2005 and was continued by six licensed operators with exports of around 80 tonnes (Kadun, S., Mauritius Government,

Mauritius; Laxaminaraya, A., cited in Conand, 2008). Stocks were rapidly depleted, particularly around Rodrigues, and the fishery is now closed.

Mozambique: From recent information, most of the sea cucumber resources in the central and the southern regions of the country are depleted, with the exception of those in the Bazaruto Archipelago National Park (Motta, H., Mozambique, personal communication). (Conand 2008)

Seychelles: Overexploitation of sea cucumbers is a concern in Seychelles. For a long period and until 1999, the fishery was unregulated and thus no catch and effort data were collected. Management regulations to control the fishery and processing were then implemented. Ameruddy and Conand (2008) report an upward trend in the catch of the main targeted species since 1999, while the catch per unit effort (CPUE), expressed in numbers of sea cucumbers collected per diver per day, shows mostly a downward trend (Ameruddy and Conand 2008). There was a particularly high increase in catch between 2004 and 2005, although the number of fishing licenses (25) remained the same. This was most likely due fishers working as a group from a mothership, which meant they could stay longer at sea (Conand 2008).

Tanzania: There has been a rapid expansion of sea cucumber exploitation at some sites of Tanzania (Mgaya, Muruke and Semesi, 1999). Depletion of sea cucumber resources was first reported at Songo Songo by Darwall (1996a, 1996b) as indicated by the harvest of juveniles. Interviews conducted by Mgaya et al. (1999) with sea cucumber collectors in Bagamoyo also indicated that the stocks were declining and the average size of individuals was decreasing. The sea cucumber fishery developed without baseline biological data and without any monitoring. The increase in export of beche-de-mer was observed from 1980s (< 200 tonnes per annum) to 1992 (617 tonnes) while they have continued to decline thereafter (Marshall, Milledge and Afonso, 2001).There has also been a decrease in the number of exporters from 23 to 8 (Conand 2008).

Transboundary Scope

Sea cucumber fishing is now widespread in the Indian Ocean and 8 countries identified the issue as being 'Relevant'. From the Level 1 prioritisation 8 countries also ranked the issue as being of 'High' importance. In the Level 2 prioritisation, 4 countries allocated an 'Overall ranking' score which was above average. This suggests that the countries consider this to be a priority transboundary issue of concern within the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	✓	✓	NR	✓	8
Importance	H	H	H	H	H	H	H	NR	H	8
Overall ranking	17	19		16	20	16	11	NR	16	4

3.3.5. Decline in populations of sea urchins

Problem Statement

Declines in sea urchin populations have been reported from countries bordering the Red Sea, and from other regions (e.g. Caribbean). Two countries within the ASCLMEs, indicated that this was a possible issue in their MEDA's.

National Scope

Madagascar: The sea urchin fishery targets edible species, such as *Tripneustes gratilla*, mainly in the region of Toliara (Madagascar MEDA 2012).

Kenya: There is a fishery for various sea urchins including: *Diadema setosum* (Leske) *Stomopneustes varioliaris* (Lamark) and *Echinometra mathaei. Echinothrix diadema* (Linnaeus), *Diadema setosum* (Leske), *D. savignyi* (cf. Brodie *et al*., 2005) (Kenya MEDA 2012)..

Transboundary Scope

Only three countries identified the issue as being 'Relevant', and from the Level 1 prioritisation only one country ranked the issue as being of 'High' importance. In the Level 2 prioritisation no countries allocated an 'Overall ranking' scores which was above average. This suggests that the countries do not consider this to be a priority transboundary issue of concern within the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	NR	✓	✓	NR	✓	NR	NR	NR	NR	3
Importance	NR	H	L	NR	L	NR	NR	NR	NR	1
Overall ranking	NR	14		NR	11	NR	NR	NR	NR	0

3.3.6. Decline in populations of prawns and shrimp

Problem Statement

Prawns and shrimp are targeted by both industrial and artisanal fisheries in shallow water throughout the ASCLMEs, and in shallow and deep water along the mainland coast. Commercial operations may overlap with artisanal or small scale fishery leading to direct conflicts in resource use. The same species are found and exploited along the entire East African coast to Kenya and also off the Indian Ocean islands (especially Madagascar). .The main target species in the mainland countries are *Penaeus indicus* and *Metapenaeus monoceros* which together currently contribute around 90 % of landed shallow water trawled prawn catches. Other commercially-valuable shallow prawn species (*P. monodon, P. semisulcatus, P. latisulcatus and P. japonicus*), but the proportions of these in trawl catches are low, with the exception of Mozambique from the early 1990s to the mid-2000s when the latter two species were specifically targeted at night. The status of the stocks of the main commercial species are unknown in many countries, although a restrospective analysis of the fishery data from five countries along the East Africa coast indicates that stocks are compromised, and various reasons are suggested Fennessy (2012) including: recruitment over-fishing (due to heavy small-scale exploitation of juveniles in inshore waters before they recruit to the trawl fishery); growth over-fishing (caused by trawling of prawns too early in the season); general over-fishing (due to excessive trawling effort); habitat degradation (due to reduced river flow and destruction of mangroves); reduced profitability of the trawl sector (due to low market prices (caused by foreign mariculture) and increased fuel prices). As prawn and shrimp are usually caught using trawlers, the gear can cause substantial habitat damage in nearshore areas, particularly seagrass beds, and these fisheries often result in bycatch of fish and more vulnerable species that frequent these habitats such as sea turtles.

National Scope

Comoros: The Comoros MEDA (2012) did not discuss the prawn and shrimp resources.

Kenya: There are small scale and commercial fisheries for Penaeid prawn (*Penaeus indicus, P. semisulcatus, P. monodon, P. japonicas,* and *Metapenaeus monoceros*), and deep water prawns (*Heterocarpus woodmasoni*). Prawn trawlers compete with the small scale fishers who share the

same fishing grounds and this leads to conflicts. Trawling methods are destructive to the habitats leading to a reduction in productivity (Kenya MEDA 2012).

Madagascar: Artisanal and traditional fisheries joined the industrial shrimp fishing after a few some years of delay. With fairly stable industrial catches in the early 1990s, a first decline in the industrial catch was observed in 1999 and a significant drop from 2002, which is a major concern (Madagascar MEDA 2012).

Mauritius: Shrimps are a potential high value product in Mauritius which are in particular demand in the tourist industry. There are five species of Penaeid shrimps as well as two species of deepwater shrimps have been identified in Mauritius and are currently being fished. As a first step towards the full exploitation of these resources, research will be carried out to determine shrimp distribution and its potential yield, which was initially estimated as a Mean Sustainable Yield (MSY) of 200 tonnes (Mauritius MEDA 2012).

Mozambique: The shallow water shrimp is the most commercially valuable marine resource and is the second most important species by volume, accounting for 29%, followed by the deep water shrimp at 8%, which were worth 46 million US dollars and 12. 5 million US dollars respectively in 2009 (USAID 2010). Commercial vessels operate mainly on the Southern Sofala Bank, Maputo Bay, Limpopo River, and Angoche. The beach seine fishery in Mozambique harvests adults and juvenile shrimps of both small and large species; generally, catches of small and juvenile shrimp outweighs those of adult shrimps (Mozambique MEDA 2012)

Somalia: Offshore trawling grounds, especially those targeting prawns, are showing signs of overexploitation with excessive bycatch and discards; inshore populations of prawns (*Penaeus* sp.) targeted by the artisanal fishery are also declining (Somalia MEDA 2012).

South Africa: The small crustacean trawl fishery on the Kwa-zulu Natal coast, targets include pink prawn (*Haliporoides triarthus*), langoustine (*Metanephrops andamanicu* and *Nephropsis stewarti)*, and red crab (*Chaceon macphersoni*). The inshore shrimp fishery operates on muddy grounds at depths of 20 to 45 m primarily on the Tugela Bank. The offshore fishery operates at depths of 100 to 600 m from Port Edward to Cape Vidal. The fishery is typical of shrimp trawl fisheries globally with a small target component but a very high fish bycatch as well as incidental catches of turtles (Fennesey and Isaksen 2007). The status of shrimp stocks caught both in the shallow and deep waters on the northern Kwazulu Natal waters is uncertain (South Africa MEDA 2012).

Tanzania: There has been unsustainable harvesting of prawns in Tanzania. The major causes have been pressures in the context of open access harvesting and inadequate management techniques of these species. The commercially important Penaeid prawn species are white prawn *Penaeus indicus* which composes 66% of catches*,* tiger prawn *P. semisulcatus 15 %,* giant prawn *P. monodon 18%,* brown shrimp *Metapenaeus monoceros* 15 % and *M .stebbingi.* The Hippolitydae are represented by *Exhippolysmata ensirostris* and the Palaemonidae represented by *Macrobrachium rude* and *Nematopalaemon tenuipes.* The prawns/shrimps landings from the commercial trawlers was about 500 tonnes in 1970, and then declined to about 200 tonnes when the joint venture company (New Mwananchi Ocean Products) was disbanded (Bwathondi and Mwaya, 1984) and have remained low or variable since then (Tanzania MEDA 2012)**.**

Transboundary Scope

Prawn and shrimp stocks may be shared between some of the countries within the ASCLMEs, particularly those along the East African mainland coast, although further studies are required to be able to confirm this possibility. Eight countries identified the issue as being 'Relevant' so this issue is a shared transboundary issue as well. From the Level 1 prioritisation 6 countries ranked the issue as being of 'High' importance. In the Level 2 prioritisation 5 countries allocated 'Overall

ranking' scores which were above average. This suggests that the countries consider this to be a priority transboundary issue of concern within the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	NR	✓	✓	✓	8
Importance	H	H	H	H	M	NR	H	M	H	6
Overall ranking	16	20	17	21	24	NR	15	13	19	5

3.3.7. Decline in populations of lobsters

Problem Statement

Several species of lobster are targeted within the ASCLMEs by commercial and artisanal fisheries. The commercial fisheries tends to target deepwater species using traps and trawls. The artisanal fisheries tend to target spiney lobsters, using tangle nets, traps, spearguns or reef gleaning methods using snorkeling or SCUBA diving. This is a valuable fishery but monitoring is limited and information on stocks is insufficient.

National Scope

Comoros: Several species of spiney lobster are found on reefs: *Panulirus japonicus, P. ornatus, P. versicolor* and *P. longipes*. The latter is the most coveted and most exploited species in the Comoros. Lobster are not currently under threat of overexploitation in the Comoros. However there is potential that future tourism growth will increase fishing pressure (Comoros MEDA 2012).

Kenya: The artisanal fishers will target spiny lobsters (*Panulirus ornatus, P. longipes, P. versicolor, P. homarus, P. dasypus, P. penicillatus*) and a commercial fishery for deep water lobster (*Puerulus angulatus, Thenus orientalis and Metanephrops andamanicus*). The export of lobster is about 47 t worth close to 500,000 USD (Kenya MEDA 2012).

Madagascar: The Malagasy 'littoral crayfish' is an important fishery resource represented by the genus *Palinurus* (*P. homarus*, *P. japonicus* or *P. longipes*, *P. penicillatus*, *P. versicolor*, *P. ornatus* and *P. dasypus*), and are found on rocky and coral reefs all around the island. The lobsters are targeted by traditional fishers using trap fishing, diving and fishing with torches. but recently, fishermen have started to use tangle nets. *Panulirus homarus* and *P. japonicus*, the dominant species in the south and south east. A study concluded that the exploitation of *P. homarus* is close to the maximum sustainable yield (MSY), and there is a tendency for fishermen to catch too many juveniles and pregnant females, which threaten the stock recruitment (Rabarison 2000).The slipper lobsters (Scyllaridae) are a frequent catch around Nosy Be, especially *Scyllarides squamosus,* while *Ibacus indicus* was also identified in southern Madagascar in 2008 up to 250m depth (Mara 2009). The mud lobsters (Thalassinidea: Callianasssidae) like *Callichurus* are common on sandy bottoms (Laboute and Maharavo 1998). The area with significant concentrations of *Palinurus delagoae* (Gilchrist) is located in southern Madagascar. On Walter Banks, an unknown species of giant lobster weighting 18 kg was discovered, named *Palinurus barbarae*, this lobster was 50 cm and could be 50 years old (Griffith & Groenveld 2006).

Mauritius: Two species of lobsters are fished around Mauritius and St. Brandon. In Rodrigues, lobster are caught by reef gleaning by snorkeling.

Mozambique: An industrial trap fishery for *Palinurus delagoae* by licensed Japanese and local vessels operated between 1980 and 1999, and achieved annual landings of up to 400 t/year. As

in South Africa, this fisheries also landed slipper lobster *Scyllarides elisabethae* and red crab *Chaceon macphersoni* as a retained bycatch. The fishery was unstable, with declines in catches, and is currently inactive (Mozambique MEDA 2012).

Seychelles: The Seychelles MEDA (2012) does not mention lobster fisheries., although this was identified as an issue of concern by the participants at the national CCA meeting.

Somalia: Spiny lobsters of the genus *Panulirus* are caught along the whole coastline by artisanal fishermen. The commercial sector also exploits two species of deep-sea lobster, *Puerulus swelli*, and *P. carrinatus*, found at depths of 150 to 400m (FAO 2005). The average size of lobsters caught has diminished, with most of the lobsters now caught before they have reached the age of maturity. Furthermore, berried females are often caught during the breeding season, when the fishery is not strictly managed (Somalia MEDA 2012).

South Africa: The small scale industrial crustacean trawl fishery targets various species but also catches the Natal deepwater spiney rock lobster (*Palinurus delagoae*) and an assortment of other crustacean and fish species. Areas of operation are confined to the province of Kwazulu-Natal. There is also a small fleet of trap boats targeting deepwater rock lobster off the south coast and another off the east coast. The south coast fishery targeted *Palinurus gilchristi*, on the Agulhas Bank, but also landed slipper lobster *Scyllarides elisabethae* and red crab *Chaceon macphersoni* as a retained bycatch. The fishery is active, stable and well-managed since 1974. The second fisheries for *P. delagoae* off the east coast is less stable, and declines in catch rates were reported between 1994 and 1997 and between 2004 and 2007 (South Africa MEDA 2012).

Tanzania: Unsustainable harvesting of lobsters occurs in Tanzania. The open access harvest for commercial artisanal species, as well as that the biology, sustainable off-take and management techniques of these species are inadequately understood and monitored. Shallow water lobsters that are exploited in Tanzania include *Panulirus ornatus, P. longipes,* which contribute more than 80% of landings, as well as *P. versicolor, P. homarus* and *P. penicillatus*. Lobster are fished using a hand-held net and an octopus, which is used to flush the lobsters out of their hiding areas so that they can be scooped up by the net. Lobsters are also caught by traps and gillnets set and by divers using spear guns. Deep-water lobsters (*Linuparus somniosus* and *Metanephrops andamanicus*) are caught in depths of 250-320 m in the southern end of the Zanzibar Channel (Tanzania MEDA 2012)**.**

Transboundary Scope

This identified was identified as being 'Relevant' by 7 countries. From the Level 1 prioritisation 6 countries ranked the issues as being 'High' importance. In the Level 2 prioritisation 3 countries allocated 'Overall ranking' scores which were above average compared with the other issues in MAC03. This suggests that the countries do not consider this to be a priority transboundary issue of concern within the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	NR	✓	✓	✓	✓	✓	✓	NR	✓	7
Importance	NR	H	H	H	H	H	H	NR	M	6
Overall ranking	NR	18		20	16	10	19	NR	7	3

3.3.8. Decline in populations of crayfish

Problem Statement

Overexploitation of crayfish was expressed as an issue of concern in Madagascar and Somalia; this however was due to confusion over the common name for lobster.

National Scope

Madagascar: The Malagasy 'littoral crayfish' is represented by the genus *Palinurus* (*P. homarus*, *P. japonicus* or *P. longipes*, *P. penicillatus*, *P. versicolor*, *P. ornatus* and *P. dasypus*). which are found on rocky and coral reefs all around the island.These species are more commonly referred to as spiney lobsters,

Transboundary Scope

Overexploitation of crayfish was expressed as an issue of concern by Madagascar and Somalia; this however was due to confusion over a the common name for different species lobster. Two countries identified the issue as being 'Relevant' and from the Level 1 prioritisation only one country ranked the issues as being 'High' importance. In the Level 2 prioritisation one country allocated 'Overall ranking' scores which were above average compared with the other issues in MAC03. This suggests that the countries do not consider this to be a priority transboundary issue of concern within the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	NR	NR	NR	NR	✓	NR	✓	NR	NR	2
Importance	NR	NR	NR	NR	L	NR	H	NR	NR	1
Overall ranking					9		17			1

3.3.9. Decline in populations of crabs

Problem Statement

The exploitation of crabs is common in several countries in the ASCLMEs. The target species include portunid crabs, mud or mangrove crabs and more rarely coconut crabs. The most commonly exploited species is the mangrove swamp crab *Scylla serrata,* which is now also being farmed. The farming of this species is further contributing to the demise of wild populations due to the harvesting of crablets for use in mariculture.

National Scope

Comoros: The coconut crab *Birgus latro* is the largest land crab in the world (up to 3 kg). It is captured by fishermen to use as bait for fishing traditional coastal fish (mullet, parrot fish, triggerfish), and it is now rare on the islands. The species is protected under Appendix II of the Nairobi Convention.

Kenya: There is an artisanal fishery for crabs, which targets portunid crab species in mangroves (*Scylla serrata*) and the swimming portunid crabs (*Charybdis spp*.), as well as *Parasesarma catenata* (Brachyura: Sesarmidae), *Epixanthus dentatus* (Decapoda: Oziidae), *Thalamita crenata* (Latreille) and Hermit crabs e.g. *Clibanarius laevimanus.* Populations of the mud crab, *S. serrata*, which are targeted by the artisanal fishery are declining in Kenya, crablets are being harvested from the wild for the mariculture sector with little regard for resource status.

Mauritius: Four species of crabs are currently being fished, but no further information is provided on this fishery (Mauritius MEDA 2012).

Madagascar: The mangrove swamp crab *Scylla serrata* is exploited by traditional and industrial fisheries. Mangrove areas near coastal cities are subject to overharvesting, while more remote

areas still support fishable stocks. Bautil et al. (1991) studied the fisheries near Mahajanga and estimated the potential sustainable yield at between 1.66 and 1.8 tonnes/km^2 mangrove/year or 5,500 tonnes/year for the whole of Madagascar. The production of crabs steadily increased from 500 tonnes in 1985 to 1,500 tonnes in 2007. To avoid overfishing, regulations were introduced in 2006 on the exploitation of the mangrove crab, *Scylla serrata*.

Mozambique: The mud crab (*Scylla serrata*) and the blue swimming crab (cf.*Portunus pelagicus*) are important artisanal fisheries. The blue swimming crab are sometimes caught with drag-nets, but the most common method to catch them is by walking in the sand at low tide with a spear. Both the method of netting and spearing of crabs result in a relatively high % of juvenile individuals as well as egg carrying females being caught and killed. Crab production and export values indicate a decline in stocks (Mozambique MEDA 2012).

Somalia: Populations of the mud crab, *Scylla serrata*, which are targeted by the artisanal fishery are also declining in Somalia.

Tanzania: There is a commercial fishery for mangrove crabs *Scylla serrata*. The potential catch of the large mangrove crab was estimated to be 5- 10 tonnes wet wt/month in Pangani and in 1989 the price of the crab was TShs. 75/Kg (Semesi and Mzava 1991). Today the price of the crab is ranges from TShs 2500-6000/kg.

Transboundary Scope

Declines in crab populations was identified as being a 'Relevant' issue by 7 countries. From the Level 1 prioritisation, 5 countries ranked the issues as being 'High' importance, mainly related to concerns about mud / mangrove crab *Scylla serrata*. In the Level 2 prioritisation no countries allocated 'Overall ranking' scores which were above average, indicating that the countries don not consider this to be a priority transboundary issue of concern within the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	NR	✓	NR	✓	7
Importance	H	H	H	H	M	NR	M	NR	H	5
Overall ranking	14	12		13	13	NR	11	NR	15	0

3.4. Excessive bycatch and discards

Problem Statement

Excessive bycatch and discards is an issue of concern for both the artisanal and industrial fisheries in the ASCLMEs. Non-selective gears used by artisanal and industrial fisheries often result in bycatch of non-commercial species and juveniles.

National Scope

Comoros: The Comoros MEDA (2012) does not discuss the issue of by-catch or discards.

Kenya: Artisanal fishers often use destructive gears such as beach seines and small-mesh gill nets, which result in the capture of juvenile fish.

Madagascar: Traditional methods of shrimp fishing are diverse in all regions of Madagascar. Five main types of gear are used and it is thought that the low selectivity of traditional gears could have a negative impact on the stock recruitments. The use of mosquito seine fishing for the traditional shrimp fishery led to the capture of juveniles of many invertebrate species, mainly in the West and Northwest coasts and beach seines are common in the region of Toliara.

Mauritius: The Mauritius MEDA (2012) does not discuss the issue of by-catch or discards.

Mozambique: Little is known about the extent of marine mammal bycatch in Mozambique. Entanglements in gillnets appear to be a major cause of dugong mortality along the whole coast. The level of this threat has increased since the early 1990s alongside an increase in gillnet use. Gillnets affects small coastal cetaceans, particularly bottlenose and humpback dolphins. A marked decline in coastal dolphin populations was observed in the early 1990s. The gill net fishery also has a by-catch comprised by *Mugil cephalus, Liza alata, L. duciae, Hemiramphus far* and *Rhabdosargus sarba*. The shrimp fishery by-catch is dominated by Sciaenidae family (Otolithes ruber, Johnius amblicephalus). The most important fish by-catch species in the semi industrial prawn fishery are *Leiognathus equulus, Gazza minuta* (Leiognathidae), *Otolithes rubbe*r (Scianidae), *Mugil cephalus* (Mugillidae), *Pomadasys maculatus, Pomadasys kakaan* (Haemulidae), *Hilsa kelee* and *Pellona ditchela* (Clupeidae).

Seychelles: Pelagic trawling is a very unselective fishing mode with a 5% bycatch which include charismatic species such as dolphins, turtles and sharks.

Somalia: The offshore trawling grounds, especially those targeting prawns, are showing signs of overexploitation with excessive bycatch and discards. A significant fraction of shrimp bycatch is composed of juvenile fish and on average, only 32% of the bycatch is retained, with a discard rate of up to 1.8 tonnes per trawler per day (KMFRI 2003).

South Africa: A number of industrial fisheries in South Africa have problems with excessive bycatch and discards: discarding of non-tuna species such as the oilfish *Rivettus pritiosus* is a growing problem in the tuna longline sector; there is a seasonal bycatch problem on the west coast with juvenile horse mackerel and on the east coast (ASCLME area), high bycatches of horse mackerel can be problematic at times; the prawn trawl fishery (deep and shallow) has a major bycatch concern; and species mixing between juvenile anchovy (*Engraulis encrasicolus*) and juvenile sardine (*Sardinops sagax*) is an “early season” fishery problem resulting in discarding and dumping (South Africa MEDA 2012).

Tanzania: One of the major threats to turtles in Tanzania is shrimp trawls, and 16 turtles (green, hawksbill and loggerhead) were caught during a by-catch survey conducted in 2007 in the industrial prawn trawl fishery (Muir, 2007b). Gillnets also pose a major threat to all species of turtles (adult and subadult) in Tanzania. Most captures are incidental (Muir, 2005, Tanzania MEDA 2012).

Transboundary Scope

Excessive bycatch and discards affects vulnerable species and stocks which are likely to be shared between the countries within the ASCLMEs. All countries identified the issue as being 'Relevant' so this issue is also a shared transboundary issue as well. From the Level 1 prioritisation 8 countries ranked the issues as being 'High' importance. In the Level 2 prioritisation 7 countries allocated 'Overall ranking' scores which were above average. This suggests that the countries consider this to be a priority transboundary issue of concern within the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	✓	✓	✓	✓	9
Importance	H	H	H	H	H	H	H	M	H	8
Overall ranking	17	19		21	19	19	21	14	18	7

3.5. Expansion of mariculture industry (biosecurity, diseases in wildstocks, exotics, habitat implications, water quality)

Problem Statement

Mariculture activities are expanding rapidly throughout the countries of the ASCLMEs in response to the increased demand for seafood and other products, both nationally and internationally, and the economic development potential this sector provides. Farming of blue-green algae, seaweed, sea cucumber, clams, pearl oyster, prawn, crab and finfish are all currently active in the region. The potential for this sector to generate employment opportunities for coastal communities is seen as an opportunity to both reduce fishing pressure on wild stocks and reduce poverty, although the employment opportunities created are not always accessible to people from local coastal communities. The expansion of this industry, in the absence of adequate planning and technical capacity, can create serious long term environmental problems which include: the permanent loss of natural habitats such as mangroves and seagrass beds, the release of contaminated and or nutrient enriched wastewater, the introduction of non-native species or diseases into wild populations and, the overexploitation of wild-caught juvenile population for use as seed stock or feed.

National Scope

Comoros: The Comoros MEDA (2012) does not discuss the issue of mariculture.

Kenya: New experimental mariculture activities have been set up along the south coast of Kenya. This a developing sector and there are 8 finfish farms, 6 crab farms and 4 prawn farms, all of which are currently producing for domestic consumption. There has however been inadequate coordination, which has resulted in land-use conflicts, problems of theft, poor water quality and other problems reported from the sector. The destruction of mangroves to make way for prawn farming, as well as the potentially harmful use of wild caught crablets, highlights some of the unsustainable practices currently taking place.

Madagascar: Mariculture is a developing sector in the Malagasy economy with research and pilot projects ongoing in mud crab, sea cucumber, blue-green algae, oyster and eel. Commercial large scale farming of prawn for export and domestic consumption, as well as small-scale production in seaweed is also established. Prawn farming has been very successful in providing employment for rural communities, supplying 4,325 permanent and 30,000 part time jobs in 2003, and export revenues worth an estimated $62 million USD (Madagascar CLA, 2012). The main impact of farms on the environment is the periodic draining of wastewater ponds. The water is rich in phosphates, nitrates and organic matters (and may also contain pathogens, antibiotics and pesticides). During the last five years, diseases emerged in wild populations of shrimp; the link to aquaculture has not yet been confirmed (Madagascar MEDA, 2012).

Mauritius: Only one mariculture farm is active in Mauritius, with cage culture being utilized to produce goldlined sea bream, red drum and cobia in Mahebourg. The farm produces both for domestic consumption and export, employs 65 people and, in 2008, produced an estimated 750 tons. Six mariculture licenses have been granted as of 2009 and the government has identified the sector as having great potential for growth. The problems include user conflicts over marine resources, competition for coastal land with hotel developers and theft and vandalism have also been highlighted as prevalent challenges. Other constraints such as the threat of cyclones and poor access to the coast. Research into the potential for the extensive lagoon areas in Rodrigues for pearly oysters, seaweed farming and sea cucumber ranching has been explored.

Mozambique: Mariculture currently employs 2,000 people in commercial seaweed farming, 80% of whom are women, and 1,000 people in commercial prawn farming, and is a strong developing sector in the Mozambican economy. There are also experimental projects underway in finfish and mudcrab, which highlight the opportunities for further development in the sector. The

Mozambique MEDA (2012) does not identify negative impacts of aquaculture. There is concern about a lack of monitoring of the existing farms and assessing the potential impacts of the projects before their implementation.

Seychelles: Few mariculture activities are currently operational in Seychelles, with only prawn, giant clam and pearl oysters being produced in small-scale commercial operations. Prawn and clam production has also been decreasing in recent years due to weak demand. Farming of clam and pearl oysters are not labour intensive practices, and offer little employment. While the prawn farm on Coetivy Island employs 350 people, only 18% are native Seychellois. As the demand for marine living resources increases and natural stocks diminish, the Seychelles Government has found it necessary to promote the development of the aquaculture/mariculture industry. In early 2009, a scoping exercise to access the potential for mariculture development was conducted and one of the recommendations from this exercise was the need for the Seychelles to develop a Master plan to drive such initiative. Seychelles is opting for caged mariculture because of the scarcity of land for based aquaculture (Seychelles MEDA, 2012).

South Africa: Medium and large-scale mariculture activity is well established in South Africa, with commercial farming prevalent in abalone, seaweed, mussels and oysters, and pilot commercial projects underway in dusky kob, silver kob and yellowtail finfish. Research is also ongoing for the production of clownfish, white margined sole, west and east coast rock lobster, scallop and blood worm. Although no introductions have occurred along the south and east coasts have been linked to aquaculture, the threat from this industry remains significant. Additionally, parasites, diseases and epifaunal species associated with target species may accidentally be introduced (Minchin et al. 2009).

Tanzania: Mariculture is a vibrant sector in the Tanzanian economy, with finfish, seaweed and mudcrab being farmed in all coastal regions, and pearls and prawns also being farmed in Mafia and Tanga. Potential overexploitation and unsustainable harvesting of juveniles for use in aquaculture is a threat to natural populations. In addition, seaweed farming was identified as a potential cause of the decline in seagrass beds (Tanzania MEDA 2012).

Transboundary Scope

Many of the countries within the ASCLMEs have or are in the process of developing or expanding mariculture activities and this is therefore a shared transboundary issue. Within the ASCLMEs, all countries identified the issue as being 'Relevant'. From the Level 1 prioritisation 6 countries ranked the issues as being 'High' importance, and in the Level 2 prioritisation 4 countries allocated 'Overall ranking' scores which were above average, indicating that the countries consider this to be a priority transboundary issue of concern within the ASCLMEs.

	Comoros	Kenya	Madagascar	Mauritius	Mozambique	Seychelles	Somalia	South Africa	Tanzania	ASCLME
Relevance	✓	✓	✓	✓	✓	✓	✓	✓	✓	9
Importance	H	H	H	H	H	H	L	M	M	6
Overall ranking	17	19		22	23	16		11	12	4

10 DISCUSSION

National CCA Meetings were completed for all 9 countries within the ASCLMEs countries between 14th July 2011 and 15th August 2011. The countries were provided with the draft outputs from the workshops and given the opportunity to review and submit comments. This report summarises the outputs from these National CCA meetings and presents the joint findings.

A review of the national MEDA was used to scope out the full range of issues identified by the countries. These issues were used to develop a 'Draft Issues Framework' which included an initial list of 50 issue categories, divided between 4 Main Areas of Concern: MAC01 Water Quality (8 issues), MAC02 Habitats and communities (15 issues), MAC03 'Declines in living marine resources' (20 issues) and MAC04 'Unpredictable environmental variability and extreme events' (7 issues).

The results of the Level 1 Prioritization exercise from the national CCA workshops revealed that all the issues identified in the 'Draft Issues Framework' were 'Relevant' to one or more of the countries in the ASCLMEs. There were differences however in the number of countries which considered the issues to be 'Relevant' now, 'Future relevant' or 'Not relevant'.

In **MAC01**, all 8 issues were considered to be **'Relevant'** by one or more of the countries. Two of the issues were considered to be 'Future relevant' by one of the countries these included: nutrient enrichment (1.3.2, Mauritius) and degradation of ground and surface water quality (1.2, Comoros). None of the issues were considered to be 'Not relevant'.

In **MAC02**, all 15 issues were considered to be **'Relevant'** by one or more of the countries. There were 4 issues that were identified as being 'Future Relevant' by one or more of the countries: wetland habitats (2.2.4, Mozambique); deep water habitats (2.3.5, Madagascar); pelagic habitats (2.4, Mozambique and Seychelles); introduction of exotic non-native species, invasives and nuisance species (2.6, Comoros). There were 10 issues that were identified as 'Not relevant' by one or more of the countries, 4 of which were identified as being 'Not relevant' by more than one country but only deep water habitats (2.3.5, Comoros, Kenya, Mauritius, Mozambique and Seychelles) was considered to be 'Not relevant' by more than half of the countries.

In **MAC03**, all 20 of the issues were considered **'Relevant'** by one or more of the countries. There were 12 issues that were considered 'Future relevant', 4 of which were considered 'Future relevant' by more than one country, these included: small pelagics (3.2.3, Madagascar and Mozambique); molluscs (3.3.1, Comoros, Madagascar and Mozambique); sea urchins (3.3.5, Madagascar and Mozambique) and; expansion of mariculture industry (3.5, Mozambique, Somalia and South Africa). A further 15 issues were considered 'Not relevant' by one or more of the countries, 8 of which were 'Not relevant' to more than one of the countries: cetaceans (3.1.2, Somalia and Comoros); small pelagics (3.2.3, Kenya, Mauritius and Seychelles); deep water demersals (3.2.4, Comoros, Kenya, Mauritius and Tanzania); molluscs (3.3.1, Seychelles and Somalia); abalone (3.3.2, all countries except South Africa); sea urchins (3.3.5, all countries except Madagascar and Mozambique); lobsters (3.3.7, Comoros and South Africa) and; crayfish / deep water lobster (3.3.8, all countries except Mozambique and Somalia). The issues that were considered 'Not relevant' by more than half the countries (abalone 3.3.2, sea urchins 3.3.5, and crayfish 3.3.8) could either be removed (e.g. sea urchins) or consolidated with other issues e.g. abalone and crayfish. The term 'crayfish' was used to refer to deepwater lobster in one of the MEDAs, so this issue could be combined with lobster.

The ranking of the issues in terms of their **'Importance'** provided an indication of the relative prioritisation of each issue at the national level within and between the Main Areas of Concerns, as well as providing a first look a the prioritisation at the regional level. For example, although all of the MAC01 issues were identified as 'Relevant', none of the issues in MAC01 were ranked as being of 'High' importance by all of the countries, and only 4 of the 8 issues (50 %) were ranked as being of 'High' importance by more than half of the countries. By comparison, 8 of the 15 issues (53.3 %) in

MAC02, and 13 of the 20 issues (65.2 %) in MAC03 were ranked as being of 'High' importance by over half of the countries. This suggested that countries of the ASCLMEs considered MAC02 and MAC03 issues to be higher priority. Furthermore, there was one issue in both MAC02 and MAC03, that was ranked as being of 'High' importance by all countries: coastal habitats (2.2.3) and reef and demersal fish (3.2.5).

The number of issues identified as being of 'High' importance varied between the countries and ranged from a minimum of 16 'High' priority issues identified by the Seychelles to 32 'High' priority issues identified by Madagascar. The 32 issues identified as 'High' priority by Madagascar included nearly all of the issues in MAC01 (7 of 8 issues), MAC02 (12 of 15 issues) and MAC03 (13 of 20 issues). By comparison, the 16 'High' importance issues identified by Seychelles were split between MAC02 (3 issues) and MAC03 (13 issues); all MAC01 issues, were considered to be of 'Medium' importance. Seychelles was not the only country to not identified any MAC01 issues as being of 'High' importance, Mauritius also did not rank any MAC01 issues as being of 'High' importance. Mauritius had 23 'High' importance issues, distributed between MAC02 (7 issues) and MAC03 (16 issues) and; all MAC01 issues were ranked as being of 'Low' importance.

The country with the second highest number of 'High' importance issues was Kenya, which identified a total of 31 'High' importance issues, split between MAC01 (6 issues), MAC02 (10 issues) and MAC03 (16 issues). Somalia identified 26 'High' importance issues in MAC01 (3 issues), MAC02 (9 issues) and MAC03 (14 issues), with a higher number of important issues related to living marine resources. Tanzania identified 24 'High' importance issues, distributed between MAC01 (4 issues), MAC02 (12 issues) and MAC03 (8 issues). Mozambique identified 23 'High' importance issues split between MAC01 (6 issues), MAC02 (8 issues) and MAC03 (9 issues). Comoros identified a total of 22 'High' importance issues, distributed between MAC01 (6 issues), MAC02 (4 issues) and MAC03 (12 issues). South Africa identified 18 'High' importance issues, split between MAC01 (4 issues), MAC02 (10 issues) and MAC03 (4 issues). The majority of countries identified more 'High' priority issues in MAC03. South Africa and Tanzania were the only two countries to identify more habitat related issues (MAC02) as being of 'High' importance than living marine resources issues (MAC03).

Comparing the 'Importance' ranking of these issues between the countries revealed the first level prioritisation of these issues at the regional level. There was two issue that were ranked as 'High' by all countries, which were: declines in reef and demersal fish (3.2.5) and coastal habitats (2.2.3). There were 4 issues that were ranked as 'High' by 8 of the 9 countries in MAC02 and MAC03, these included: coral reefs (2.3.1), sharks and rays (3.2.1), sea cucumbers (3.3.4) and bycatch (3.4). There were 4 issues ranked as 'High' by 7 of the 9 countries: upland habitats (2.2.1), turtles (3.1.4), large pelagics (3.2.2), cephalopods (3.3.3). A further 10 issues were ranked as 'High' importance by 6 of the 9 countries, split between MAC01 (4 issues), MAC02 (3 issues) and MAC03 (3 issues), which included: alteration of natural river flows (1.1), ground and surface water quality (1.2), solid waste (1.3.5), and oil spills (1.3.6), shoreline change (2.1), mangroves (2.2.6), and pelagic habitats (2.4), prawn and shrimp (3.3.6), lobster (3.3.7) and mariculture (3.5). Finally, in MAC02 and MAC03 there were 7 issues ranked as being of 'High' importance by 5 of the 9 countries: coastal forest (2.2.2), wetlands (2.2.4), estuaries (2.2.5), seagrass (2.3.2), marine mammals (3.1.1), cetaceans (3.1.2), small pelagics (3.2.3). All other issues were ranked as 'High' by 4 or less of the countries.

Consideration of the **transboundary** nature of each of the issues in the Draft Issues Framework, in terms of whether the issues were 'Transboundary', 'Future transboundary' or 'Not transboundary' revealed that the majority of countries considered the majority (but not all) issues to be either 'Transboundary' in the present day or 'Future transboundary' within 10 years. The issues that were considered to be 'Transboundary' by all countries were: chemical contamination (1.3.3), oil spills (1.3.6), coral reefs (2.3.1), turtles (3.1.4), large pelagics (3.2.2) and bycatch (3.4). The exercise however also demonstrated that those issues that had been listed as 'Not transboundary' from the national perspective, were in fact mostly common or shared issues between the countries, and hence transboundary.

The Group work Session on **'Baseline Data'** revealed that while there is some data available for the all of the issues (43 of 43 issues, or 100 %) in the Draft Issues Framework, there are gaps and concerns with regards the availability or quality of these data. Common concerns that were raised by workshop participants in relation to the baseline datasets included: the data being of limited or patchy geographic extent, poor data quality or out of date data, or data accessibility issues due to the data being disparately held between different governmental departments and or by local or international non-governmental organisations. There were 37 of the 43 issues for which there was baseline data, or at least a partial baseline dataset in more than half of the countries. The 6 issues, for which baseline or partial baseline data is limited, and may only be available in less than half the countries, included some of the lower importance issues:

- 2.3.4. Disturbance, damage and loss of soft sediment habitats
- 2.3.5. Disturbance, damage and loss of deep water habitats (including sea mounts)
- 2.6. Introduction of exotic non-native species, invasives and nuisance species
- 3.3.2. Declines in populations of abalone
- 3.3.5. Declines in populations of sea urchins
- 3.3.8. Declines in populations of crayfish

In **MAC01**, over half (50 %) of the countries have some baseline data for 6 out of the 8 issues (75 %). Issues where there appears to be a gap in the availability of baseline data included coastal and marine water quality data, particularly with regards nutrients (1.3.2) and suspended solids (1.3.4).

In **MAC02**, over half (50 %) of the countries have some baseline data available for 9 out of the 15 issues (60 %) of the issues. The majority of countries (7 or more of the 9 countries) have baseline data available for upland watershed habitats (2.2.1), coastal forests (2.2.2), mangroves (2.2.6), coral reef habitats (2.3.1). Issues where there appears to be a major gap in the availability of baseline data in more than 50 % of the countries includes: coastal habitats (2.2.3), estuarine habitats (2.2.5), macroalgal habitats (2.3.3), soft sediment habitats (2.3.4), deep water habitats (2.3.5), pelagic habitats (2.4), and invasive species (2.6).

In **MAC03**, over half (50 %) of the countries have some baseline data available for 10 out of the 20 issues (50 %). The majority of countries (7 or more of the 9 countries) have baseline data for 3 issues including sea turtles (3.1.4), large pelagics (3.2.2.), reef and demersal fish (3.2.5). None of the countries had baseline data or information on crayfish (3.3.8), but this is perhaps unsurprising as the issues were also not considered to be 'Relevant' by the majority of the countries. Other issues where there does appear to be a significant gap in the availability of baseline data for more than 50 % of the countries includes: marine mammals (3.1.1), cetaceans (3.1.2), molluscs (3.3.1), abalone (3.3.2), cephalopods (3.3.3), and crabs (3.3.9).

The **'Monitoring'** exercise revealed similar trends as was found for the 'Baseline' data. There is some type of monitoring for 74 % (36 of 43) issues within the ASCLMEs region. The 7 issues for which there is no routine monitoring, or only limited (site specific or periodic) monitoring, in all of the countries within the ASCLMEs region include: microbiological contamination (1.3.1), suspended solids (1.3.4), macroalgae (2.3.3), coastal habitats (2.2.3), macroalgae (2.3.3), deep water habitats (2.3.5), abalone (3.3.2), sea urchins (3.3.5) and crayfish (3.3.8). These issues are generally those that were identified as being of a lower priority, with the exception perhaps of microbiological contamination. In addition there were 18 of the 43 issues (41.9 %) for which there is either no routine monitoring or only limited monitoring in more than half the countries, which were roughly equally divided between MAC01 (5 issues), MAC02 (5 issues) MAC03 (8 issues) as follows: ground and surface water (1.2), nutrients (1.3.2), chemical contamination (1.3.3), solid wastes (1.3.5), oils spills (1.3.6), shoreline change (2.1), wetlands (2.2.4), seagrass (2.3.2), soft sediment habitats (2.3.4), pelagic habitats (2.4), marine mammals (3.1.1), sharks and rays (3.2.1), molluscs (3.3.1), cephalopods (3.3.3), sea cucumbers (3.3.4), sea urchins (3.3.5), crabs (3.3.9), excessive bycatch and discards. These issues include some of the higher priority issues that have been identified as priority transboundary

concerns both by the countries and or as common or shared issues at the regional level. While these findings have been reviewed at the country level, they will also still need to be cross-validated against the monitoring framework that has been prepared by the PCU (Lucy Scott, pers. comm.). The results nevertheless suggest that there are still some significant gaps in monitoring needs that will need to be addressed within the ASCLMEs region in the future.

The results of the **Level 2 prioritisation exercise** provided a more information on the importance of these issues in terms of the severity and scope at both the national and regional level. In this exercise, the numeric ranking scores (1-4) were used instead of the codes (VH, H, M and L). This allowed for better discrimination of the ranking of issues than had been achieved with the Level 1 prioritisation. The 'Overall severity' and 'Overall scope' scores for each issue were summed, to give the 'Overall ranking' score for each issue. The top 3 highest 'Overall ranking' scores within each MAC were used to identify the highest priority issues for each country, as listed below:

- Comoros, had 13 issues with an above average 'Overall ranking'. The highest ranked issues were those related to living marine resources (MAC03) and included turtles (24), large pelagics (23), and sharks and rays (22), followed by habitat related issues (MAC02) concerning coral reef habitats (20), shoreline change (17), upland watersheds (17), and coastal habitats (17), followed by water quality issues (MAC01), relating to microbilogical contamination (16), river flows (15), solid wastes (15) and oil spills (15).
- Kenya, had 20 issues with an above average 'Overall ranking'. The highest ranked issues were those related to habitats (MAC02) and included upland / wateshed habitats (24), mangroves (22), coral reefs (22), and wetlands (21), followed by declines in living marine resources (MAC03), including reef and demersal fish (21), prawn and shrimp (20), cephalopods (19), sea cucumbers (19), excessive bycatch (19), mariculture (19), followed by water quality concerns, including solid wastes (18), river flows (17), and nutrients (15).
- Madagascar, had 12 issues with an above average 'Overall ranking'. The highest ranking issues varied between the MAC's, while the lowest ranking issues were all related to declines in living marine resources (MAC03). The highest ranking issue was microbiological contamination (24), followed by mangrove habitats (24), coastal forests (21), oil spills (20), coral reef (19), seagrass (19), pelagic (19) and turtles (19), chemicals (18), prawn and shrimp (17) and cetaceans (16).
- Mauritius, had 20 issues with an above average 'Overall ranking'. The highest ranking issues were those related to living marine resources (MAC03) and included deep water demersals (24), reef and demersal fish (24), large pelagics (23) and mariculture (22), followed by habitat related issues (MAC02) including shoreline change (22), coral reefs (21), mangroves (20), and then water quality issues (MAC03) including microbiological contamination (14), solid wastes (14), river flows (13) and ground and surface water (13).
- Mozambique, had 24 issues with an above average 'Overall ranking'. The highest ranking issues were those related to living marine resources or habitats and included prawn and shrimp (24), mariculture (23), coastal habitats (23), mangroves (23), shoreline change (22), turtles (22), upland watersheds (21), followed by water quality issues including river flows (19), solid wastes (17), ground and surface water (15) and microbiological contamination (15).
- Seychelles, had 16 issues with an above average 'Overall ranking'. The highest ranking issues were mixed between the different MAC's, starting with shoreline change (24), coral reefs (24), oil spills (22), sharks and rays (21), large pelagics (21), solid wastes (19), bycatch (19), river flows (18) and pelagic habitats (18).
- Somalia, had 22 issues with an above average 'Overall ranking'. The highest ranking issues were related mainly to living marine resources (MAC03) and included sharks and rays (22), large pelagics (22), bycatch (21), and reef and demersal fish (20), followed by coral reef habitats (19), oil spills (17), chemical contamination (17), upland watershed habitats (17),

microbiological contamination (16), solid wastes (16), coastal forests (16), mangroves (16), pelagic habitats (16) and nutrient enrichment (15).

- South Africa, had 19 issues with an above average 'Overall ranking'. The highest ranking concerns were those related to water quality (MAC01) including river flows (19) and ground and surface water (19), followed by habitat related issues (MAC02) including coastal habitats (19), wetlands (19), estuarine (19), soft sediments (19), upland watersheds (18), coastal forest (18), mangrove (17), followed by concerns related to living marine resources (MAC03) including, sharks and rays (16), large pelagics (15), reef and demersal fish (15), molluscs (14), small pelagics (14) and deep water demersals (14).
- Tanzania, had 19 issues with an above average 'Overall ranking'. The highest ranking issues were related to habitats (MAC02), including mangroves (24), coastal habitats (23), coral reef habitats (23), shoreline change (22), followed by river flows (20), cephalopods (19), prawn and shrimp (19), small pelagics (18), reef and demersals (18), ground and surface water (18), solid wastes (18), suspended solids (17), sea cucumbers (16)and bycatch (16).

Comparing the Level 2 Prioritisation results for all countries revealed a 'second glimpse' at the ranking of these issues at the regional level. The total number of countries with an above average 'Overall ranking' score was summed for each issue, and; the issues with an above average number of countries with above average 'Overall ranking' scores were then highlighted. This process identified 20 potential top priority transboundary issues within the region, which included 4 issues in MAC01, 7 issues in MAC02 and 8 issues in MAC03.

The Level 2 prioritisation identified two issues with an above average 'Overall ranking' scores in 8 of the 9 countries, both of which in MAC02: mangrove habitats (2.2.6) and coral reefs (2.3.1). There were 8 issues with above average scores in 7 of the 9 countries, distributed between MAC01 (2 issues), MAC02 (3 issues) and MAC03 (3 issues), these included: river flows (1.1) and solid wastes (1.3.5), shoreline change (2.1), coastal habitats (2.2.3), pelagic habitats (2.4), sharks and rays (3.2.1), reef and demersal fish (3.2.5) and bycatch (3.4). There was a further 4 issues with an above average scores in 6 of the 9 countries, divided between: MAC02, upland / watershed habitats (2.2.1) and coastal forests (2.2.2), and; MAC03, turtles (3.1.4) and large pelagics (3.2.2). There were 4 issues with an above average score in 5 of the 9 countries, divided between: MAC01, ground and surface water (1.2) and microbiological contamination (1.3.1), and; MAC03, small pelagics (3.2.3) and prawn and shrimp (3.3.5). Finally, there were two issues with above average scores in 4 of the 9 countries in MAC03, which had above average adjusted scores within MAC03, and these included sea cucumbers (3.1.4) and mariculture (3.5)

The results of the Level 1 and Level 2 prioritisation were broadly consistent, but there were some discrepancies:

- In **MAC01**, the Level 1 and Level 2 prioritisation exercises both identified 4 issues, 3 of which were identical: alteration of natural river flows (1.1), ground and surface water quality (1.2), and solid waste (1.3.5). The fourth issue identified by the Level 1 prioritisation exercise was oil spills (1.3.6), which was ranked as being of 'High' importance by all 9 countries in Level 1, but only ranked above average by 4 countries in Level 2. The fourth issue identified by the Level 2 priorisation exercise was microbiological contamination (1.3.1), which had an above average 'Overall ranking' by 5 countries in Level 2, but was only ranked as being of 'High' importance by 2 countries and of 'Medium' importance by 5 countries in Level 1.
- In **MAC02**, the Level 1 and Level 2 prioritisation exercises identified 10 and 7 top priority issues respectively. There were 7 top priority issues in common between Level 1 and 2, including: shoreline change (2.1), upland / watershed habitats (2.2.1), coastal forests (2.2.2), coastal habitats (2.2.3), mangrove (2.2.6), coral reefs (2.3.1) and pelagic habitats (2.4). The additional issues identified by Level 1 were all ranked as being of 'High' importance by 5 countries and included: wetlands (2.2.4), estuarine (2.2.5) and seagrass (2.3.2). In Level 2,

these issues had above average 'Overall ranking' scores by < 3 countries: wetlands (2.2.4) (3 countries), estuarine (2.2.5) (1 country) and seagrass (2.3.2) (3 countries).

- In **MAC03**, the Level 1 and Level 2 prioritisation exercises identified 13 and 9 issues respectively. There were 9 top priority issues in common between Level 1 and 2, including: turtles (3.1.4), sharks and rays (3.2.1), large pelagics (3.2.2), small pelagics (3.2.3), reef and demersal fish (3.2.5), sea cucumbers (3.3.4), prawn and shrimp (3.3.5), bycatch (3.4) and mariculture (3.5). The 4 additional issues identified by the Level 1 exercise included: marine mammals (3.1.1) (5 countries), cetaceans (3.1.2) (5 countries), cephalopods (3.3.3) (7 countries), spiny lobster (3.3.7) (6 countries). The issues did not have above average 'Overall rankings in Level 2: marine mammals (3.1.1) (2 countries), cetaceans (3.1.2) (3 countries), cephalopods (3.3.3) (2 countries), spiny lobster (3.3.7) (3 countries).

Impact and causal chain analyses were completed by the countries for their top priority issues within each of the three MACs. Collectively the countries completed 72 chains (either impact, causal or both chains) covering 29 of the 43 issues (67 % issues). These included chains for all 18 of the top ranked issues identified through Level 2 prioritisation exercise. The number of chains prepared for each issue by the countries varied between 0-6 chains. The issue for which the maximum number of chains was prepared was coral reef (2.3.1). The 14 issues for which no chains were prepared were typically issues that had not been identified as a high priority issue in either of the Level 1 or Level 2. There were some issues that were ranked as being of 'High' importance by more than half of the countries at Level 1, for which no chains were prepared e.g. seagrass (2.3.2) and cephalopods (3.3.3). There were chains prepared for all those issues identified with average 'Overall ranking' scores from Level 2. There are also some chains of issues identified as a priority at the national level were not then identified as top priority issues at the regional level e.g. nutrient enrichment (1.3.2), chemical contamination (1.3.3), soft sediment habitats (2.3.4), and introduction of exotics (2.6) .

The countries which prepared the most chains were Madagascar, Seychelles, Mauritius (12 issues), followed by Mozambique (10 chains), Kenya (9 chains), Tanzania (7 chains), South Africa (7 chains), Comoros (3 chains) and Somalia (1 chain). The number of chains each country prepared reflected a combination of factors such as the number of workshop participants (e.g. Somalia had a very small number of participants and the chain was prepared in plenary), their experience in causal chain analysis, familiarity of the participants with the wide range of issues (e.g. not all countries had technical specialists for all fields present at the workshops) and language challenges (e.g. Comoros and Mozambique, where it was necessary to have additional translators to facilitate the process).

The national results of the impact and causal chain analyses were consolidated into tabular form to enable cross comparison and consolidation of the impacts and causes. These tables provide the basis for the development of regional impact and causal chains for use in the TDA process.

11 CONSTRAINTS

11.1 CHALLENGE 1 – STATUS OF THE MEDA AND OTHER DOCUMENTS

The documents provided for the purposes of this assignment and which provided the basis for the construction of the 'Draft Issues Framework' included the draft MEDA for eight out of the nine countries (with the exception of Comoros) and an Annex XIII, which listed the main 'Areas of Concern' for each country for all nine countries. The version of the MEDA's supplied were incomplete and still undergoing review by national and regional experts. A initial review of these documents revealed that the identification and analysis of the issues or 'Areas of Concerns', and hence Annex XIII, was generally poor and inconsistent. Comparison of the issues listed as 'Areas of Concern' in Annex XIII with those discussed in the MEDA documents, revealed that not all the concerns were captured in the Annex. Conversely, not all of the concerns listed in the 'Areas of Concern' were discussed in the MEDA. In some instances, the list of concerns that had been supplied with the MEDA document template were simply left in as bullet points. While these may have been

pertinent issues of concern to the country, they were then not discussed in the text of the MEDA. Furthermore, the majority of the MEDA documents were also missing key sections and annexes. Various background documents that were to be included in the MEDAs, either in the main body of the text, or as annexes were either still under preparation or were not available in advance of the national CCA meetings (e.g. Coastal Livelihood Assessments, Cost-Benefit Analyses and Policy and Governance Analyses). This meant that a new process needed to be developed to construct a comprehensive list of issues categories for inclusion in the 'Draft Issues Framework', and this presented some challenges to the development of the impact and causal chains.

11.2 CHALLENGE 2 – WIO-LAB AND SWIOFP

The Agulhas and Somali Currents Large Marine Ecosystems (ASCLMEs) Project is one of three component projects within the multi-agency ASCLMEs Programme. The three component projects should have been implemented in parallel, such that each Project contributed information into a joint TDA / SAP process. In reality, scheduling differences in the implementation of these Projects has meant that the 3 project were implemented in sequence instead of in parallel. This has presented some challenges in aligning the TDA to SAP process.

The Western Indian Ocean-Land Based Sources (WIO-LaB) Project that aimed to address land-based sources of pollution (implemented by UNEP) was implemented and completed first. The WIO-LaB project produced a TDA and SAP, which has since been adopted by the Nairobi Convention. The South-Western Indian Ocean Fisheries Project (SWIOFP) that aims to build knowledge for managing industrial offshore fisheries (implemented by the World Bank) commenced after the ASCLME Project. These two projects have since aligned their workplans in order to allow for the development of a joint TDA/SAP. Certain key outputs from the SWIOFP project that would ideally have fed into the impact and causal chain analysis process were yet to be completed.