Project Document

United Nations Development Programme
Global Environment Facility

Governments of Comoros, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, South Africa, Tanzania

Programme for the Agulhas & Somali Current Large Marine Ecosystems

Agulhas & Somali Current Large Marine Ecosystems Project

PIMS 2205

Brief Description: The Agulhas Current Large Marine Ecosystem (ACLME) stretches from the north end of the Mozambique Channel to Cape Agulhas and is characterised by the swift, warm Agulhas current, a western boundary current that forms part of the anticyclonic Indian Ocean gyre. The Somali Current Large Marine Ecosystem (SCLME) extends from the Comoros Islands and the northern tip of Madagascar up to the Horn of Africa. It is characterised by the monsoon-dominated Somali current, which has a strong, northerly flow during the summer, but reverses its flow in the winter. These two LMEs are both complex and interactive, and are strongly influenced by the South Equatorial Current, which is funnelled across the Mascarene Plateau east of Madagascar before diverging north and south to become components of the Agulhas and Somali Currents. The LMEs are primarily defined by their bathymetry, hydrography, productivity and biota. They are characterized by a dynamic system of ocean currents and upwelling cells, which regulate climate and influence weather patterns, sea temperatures, water chemistry, productivity, biodiversity and fisheries. They also represent an important repository of living marine resources, which underpin the livelihoods of coastal communities in 10 countries and territories.

Biodiversity-wise, the area is considered to be a distinct biogeographical province within the larger Indo-West Pacific region with high levels of regional endemism and a high diversity of marine life, from phytoplankton and zooplankton that drive important commercial and artisanal fisheries, to charismatic and endangered species such as the Coelacanth, dugong, turtles, and many species of cetaceans. Habitat alteration, pollution, overexploitation of biological resources, and the adverse effects of environmental variability represent the main threats to the ecosystems. Environmental variability within the LMEs includes variations in surface seawater temperature, seasonal changes in temperature gradients across the Indian Ocean, and the El Niño Southern Oscillation (ENSO). This variability is a particular concern as it threatens the

sustainability of coastal livelihoods, is altering critical habitats and their species compositions (e.g. coral reefs), and is hampering long-term management planning efforts.

Although the processes and ecosystem functions related to these two LMEs have a major influence on the societies and economies of the area, very little detailed information is available upon which to base effective, cooperative transboundary management initiatives. The management of marine resources is currently sectoral and country-based. The main barriers to the development of an ecosystem approach to transboundary management include inadequate data, lack of regionally based and coordinated monitoring and information systems, lack of national and regional capacity, and the absence of full stakeholder involvement. It is impossible, under this situation for governments to manage fisheries and other marine resources in the absence of an understanding of the ocean-atmosphere, trophic and biogeochemical dynamics that characterise the LMEs. Therefore there is a clear need for an effective assessment process to capture the requisite data to fill important gaps in information for management purposes. This project aims to replicate the highly successful approach used by the Benguela Current LME (BCLME) project wherein the presence of BENEFIT (the Benguela Environment Fisheries Interaction and Training Programme) was instrumental in providing much of the requisite scientific data and information necessary to the development of a TDA and subsequently focused the SAP which is now being used for regional management of the BCLME. The project will not only move the countries of the region toward an important WSSD target i.e. an ecosystem based approach to management of the LMEs, it will also help to achieve other WSSD targets including strengthened regional cooperation frameworks, and the maintenance or restoration of fish stocks on an urgent basis, where possible by 2015.

The proposed project is part of a multi-project, multi-agency Programme (The Programme for the Agulhas and Somali Current LMEs) to institutionalize cooperative and adaptive management of these LMEs. A phased approach is planned that progressively builds the knowledge base and strengthens technical and management capabilities at the regional scale to address transboundary environmental concerns within the LMEs, builds political will to undertake threat abatement activities and leverages finances proportionate to management needs. The Programme includes two parallel projects that address land-based sources of pollution (UNEP) and build knowledge for the purposes of managing industrial fisheries (World Bank). Phase 1 of the UNDP project will aim to address the significant coastal and offshore data gaps for these LMEs by capturing essential information relating to the dynamic ocean-atmosphere interface and other interactions that define LMEs along with critical data on artisanal fisheries, larval transport and nursery areas along the coast. The project aims to deliver a TDA and SAP for the Agulhas Current LME, while preparing an interim TDA for the southern part of the Somali Current LME, which can be expanded when the status of governance within the northern region becomes more stable. The parallel UNEP and World Bank Projects will feed pertinent information into the TDA/SAP formulation process, and identify policy, legal and institutional reforms and needed investments to address transboundary priorities. Collectively, the projects build foundational capacities at regional scale for management of the LMEs. Provision is made through the UNDP project for Programme coordination.

TABLE OF CONTENTS

LIST OF ANNEXES:

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

AA Monsoon	Asian-Australian Monsoon
ACEP	Africa Coelacanth Environment Programme
ACLME	Agulhas Current Large Marine Ecosystem
ASCLMEs	Agulhas and Somali Current Large Marine Ecosystems
CBD	Convention on Biological Diversity
CB&T	Capacity Building and Training
CBOs	Community-based Organizations
CCRF	Code of Conduct for Responsible Fisheries
COI	Indian Ocean Commission
CORDIO	Coral Reef Degradation in the Indian Ocean
CRC	University of Rhode Island Coastal Resources Centre
DEAT	Department of Environmental Affairs and Tourism (South Africa)
DIM	Data and Information Management
DLIST	Distance Learning and Information Sharing Tool
DSS	Decision Support System
EAC	East African Commission
EAME	East African Marine Ecoregion
EET	Environmental Endowment Trust
EIA	Environmental Impact Assessment
ENSO	El Niño Southern Oscillation
FAD	Fish aggregating device
FAO	Food and Agricultural Organization
GCRMN	Global Coral Reef Monitoring Network
GEF	Global Environment Facility
GEMPA-EA	Group of Experts in Marine Protected Areas for Eastern Africa
GIS	Geographic Information System
GIWA	Global International Waters Assessment
GOOS	Global Ocean Observing System
GPA	Global Programme of Action for the Protection of the Marine Environment from Land-based Activities
ICRAN	International Coral Reef Action Network
ICRI	International Coral Reef Initiative
ICZM	Integrated coastal zone management
IFREMER	(Institut Français pour la Recherche et l'Exploitation de la Mer)
IMS	Institute for Marine Sciences, Dar es Salaam, Tanzania
IOC	Intergovernmental Oceanographic Commission
IOTC	Indian Ocean Tuna Commission
IUCN	The World Conservation Union
IW	International Waters
IW:LEARN	International Waters Learning Exchange and Resource Network
LME	Large Marine Ecosystem
MA	Modular Approach to LME Management
MCM	Marine and Coastal Management Division of the DEAT (South Africa)
MDGs	Millennium Development Goals
M&E	Monitoring and Evaluation
MODIS	Moderate Resolution Imaging Spectroradiometer
MPA	Marine Protected Area
MPRU	Marine Parks and Reserves Unit
NBSAP	National Biodiversity Strategy and Action Plan
NEAP	National Environmental Action Plan
NEMC	National Environment Management Council (Tanzania)
NEPAD	The New Partnership for Africa's Development

NFP	National Focal Point
NGFPA	National Government Focal Point Agencies
NGO	Non-Governmental Organization
NOAA	National Oceanographic and Atmospheric Administration (USA)
NORAD	Norwegian Agency for Development Cooperation
OAU	Organization for African Unity
ORI	Oceans Research Institute (Durban, South Africa)
PA	Programmatic Approach for the Agulhas and Somali LMEs
PC	Project Coordinator
PDF	Project Development Facility
PIR	Project Implementation Review
POPs	Persistent Organic Pollutants
PPER	Project Performance and Evaluation Review
PSC	Project Steering Committee
QA	Quality Assurance
QC	Quality Control
SADC	South African Development Community
SAP	Strategic Action Programme
SCLME	Somali Current Large Marine Ecosystem
SeaWiFS	Sea-viewing Wide Field-of-view Sensor
SIDS	Small Island Developing States
STAP	Science and Technical Advisory Panel of the GEF
SWIOFC	Southwest Indian Ocean Fisheries Commission
SWIOFP	Southwest Indian Ocean Fisheries Programme
TAFIRI	Tanzania Fisheries Research Institute
TDA	Transboundary Diagnostic Analysis
TOR	Terms of References
TPR	Tri-partite Review
UNCLOS	United Nations Convention on Law of the Sea
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNOPS	United Nations Office for Project Services
WB	World Bank
WCS	Wildlife Conservation Society
WIO	West Indian Ocean
WIO-LaB	UNEPGEF Project: Addressing land-based activities in the Western Indian Ocean
WIOMSA	West Indian Ocean Marine Sciences Association
WIOTOC	Western Indian Ocean Tuna Organisation Convention
WMU	WIO-LaB Managing Unit
WWF	World Wide Fund for Nature

SECTION 1: PROJECT RATIONALE

PART I: SITUATION ANALYSIS

1. The West Indian Ocean (WIO) region includes 10 countries and dependencies[1] (See **Table 1** below for data on land and sea areas). The region encompasses two of the world's 64 identified Large Marine Ecosystems (LMEs), the Agulhas Current LME and the Somali Current LME (see **Figure 1** for location). The Agulhas Current LME (ACLME) in the South is a typical western boundary current system, the largest of its kind in the World. It includes the Agulhas Current proper which runs westwards along the east coast of South Africa, as well as its source regions in the Mozambique Channel and east of Madagascar. The Somali LME (SCLME) extends geographically south-to-north from the Comoros Islands and the northern tip of Madagascar to the horn of Africa. A large number of ocean currents predominate - notably the Zanzibar Current, South Equatorial Current, the East Madagascar Current, and the East African Coastal Current. During the southwest monsoon, the SCLME becomes one of the most intense coastal upwelling systems in the world, bringing rich nutrients to the surface waters. The SCLME supports a sizable pelagic tuna fishery. Similarly, the ACLME is an area characterized by dynamic nutrient cycling and upwelling cells with coupled fisheries potential. However, many of the ecosystem-related functional areas, such as upwellings, larvae recruitment zones, nurseries and breeding grounds, areas that demonstrate resistance to coral bleaching, etc., are generally poorly known, despite their great ecological and economic importance for the region.

TABLE 1: ASCLMEs COUNTRY BACKGROUND DATA (2003 DATA, WORLD BANK)

Country	Land Area km2	Coastline km	EEZ km2	Population millions	GDP US$ billion
Comoros	217	427	100,000 (est)	0.6	0.32
Kenya	586,000	640	100,000 (est)	31.3	13.8
Madagascar	587,000	4,500	1,150,000	17	6
Mauritius	1,860	276	1,500,000 (est)	1.2	5
Mozambique	800,000	2,700	400,000 (est)	18.8	4.3
Seychelles	455	600	1,300,000	0.08	0.72
Somalia	637,000	3,320	600,000 (est)	9.6	No Data
South Africa	1,220,000	2,798	540,000 (est)	45.3	159.8
Tanzania	945,000	1,424	280,000 (est)	36	9.9

2. Available knowledge indicates that the ASCLMEs region encompasses a high degree of biodiversity and endemism. Both LMEs are considered to be moderately productive based on global primary productivity estimates[2]. The LMEs have been characterized by GIWA as being severely impacted in relation to the overexploitation of fisheries. However, statistics are generally poor, and the precise impact of fishing methods is still speculative. There are clear gaps in the understanding of coastal and marine ecosystems within the ASCLMEs.

3. New information[3] is now coming to light regarding the ASCLMEs area which is altering the previous understanding of the complex ocean-atmosphere dynamics in the region and their relationship to ecosystem functions such as productivity, larval transport and fisheries. Previously unknown channels (some over 10km in width and over 100 m deep) have recently been discovered around the Mascarene Plateau (East of Madagascar) which influence the flow of the South Equatorial Current and associated nutrient and productivity relationships. Species of invertebrates that are new to the area are being discovered and it is expected that many taxa new to science would be identified after analysis of recent collections. Extensive areas of previously unmapped seagrass

[1] The region includes 8 countries, eligible for GEF financial assistance: Comoros, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, South Africa, and Tanzania. The region also includes Somalia and the French Indian Ocean dependencies.

[2] SeaWiFS global primary productivity estimates

[3] Presented at a recent (2004) Discussion Meeting at the Royal Society, London reviewed current knowledge of the Atmosphere-Ocean-Ecology Dynamics in the Western Indian Ocean

beds and shallow coral reefs have also been identified. Scientists conclude there is still a great lack of information about the area, not only in absolute terms, but also relative to other oceans such as the Pacific. In order to develop systematic management frameworks for the LMEs and their constitute habitats, a better integration of the information on ecology, oceanography, biophysics and human requirements is needed, as is data in areas where it is lacking and a better understanding of the complex interactions and linkages among the various marine ecosystems.

4. Better prediction of climatic and oceanographic variability (essential, for example, in the context of rain-fed agriculture, watershed welfare and the management of sustainable marine resources use) is of critical importance to the developing countries of this region. There is also an urgency to synthesise accurate data on the state of the region's artisanal fisheries and its linkages to the physicochemical and biological functions within the LMEs as well as its interactions with the offshore commercial fisheries. Furthermore, there is inadequate data regarding larval transportation and the distribution and welfare of important nursery areas around the coastlines of the LMEs. All of these gives strong justification and impetus to the urgent requirement for gathering baseline information and developing coordinated monitoring and observation systems, as needed to provide a management framework.

5. A global effort is currently underway led by the World Conservation Union (IUCN), the Intergovermental Oceanographic Commission (IOC) of UNESCO, other UN agencies (including UNDP, UNEP and the World Bank) and the United States' National Oceanic and Atmospheric Administration to improve the long-term sustainability of resources and environments of the world's LMEs. Further information on this initiative can be found on the LME website at www.edc.uri.edu/lme. This website lists details regarding the current status of each of the world's LMEs and notes that within the ASCLMEs region there is a need to implement monitoring efforts on spatial and temporal scales to identify the ecosystem effects of climate change and to discover the major driving forces causing large scale changes in biomass yields. The site further concludes that research assessment and management Programmes need to be implemented in order to address long-term governance concerns. The GEF has developed a strategy (based on lessons from its Benguela Current LME Project) for undertaking such recommended assessments (particularly in areas like the ASCLMEs region where data is limited) and then using this vital information to inform a standard process of Transboundary Diagnostic Analysis (TDA) which in turn provides the foundation for the development of a Strategic Action Programme for cooperative management and better regional governance of LMEs.

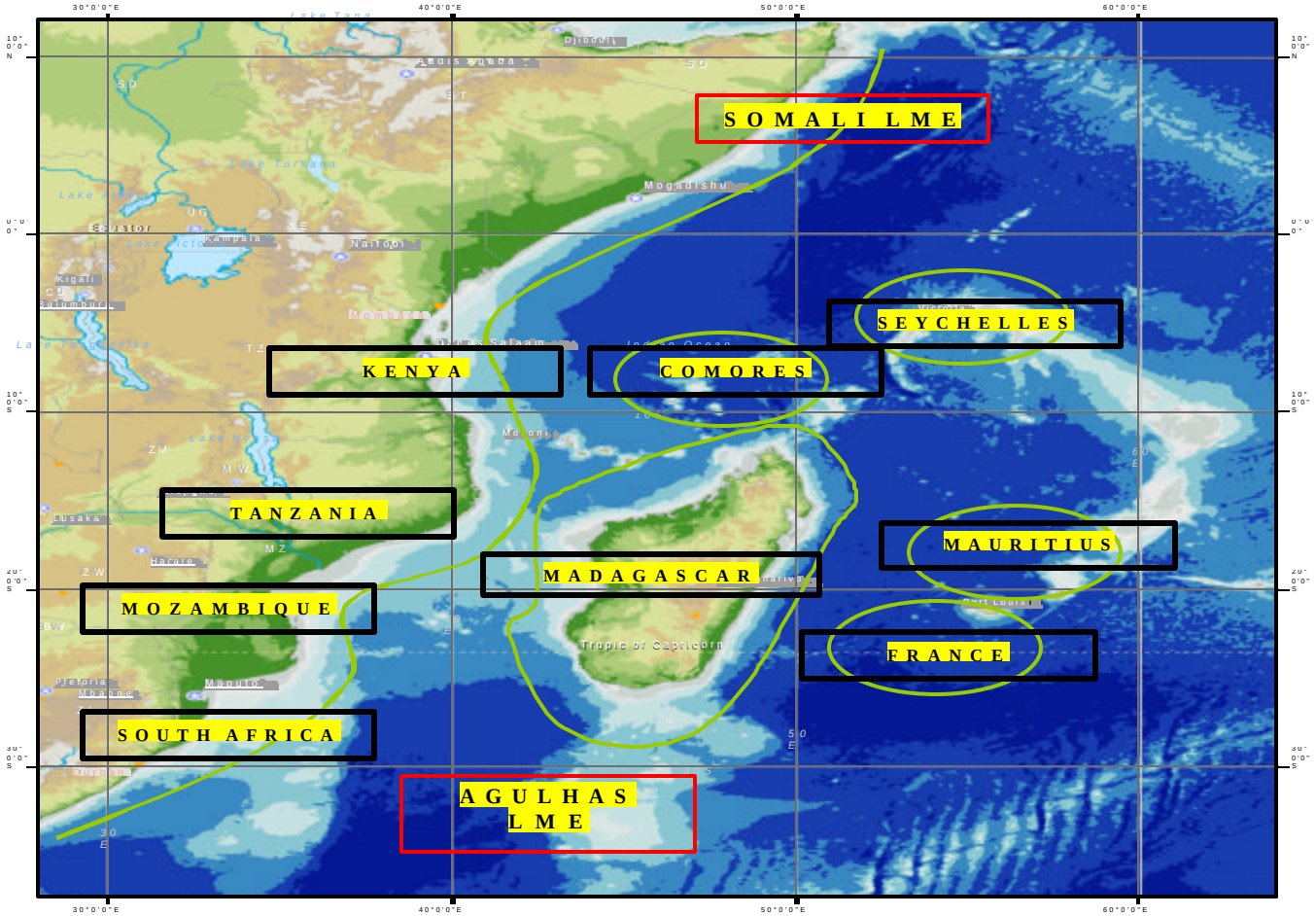
6. Figure A (below) shows the area surrounding the ASCLMEs and constitutes the approximate System Boundary for the Proposed Project. Figure B outlines the currently established geographic contours of the LMEs.

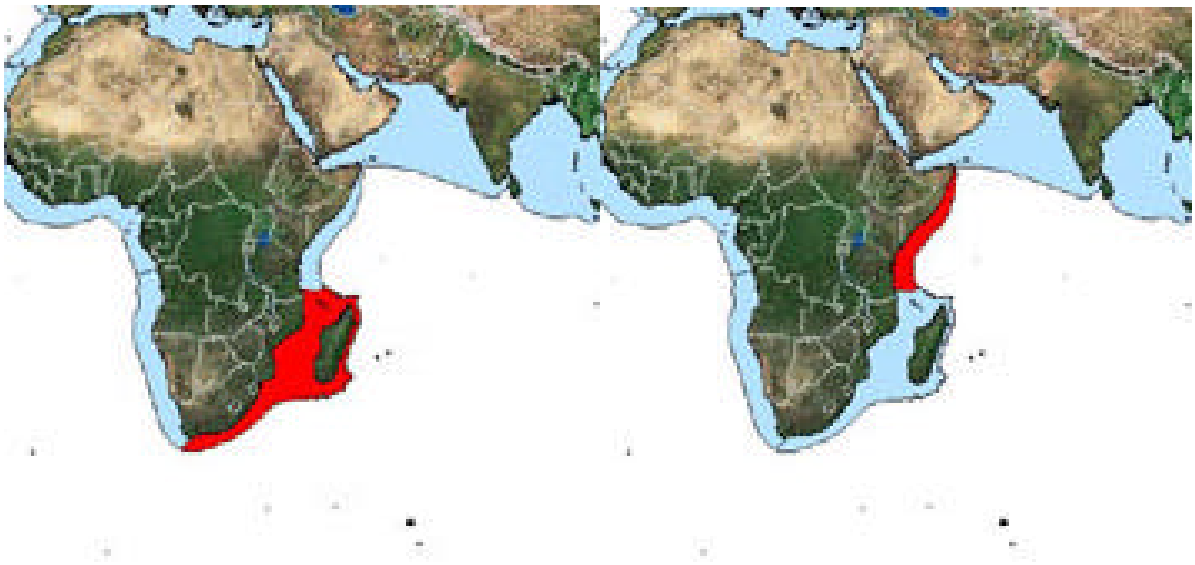
BACKGROUND - PHYSICOCHEMICAL INFORMATION

7. The two identified LMEs addressed by this project sit within the western Indian Ocean region along the eastern coastline of Africa with the ACLME to the south and the SCLME to the north. (see Figure B). This oceanic region harbours a variety of submerged geomorphological features, including abyssal plains, oxygenated slopes and basins, mid-ocean ridges seamounts and ocean trenches[6]. Some of the deep ocean trenches range from 6,000 to 7,000 metres in depth. Continental shelves in the region tend to be narrow in the north, along the Somali coast, and gradually widen further to the south. The average depth of these shelves range from 200-300 meters. The region has a number of key geographic features, which influence the biological and physicochemical environment. These include the Mascarene Plateau which extends as a fault-composite arc for 2300 km from the Equator southward, with water depths ranging from 0 to 100 m.[7] . The Plateau acts as a barrier to latitudinal water flows and is therefore of distinct, regional importance and almost certainly influences both the ACLME and the SCLME.

[2] Spencer et al 2005
[4] Gallienne, C.P. and D. Smythe-Wright, 2005
[5] New et al, 2005
[6] Bablan Ingole and J. Anthony Koslow, Indian Journal of Marine Sciences, Vol. 34 (1), March 2005.
[7] Rolph Payet. The Royal Society Press (In-press).

FIGURE A: **MAP OF THE ASCLMES REGION SHOWING PARTICIPATING COUNTRIES, CONTINENTAL SHELVES AND HIGH SEAS**





AGULHAS CURRENT LME **SOMALI CURRENT LME**

FIGURE B: MAP OF AFRICA AND INDIAN OCEAN SHOWING POSITIONS OF AGULHAS CURRENT AND SOMALI CURRENT LMES (IN RED)

8. The prevailing wind regimes can be divided into two distinct systems: the monsoon regime that dominates the Somali Current LME), and the subtropical high-pressure system that dominates the southern part (the Agulhas Current LME). The Northeast Monsoon affects the climate of the northern Indian Ocean from December to April and is characterized by northeasterly winds over the tropics and northern subtropics. The Northeast Monsoon has winds of moderate strength, with dry terrestrially derived air and the wind direction tends to be from Arabia to Madagascar. In contrast, during the months of June to October, the Southwest Monsoon reverses the wind direction and the winds then tend to be much stronger, with an intense wind jet developing along the high east African mountains. However, strong winds blow steadily over the entire western Indian Ocean north of the equator. During the summer disturbances in air pressure and wind movement frequently create cyclones. These cyclones can intensify to become hurricanes that move in a westerly direction. Those that make landfall generally do so over Mauritius, Madagascar or Mozambique and can cause extensive wind damage and flooding, with an attendant loss of life. The subtropical part of the region to the south is dominated by the normal high-pressure system prevalent in these latitudes. The pressure differences prevailing in the region cause the Trade Winds that are geographically uniform over the western Indian Ocean, but stronger than those prevailing in other oceans. The wind patterns in the Indian Ocean are primarily influenced by its geography and, in particular its proximity to two large continental masses.

9. The Agulhas Current is the western boundary current of the South Indian Ocean and flows down the east coast of Africa from 27°S to 40°S[8]. The source water for the current derives from he Mozambique Channel eddies[9] and the East Madagascar Current with the greatest source of water arriving through re-circulation of the southwest Indian Ocean sub-gyre[10]. The movement and direction of the current varies both seasonally and geographically across its extent. Generally, it is limited to the top 2,300m of the ocean[11] but this depth limit increases with increasing latitude and there is a further seasonal variation causing oscillation in sea surface height within the current. The main variability within the Agulhas Current are the large, solitary meanders (natal pulses)[12] which occur about 6 times per year. These then spawn an Agulhas ring that subsequently moves into the South-East Atlantic Ocean. The warm-water link between the Indian and South Atlantic Oceans is likely to have a strong influence on global climate.

10. The Somali Current, the western boundary current of the northwest Indian Ocean, reverses direction with season. During the Northeast Monsoon, the Somali Current flows south and meets the north flowing coastal Zanzibar Current (which derives from the South Equatorial Current). With the transition from Northeast to Southwest monsoons, an intense Indian Equatorial Jet (EJ) develops within these waters. The behaviour and effect of this jet is still not well known, however studies show that the jet generally appears between April and June for short (one-month) periods. The jet may result in a physical forcing although its influence on productivity is still not well understood. The Zanzibar Current's geographical extent is seasonally determined so that its interaction with the Somali Current shifts southward as the Monsoon progresses[14]. During the Southwest Monsoon the Zanzibar Current strengthens causing the Somali Current to change direction and flow northward as an intense coastal jet that may reach velocities of 3.5 meters per second. The flow trajectory along the coastline is complex and a strong upwelling cell develops as a result. Two coastal upwelling gyres also develop which combine as the monsoon intensifies. By the time the Southwest Monsoon peaks in August the Somali Current is established as a continuous current running from the Zanzibar Current (south) to the East Arabian Current (north). Nutrients and primary

[8] Gordon, 1985

[9] de Ruijter et al., 2002

[10] Gordon, 1985; Stramma and Lutjeharms, 1997

[11] Donohue et al., 2000

[12] Bryden et al., 2003, Lutjeharms et al., 2003, Van Leeuwen et al., 2000

[13] An interesting aspect of the Agulhas Retroflection is that it periodically sheds pinched-off anticyclonic rings 320 km. in diameter at its westernmost extension. These rings enclose pools of relatively warm and saline Indian Ocean water whose temperature is more than 5°C warmer and salinity 0.3 psu greater than South Atlantic surface water of similar density (Gordon, 1985). The rings keep their distinctive thermal characteristics as far west as 5°E and as far south as 46°S, and they drift into the South Atlantic at approximately 12 cm s^{-1} (Lutjeharms and van Ballegooyen, 1988).

[14] The surface waters of the Zanzibar Current are prevented by the Monsoon from moving northward during this season; at depth however, the current continues as an undercurrent below the Somali Current.

productivity in the surface waters are generally low, although this is seasonal with higher values being associated with surface waters in the upwelling areas.

11. However, new studies and research[2] are replacing the traditional view (inter-seasonal and inter-annual climate variability in the Agulhas and Somali Current LMEs (ASCLMEs) region, and particularly the cycle of seasonally reversing monsoon winds) with a more complex picture of long-term air-sea interactions and ocean-atmosphere dynamics. One of the most notable forcing agents behind these climatological and oceanographic boundary changes is the Mascarene Plateau which interrupts the westward flow of the South Equatorial Current and consequently determines the fluxes of water, nutrients and biogeochemical constituents – the essential controls on ocean and shallow-sea productivity and ecosystem health. The Plateau extends in range some 2,000 km from the Seychelles in the north to Reunion in the south and covers an area of approximately 115,000 km^2 with water depths ranging from 8-150 metres. At its edge it plunges some 4,000 metres to the abyssal plain. Recent data from the Mascarene Plateau[15] indicate support for the theory that an open-ocean upwelling system is associated with this area. Further evidence[16] shows that the flow of the South Equatorial Current delivers high levels of nutrients to the waters of the central and northern Plateau regions, which may be responsible for higher levels of productivity in these areas all the way up the food chain. There is growing evidence that the Mascarene Plateau area may represent a separate LME in its own right.

12. There is limited information available on the wider chemical oceanography of the ASCLMEs region. The area is considered to be very oligotrophic and characterised by low nutrient concentration, low phytoplankton biomass and a predominance of regenerated production. Ammonium is found to be the major nitrogen substrate supplying between 50-99% of the phytoplankton nitrogen requirements. Nutrient levels do vary seasonally, especially between the monsoons. The Indian Ocean generally is subject to large variations in salinity as a result of drastic changes in rainfall both seasonally and from year to year (again, associated with the monsoons). Sea surface salinity is affected by rainfall, but is also affected by anomalous anticyclonic winds blowing in the southeast Indian Ocean block the transport of saltier water out of the western Indian Ocean. Winds in the region are seen to effect salinity and rainfall both of which are linked to El Nino events.

13. Annex 2 provides a summary of the present day oceanographic knowledge within the ASCLMEs region. Maps depicting the surface currents of the ASCLMEs appear below in Annex 7.

BACKGROUND – BIOLOGICAL CONTEXT

14. The region's mangroves, seagrass beds and coral reefs reflect a high degree of biodiversity and endemism and, along with beaches and estuaries, serve as a home, breeding ground and/or nursery areas for many species (see www.edc.uri.edu/lme for references). Ocean currents in the area disperse the larvae of fish and crustaceans from spawning areas to other habitats, and thus play an important role in recruitment. The exact dispersal mechanisms and range of species remain poorly known, and associated ecological and physical processes need to be studied. However, the inshore current is thought to play an important role in larvae dispersal in the Somali Current LME, along the coastlines of Kenya and Tanzania, while in the Agulhas Current LME, the South Madagascar upwelling is thought to supply recruits for parts of the Mozambique Channel (Lutjeharms, 2004). The Angoche upwelling, off the coast of Mozambique is thought to be similarly important in this regard (ibid). This also holds true for coral dispersion where it is now generally accepted that one reef system can provide the spawning recruitment for another reef system some hundreds of miles down-current. A better understanding of these processes is needed in order to identify priority areas for conservation endeavours, while improving the ability to adapt fisheries management in the face of environmental variability. Several studies have indicated that the Agulhas Current is responsible for the dispersal of the early life history stages of various fish species. Both the ACLME and the

[2] Spencer et al 2005
[15] Gallienne, C.P. and D. Smythe-Wright, 2005
[16] New et al, 2005
[17] Tomczak, Matthias & J Stuart Godfrey: Regional Oceanography: an Introduction 2nd edn (2003)
[18] Abbreviations include those for the East Arabian Current (EAC); South Java Current (SJC); Zanzibar Current (ZC). Other abbreviations denote Fronts and include the Subtropical Front (STF); Antarctic Polar Front (PF) and the Weddell Gyre Boundary (WGB)[18].

SCLME are Class II, moderately productive ecosystems (150-300gC/m^2-yr) based on SeaWiFS global primary productivity estimates. Little is documented on seasonal fluctuations in zooplankton within these LMEs.

15. Over 11,000 marine fauna are currently recorded from the western Indian Ocean region (island states included). The species inventory is however incomplete, and there are large gaps in the data set. Existing data are based largely on fragmented shallow–water surveys. The benthic invertebrates of deeper waters, especially those of the continental slope and abyssal zone, remain virtually unexplored[19]. Beyond the thirty meter gradient little is known about species diversity and population densities, and within the thirty meter gradient much remains to be described. According to some projections, less than 50% of the marine species actually present have been described and that, at existing rates of description, it will take 200 years to fully describe the remaining fauna (Griffiths, Indian J, Mar. Sci. In press). The region has a high diversity of marine life[20], from phytoplankton and zooplankton that drive the fisheries, through several thousand species of larger invertebrates and fish of which many (such as tuna, lobster, shrimp, oysters, clams, etc.) are of economic significance, to charismatic species such as the Coelacanth, dugong, turtles and many species of cetaceans. There are also important seabird populations, particularly on the offshore islands.

16. Seagrass beds, coral reefs and mangrove forests provide important critical habitats of high diversity within the ASCLMEs. Of the 50 globally described seagrass species, 13 are found in the Mascarene Plateau area[22]. Preliminary data from the *Shoals of Capricorn* Marine Programme indicate very large, previously uncharted, seagrass beds in the Mascarene Plateau (Burnett *et al.* 2001). Coral reefs are founds throughout the area providing important habitat for fish, invertebrates and lower organisms. These include fringing and patch reefs along the coast and offshore islands, although these are broken around river outlets. The region is characterized by high endemism amongst the coral fauna. The total predicted number of coral species in the western Indian Ocean is over 370 (UNEP-WCMC). Coral reef status has been assessed along the coastline of East Africa[23] and throughout the Indian Ocean Island States[24]. Coastal reefs cover an area in total of just under 7,000 km^2. Mangrove forests are found mainly in nutrient rich river estuaries, including the estuaries of the Limpopo, Zambezi and Rufiji and Tana Rivers. These habitats are critical fish spawning and nursery areas, and provide other vital ecological services, such as shoreline shelter from ocean swells.

17. Seamounts may be rare within the ASCLMEs or around the Mascarene Plateau, but so little is known regarding the bathymetry and topography of certain areas within the region (especially the Mascarene Plateau) that lack of knowledge of the presence of seamounts may be a reflection of the general lack of knowledge for this area.

BACKGROUND – SOCIO ECONOMIC CONCERNS

18. 160 million people reside in countries bordering the ASCLMEs area while the overall coastal population in the region (including the islands) is estimated at some 55 million. The region is characterised by some of the highest poverty levels in the world. This population is greatly influenced by environmental phenomena linked to the Indian Ocean. Most nations in the area place great reliance on the sea to assure food security through the harvest of living marine resources for subsistence and employment including from artisanal fisheries, transport and coastal tourism industries.

[19] Ibid

[20] Ibid
[21] Western Indian Ocean Environment Outlook, Global Environment Outlook 2000, UNEP.
[22] Ibid
[23] Obura et al, 2005
[24] Ahamada et al, 2005
[25] Obura et al, 2005
[26] Ahamada et al, 2005
[27] Turner, J. and R. Klaus, 2005.
[28] The Royal Society. 2005.

19. The Agulhas and Somalis Current LMEs support regionally important fisheries, with industrial fishery landings of approximately 280,000 metric tones per annum (FAO 2002)[29]. The main industrial fisheries include the tuna fisheries, and smaller fisheries for orange roughy, squid, lobster and prawns. The fishing industry provides a significant contribution of foreign exchange to the region. Fisheries exports of US$943 million significantly surpassed imports of US$227 million in 2002. Catches by vessels of non-African states represent about 25 to 30 percent of fish catch. Commercial fishing for shrimp and for pelagic species such as tuna have secondary effects in their impact on other species such as cetaceans and turtles, while processing factories and port developments have an impact on the coastal zone in terms of pollution, habitat destruction and the concentration of people. Meanwhile, data suggests fishing effort is escalating, especially by distant fishing nations operating in international waters. Inevitably this expanding fishing effort will focus on the upwellings and higher nutrient and productivity areas associated with the Agulhas and Somali Current LMEs and the Mascarene Plateau. However, most of the region's fisheries go unreported in global statistics, largely due to their unregulated and informal nature.

20. Fish often represent the primary source of animal protein for many local communities in the region. Nutritionally, fish are an important source of protein, especially where other sources of animal protein are scarce or expensive. This is particularly the case in the Small Island Developing States (SIDS). The share of fish to animal protein exceeds 50% in Seychelles and Comoros and is greater than 20% in all countries except Kenya, South Africa and Madagascar. Rice, maize, wheat and cassava make up the bulk of the food consumed by the people of the region. However there are essential micro-nutrients not found in these staples or found only in small quantities, for example iron, iodine, zinc, calcium, and vitamin A. Symptoms of these deficiencies in the region include goitre. Fish are particularly rich in these micronutrients, for example iodine, and also contribute fatty acids necessary for the development of the brain and body. The importance of fish in the diet of a population is therefore now widely recognized, especially for the diets of young children, infants and pregnant women. Further, fish harvesting, processing and marketing generates livelihoods, employment and income for approximately 2.2 million people along the coast of the ASCLMEs. Although employment cannot be taken as a firm assurance of food security, artisanal fisheries exist in coastal areas where alternative employment opportunities are scarce. The sector thus makes a key contribution to household welfare (including both subsistence and income generation).

21. Artisanal and subsistence fishers take a much wider range of fish and invertebrates than do industrial/commercial fisheries. This is because small-scale fishers of the region are resourceful in developing different fishing techniques to take advantage of every possible niche available for harvesting. More than 100 artisanal fishery types have been identified and described for the region which range from passive trap fishing to labour-intensive seine netting and spear fishing[32]. The IOTC estimate that artisanal fishermen now take as many of the 16 tuna species in the Indian Ocean as a whole as do the industrial fleets. This may serve to highlight the significance of the need for a clear definition between artisanal and subsistence fishermen. Artisanal fishing, which generally requires low financial capital inputs, often constitutes the basis of a diversified livelihood strategy for coastal communities. It can help to i) spread risks between various economic activities in an uncertain environment and therefore reduce vulnerability, ii) create a synergy with other livelihoods and enhance capital accumulation, and iii) generate cash. Fishing, even as a secondary activity is therefore important for the generation of income for coastal communities along a large swathe of the region's coastline. Most of the region's 236,000 fishers use low technology gear (harpoons, hand lines, traps, seines and nets) that take a diverse catch of fish and invertebrates, including, at times, other marine animals (e.g. turtles). One of the main social concerns relating to artisanal fisheries

[29] This estimate does not take to account takings from distant water fishing fleets in international waters and does not take full account of artisanal fisheries. According to other estimates, the total catch including subsistence, artisanal and industrial landings, and takings by distant water fishing nations in international waters, approaches 4 million metric tones[29] per year (Van der Elst, 2004).

[30] These rates of growth contrast with growth in urban centers which is particularly high, and the total resident population in these areas is expected to double in about 25 years. Mombassa, Dar es Salaam, and Maputo are for instance, registering growth rates of 5.0%, 6.7% and 7.2% per annum respectively.

[31] This estimate does not take to account takings from distant water fishing fleets in international waters and does not take full account of artisanal fisheries. According to other estimates, the total catch including subsistence, artisanal and industrial landings, and takings by distant water fishing nations in international waters, approaches 4 million metric tones[31] per year (Van der Elst, 2004).

[32] Western Indian Ocean Environment Outlook. 2000

is the need to improve the social and economic situation of traditional fishing communities. There is considerable evidence that such communities are amongst the poorest segments of society in the region. This situation is getting worse as the number of artisanal fishermen increase as a reflection of the lack of alternatives within the local economies.

22. The problem of poverty has been aggravated by recent drought situations that have hit parts of the region in recent years, manifested in recurring food crises. Poverty and food security are linked concepts. People who are chronically poor usually lack access to food. Additionally, malnutrition negatively affects people's working and learning capacity, and may affect vulnerable groups living just above the poverty threshold, causing them to enter the ranks of the poor. Poverty in the region is particularly acute among vulnerable groups such as households headed by the elderly and children (that are now on the increase due to the impact of the HIV/AIDS pandemic). Fisheries workers are a group highly vulnerable to HIV/AIDS, often as a result of the migrant nature of their work. Increased understanding of the nature of the fisheries in the region, in particular near-shore fisheries will serve to enhance their management. This will ensure that fish remains an important food source for coastal communities over the long-term horizon. This is especially important on the African coastline where HIV/AIDS infection rates can be as high as 20-25% and where the compound effects of morbidity from the illness and malnutrition (i.e. from food crises) is leading to high mortality amongst vulnerable groups.

BACKGROUND - POLICY AND INSTITUTIONAL CONTEXT

International, regional and national policy frameworks

23. Environmental management activities in the region are aligned with a number of global and regional policy frameworks. Table 2 summarizes the key policy frameworks pertaining to the ASCLMEs region.

TABLE 2: AGULHAS & SOMALI CURRENT LMES COUNTRY PROFILES – INTERNATIONAL AGREEMENTS

Convention / membership	Somalia	Kenya	Tanzania	Mozambique	South Africa	Madagascar	Comoros	Seychelles	Mauritius	France	EU
UNCLOS III (1982)	X	X	X	X	X	X	X	X	X	X	X
Nairobi (UNEP)	X	X	X	X	Soon	X	X	X	X	X	X
FAO Code declaration	X	X	X	X	X	X	X	No	X	X	X
Straddling stocks	No	No	No	No	X	No	No	X	No	X	X
SWIOFC		X	X	X	X	X	COI BLOCK OF 'TUNA COUNTRIES' X				X
IOTC	No	No	No	No	No	X	No	X	X	X	
WIOTOC	No	No	No	X	No		X	X	X		
COI	No	No	No	No	No	X	X	X	X	X	X

Convention / membership	Somalia	Kenya	Tanzania	Mozambique	South Africa	Madagascar	Comoros	Seychelles	Mauritius	France	EU
EAC	**No**	**X**	**X**	**No**	**No**	**No**	**No**	**X**	**No**	**No**	**No**
SADC	**No**	**No**	**X**	**X**	**X**	**Soon**	**No**	**No**	**X**	**No**	**No**

24. Table 3 describes the regional institutions established to give effect to these frameworks.

TABLE 3: INSTITUTIONAL CONTEXT - REGIONAL INSTITUTIONS

Institutions	*Member Countries*	*Function/Mandate*
The Nairobi Convention	All participating countries of the project	To protect and manage the marine environment and coastal areas of the Eastern African region.
New Partnership for African Develop. (NEPAD)	All participating countries of the project	Development of a common and integrated regional platform for the management of marine and coastal resources as a model in Africa. Establishment of an Africa environmental resource centre under consideration.
South African Dev. Community (SADC)	Mozambique, South Africa, Seychelles, Tanzania	Marine Fisheries and Resources Programme aims at the development of marine fisheries in the SADC region. SADC supports a fisheries monitoring Programme in several member countries.
Indian Ocean Commission (IOC)	Comoros, Madagascar, Mauritius, Seychelles	Improve living standards in the participating countries. Promote cooperation in diplomacy, economy, trade, agriculture, fishing, and the conservation of resources and ecosystems.
Indian Ocean Tuna Commission (IOTC)	Australia, China, Comoros, Eritrea, European Community, France, India, Islamic Republic of Iran, Japan, Kenya, Republic of Korea, Sultanate of Oman , Madagascar, Malaysia, Mauritius, Pakistan, Philippines, Seychelles, Sri Lanka, Sudan, Thailand, United Kingdom and Vanuatu.	The IOTC is an intergovernmental organization mandated to manage tuna and tuna-like species in the Indian Ocean and adjacent seas. Its objective is to promote cooperation among its Members with a view to ensuring, through appropriate management, the conservation and optimum utilization of stocks.
Southwest Indian Ocean Fisheries Commission (SWIOFC)	Commission recently formed. Mandate developed and agreed upon. First meeting held and operations recently begun. Steering Committee comprised of Seychelles, France, E.C., Australia and New Zealand. Membership is open to any country within or bordering the SWIO, from Somalia to South Africa.	Functions proposed include measures intended to: Ensure long-term conservation of fisheries resources through application of an ecosystem approach; prevent or eliminate over-fishing and excess fishing capacity; apply a precautionary approach consistent with the FAO Code of Conduct and the 1995 Agreement; maintain fish stocks at levels that are capable of producing maximum sustainable yield, and rebuild stocks to those levels; ensure that fisheries practices and management approaches take due account of need to minimize harmful impact on the marine environment; protection of biodiversity; and give full recognition to the special requirements of developing States.

25. Much work needs to be done to introduce ecosystem-based assessment and management to ASCLMEs countries. The policy framework for national ecosystem management is generally insufficient: all eight countries have national environmental plans and most countries have fisheries master plans; however, the international coordination of these plans through the participation of all stakeholders in the transboundary diagnostic analysis (TDA) and the strategic action plan (SAP) processes for these adjoining large marine ecosystems has not yet been undertaken. Several countries have instituted near-shore governance mechanisms or institutional structures to

manage marine and coastal resources, but these have yet to be harmonized in international agreements regarding standardization of ecosystems condition assessment indicators, and the prioritisation of agreed upon actions on which success depends. Some likely plans are embedded in integrated coastal zone management initiatives. Common policies and actions under development or adopted by countries throughout the region include:

- National Fisheries Management Strategies to promote sustainable and responsible fisheries development, optimisation of sector benefits, development of fisheries-related MPAs, resolution of conflicts within and between artisanal and commercial fisheries, and improved monitoring and data collection to underpin the management of commercial fishing operations.
- Development of integrated ecosystem conservation and management approaches through management of coastal pollution, expanding the network of MPs, monitoring and control of coastal development, general monitoring of the coastal environment (including coral reefs and ecotoxicology)
- Promoting the involvement of coastal communities in a fair and equitable manner to achieve socially and economically sustainable resource exploitation and management.
- Promotion of sustainable development and economic recovery plans linked to the protection and maintenance of ecosystem functions.

26. Specific relevant policies in the participating countries are summarised in Annex 3.

THREATS TO THE LMEs

27. Human induced pressures on the ASCLMEs are increasing at an accelerating pace. There are four primary threats to the ecological integrity of the ASCLMEs, namely:

- Human induced habitat destruction and alteration of the marine environment;
- Pollution of the marine environment;
- Overexploitation of fisheries resources; and
- High by-catch and incidental mortality of marine fauna in commercial fisheries operations; and adverse consequences related to anthropogenic related environmental variability within LMEs.

Table 4 provides a more detailed description of these threats.

TABLE 4: DESCRIPTION OF THREATS TO THE ASCLMEs

Threat	Description
Human induced habitat destruction and alteration of the marine environment	Habitat destruction is manifest in the degradation of seagrass, loss of mangroves and damage to coral reefs. The severity of habitat disturbance varies throughout the region, with 'hotspots' concentrated in areas with high population densities and rates of population increase. Problems are particularly acute around urban and suburban centres. Mangroves are being cleared for mariculture or for salt production. Coral reefs are being mined in certain areas for lime and for construction materials, as well as for the curio trade. In several areas, coral reefs are also being damaged by the use of explosives for dynamite fishing, despite this practice generally being banned.
Pollution of the marine environment	Point and non-point land based pollution of coastal areas in the WIO is a growing problem. Large quantities of fertilizer and pesticides used in agricultural areas gradually make their way to the sea as runoff. Siltation has increased each year as a result of human activities on land such as mining, clearing for agriculture, industry, urban growth and dredging, and this is changing the coastal configurations of river deltas. Mining of titanium and zirconium, and mining-related activities in general, have adverse down stream impacts and disturb sand dune systems, wetlands and estuaries. Marine-based sources of pollution stem from the exploitation of the seabed for oil, minerals, sand and corals. Shipping around Cape Agulhas in South Africa, is exposed to extremes of weather conditions, which greatly increases the risk of major marine pollution incidents, particularly from oil tankers. Ship spills, ballast discharges, bilge washings, offshore oil exploration, and refinery effluents cause oil pollution. This type of pollution is particularly prevalent in the Somali Current LME because it includes major tanker routes carrying oil produced in the Persian Gulf to markets.

Threat	Description
	Pollution from land based and marine sources is often localized, and currents play a major role in transporting pollutants from distant sources. The inshore circulation within the SCLME provides conveyance for the transport of pollutants on the Kenya/ Tanzania coasts, including heavy metals and POPS from industrial centres in the region. In the ACLME, coastal currents running along the shoreline from Maputo in Mozambique through Kwa Zulu Natal in South Africa receive considerable urban and industrial runoff, and pollutants discharged by rivers. These currents are influenced by upwelling cells, which in turn have bearing on pollution transport to areas downstream.
Overexploitation of fisheries resources; and unnecessarily high by-catch and incidental mortality of marine fauna in commercial fisheries operations	Generally artisanal fisheries are considered to be fully or over-exploited in the region, especially near centres of population. There are now few, if any underexploited nearshore areas in the ASCLMEs[33]. Fishing intensities have increased dramatically over the past two decades, as a result of population increase along the coastal fringe. Known demersal and semi-pelagic (non-tuna) resources are generally heavily-exploited inshore and less-exploited offshore, although information on the pressures placed by distant fleet fisheries on the resource is still largely incomplete. Limited potential for increased catches exist except for Madagascar, Mozambique and Somalia where potential for increasing catches of some species may be significant. However, reported catches for Madagascar and Mozambique may actually be underestimates because of the difficulty of estimating artisanal catches over their long coastlines. Prawn fisheries have artisanal as well as industrial sub-sectors. The industrial sub-sectors account for significant export revenue and are limited-access fisheries managed to optimise economic return. Coastal prawn resources are heavily exploited. There is a significant by-catch problem in the ASCLMEs. While actual by-catch tonnage is impossible to quantify (about one-third of reported catch is not identified by species and illegal, unreported and under-reported catch would significantly increase by-catch tonnage) information on by-catch from the shrimp fishery is telling. The Trawl fisheries for shrimps in tropical and subtropical regions generate by-catch of up to 70 % of total catch, since this catch is of lower value than the target species it is normally discarded at sea.
Adverse consequences related to anthropogenic related environmental variability within LMEs	Human forced climate change in the region is increasing environmental variability, with ramifications for weather, fisheries and biodiversity. Oceanographic effects from climate change such as elevated water temperatures and changes in storm frequency have contributed to increased variability in catch and species composition. Increases in sea surface temperatures have had a severe impact on coral fauna, with episodic coral bleaching events tied to El Niño Southern Oscillation phenomena. The incidence of coral mortality following such events has increased dramatically. The coral bleaching events of 1998 reduced hard coral cover throughout much of the ASCLMEs area by between 30-95%. So far, the reefs of the Mascarenes have escaped mass mortality from bleaching, which now increases their conservation significance within the wider Indian Ocean where such mortalities have been widespread, and close to catastrophic in some areas. It is predicted that if management doesn't improve and there are repeated climate-related stresses (which are seen to be inevitable) then most of the reefs in the region will have less than 20% cover by 2014. Furthermore, acidification of the oceans as a result of increased carbon dioxide levels is another serious concern. Ocean acidification is essentially irreversible during our lifetimes. The impacts of ocean acidification on marine organisms and their ecosystems are much less certain. However, there is convincing evidence to suggest that acidification will affect the process of calcification, by which animals such as corals and molluscs make shells and plates from calcium carbonate. The tropical and subtropical corals are expected to be among the worst affected, with implications for the stability and longevity of the reefs that they build and the organisms that depend on them. Other calcifying organisms that may be affected are components of the phytoplankton and the zooplankton, and are a major food source for fish

[33] Some minor areas of the coast of Mozambique and Madagascar excepted. For example, along an isolated stretch of coast between Inhambane (city) and Villanculos.

Threat	Description
	and other animals. Many low-lying coastal areas are extremely vulnerable to sea level rises associated with climate change. This is likely to cause losses in productive coastal lands and threaten wetlands and other coastal habitats. An increase in the frequency and intensity of extreme weather events associated with climate change, including cyclones and droughts is also expected. The degree of environmental variability caused by climate change is expected to be conditioned by ocean-atmosphere links, which remain poorly understood in the region. This is compromising the ability to plan adaptive measures.

28. The NOAA LME site carries background information on each of the World's LMEs for each of the LME modules. The module on Ecosystem health and Pollution ranks the Somali Current LME as severely impacted in the areas of habitat and community modification, and fisheries. The same Module for the Agulhas Current LME lists it as being severely impacted through unsustainable exploitation of fisheries, i.e. overexploitation, excessive non-target species by-catch and discards, and destructive fishing (i.e. use of fine-mesh nets).

29. Although the GIWA process has yet to finalise its assessment of either the Agulhas Current or the Somali Current LMEs, it has reported on the assessment of the Indian Ocean Islands and the vast expanse of ocean between them. The most important transboundary concern identified by GIWA for that area is pollution as in (i) pollution of groundwater, surface water, and wetlands; (ii) risks for human health; (iii) degradation of coastal marine environments (including coral reefs) and tourist attractions such as beaches; (iv) possible disease outbreaks and the destruction of fisheries; (vii) accumulation and toxic effects of leachates; and (viii) eventually impact on the economy.

30. The aforementioned threats have determinants that may be separated into ultimate and intermediate root causes. Ultimate root causes include population increases especially in coastal areas, poverty (four of the participating countries rank among the thirty poorest countries in the world), and anthropogenically-induced climate change. The project is relevant to poverty reduction, and therefore to the amelioration of many of these root causes. These causes lie beyond the scope of this project. Intermediate root causes are capacity related: notably a deficit in capacities at the systemic, institutional and individual levels to manage the ecosystem. The root causes are elaborated in Annex 4. The basic lack of understanding of key LME processes is a major constraint in advancing joint management endeavours. The intermediate root causes are further elaborated in the following analysis of the baseline.

BASELINE ANALYSIS

31. The business-as-usual course of events prevailing over the next 5 years in the absence of GEF intervention, includes the activities of government ministries and institutes and donor activities aimed at managing marine resources at largely national level. These interventions make an important contribution towards the management of coastal and marine resources in the ASCLMEs region, and thus provide an important base in which this project is nested. Table 5 lists the main baseline activities, along with their implementing bodies. Key Programmatic gaps serving as constraints to LME management are highlighted.

TABLE 5: PROJECT-RELATED BASELINE ACTIVITIES

Baseline Activity	Organization/Project/ Programme	Gaps
Oceanographic Assessment Country EEZ based oceanographic research, data and information creation, collection and storage	Government Oceanographic Institutes or oceanographic departments in environment or fisheries ministries	Little or no emphasis on transboundary issues. Very shallow layer of trained oceanographers and limited budgets limit the number of ship cruises and purchase of specialized equipment for non-ship based activities such as GIS based modelling. Limited opportunity for extra-national training. Data and information is nationally based and not generally shared at regional level. Public participation generally not emphasized.

Baseline Activity	Organization/Project/ Programme	Gaps
Training (Physical and Chemical Oceanography and related Ecology/ Biology disciplines). Training of oceanographers Training marine scientists	University based oceanographic and marine sciences advanced degree Programmes	With the exception of South Africa, very low enrolments and limited or no oceanographic or marine sciences Programmes offered in curricula. Retention of university trained scientists very difficult. Limited ability for professional advancement (connected to low retention rates).
Applied Research Marine ecology Bio-indicators Ecosystem modelling Fish inventories Mascarene Plateau	French IRD (THETIS Programme), ECOMAR, IFREMER Shoals of Capricorn Project (RGS). Training in scientific, practical and marine safety skills, in order to support research	Entry level is large pelagic fisheries giving limited breadth to ecosystem based, LME approach. Limited geographic range of interest across the ASCLMEs due to limited membership of project participating countries. Country and regional capacity building emphasis limited in scope. Data and information not generally available at regional level and more narrowly targeted to tuna and other large pelagic fish. Specific focus on Mauritius and Seychelles rather than region as a whole.
Information Management Establishment and maintenance of marine sciences data and information bases. Electronic access to four main gateways of ocean related information	 UN Atlas of the Oceans	Data and information fragmented across institutions. Data sets are not consistent across the region. There is no regional database. Serves as a repository of selected marine based data and information. No operational capacity in the WIO.
Integrated Coastal Zone Management (ICZM) Management of marine biodiversity and natural resources Awareness activities in the CZ Regional Training and Excellence Centres Negotiating capacity Pilot CZM projects	EU IOC/COMESA National activities in Kenya, Madagascar, Mauritius, Mozambique, Seychelles South Africa, Tanzania	No emphasis on offshore areas as needed to ensure LME level management. Data and information will be limited primarily to coastal areas and covering coastal marine resources, as will training and public participation initiatives including awareness building.
Pollution Abatement Coastal zone and EEZ based pollution abatement	Ministries of Environment and related Departments and Agencies	Lack of accurate data baselines to measure relative levels of pollution makes much activity reactive in nature. A shallow layer of trained staff, poor training opportunities, and limited budgets make monitoring and enforcement activity difficult. There is very little interaction among ministry personnel at the regional level, and correspondingly, limited sharing of data sets.
Fishery Management (Stock Assessment) Tuna resource assessment and management including research on and monitoring of stocks, tagging, targeted to tuna and related, large pelagic species	IOTC	Focus is on tuna stocks and no significant emphasis on LME approach. Limited representation of participating countries as many are not IOTC members. No near-shore emphasis. Limited emphasis on country capacity building for LME based investigations. Data and information targeted to tuna and related species. Some data and information likely to be proprietary.
Artisanal Fisheries Improve understanding of small scale fisheries Address destructive fishing practices	Jakarta Mandate (NORAD and IUCN)	No overall emphasis on LME wide science and LME wide management approaches.
Fisheries Management: Control Improved management of fisheries	SADC MCS Programme (EU)	Emphasis limited to fisheries resources. Not all participating countries are members of the SADC thus

Baseline Activity	Organization/Project/ Programme	Gaps
through institutional capacity building in monitoring, control and surveillance		limited geographic scope. Little data and information collected.
Environmental Variability Exploration of causes and effects of coral bleaching and mass mortality of corals in seven countries of the WIO Scattered research on Ocean-atmosphere links and meteorology of the Indian Ocean	CORDIO-SIDA Project	Activities confined to coral reefs and no overall emphasis on LME based management. Information not codified and available to the region
Conservation of Biodiversity Creation of a participating network of MPAs Creation of a working network of MPA managers	WIO-MPA (WWF/FFEM/CI)	Narrow focus on marine and coastal protected areas. Some capacity building but again targeted to MPA personnel. Capacity building and stakeholder involvement primarily tied to coastal zone related management and resource issues.
Awareness Raising Increase public awareness on related issues Plan and conduct targeted research activities of national and regional importance Disseminate information and data aimed at helping to achieve sustainable use	Marine Science for Management Programme (SIDA) and administered by WIOMSA Shoals of Capricorn Project (RGS)	Restricted to coastal environment and no significant emphasis or focus on LME wide management issues or the filling of LME wide knowledge gaps. Project reach limited to Seychelles and Mauritius and limited emphasis on coastal and coral reef based ecology.

32. An earlier version of a TDA was prepared by the UNEP as part of previous PDF-B for the West Indian Ocean. The TDA was described by the UNEP as very preliminary in nature, and that much remains to be done before a TDA and SAP that meets GEF standards is in place. Notwithstanding the very preliminary nature of the existing TDA, the major threats that were identified during the TDA development process are quite similar to those identified by the ASCLMEs and SWIOFP projects during preparation. The UNEP Preliminary TDA identified the following list of major perceived problems and issues. It included four existing problems/issues:

a) Shortage and contamination of fresh water;
b) Decline in harvests of marine and coastal living resources;
c) Degradation of coastal habitats (mangroves, seagrass beds, and coral reefs), loss of biodiversity; and
d) Overall water quality decline and contamination of coastal waters, beaches and living resources.

33. Root causes identified in the UNEP driven preliminary TDA were also similar to those that have been identified during preparation by the ASCLMEs and SWIOFP projects, and were as follows:

1. Rapid growth in coastal population and urbanization
2. Lack of policies and legal framework
3. Inadequate knowledge
4. Institutional Weakness
5. Lack of management strategies
6. Inadequate financing mechanisms and support, lack of investments

34. Elements of this preliminary UNEP TDA may be used in the overall TDA as coordinated by UNDP where appropriate. The GEF is now providing catalytic support to a revision of this preliminary TDA.

Barriers to LME Based Management

35. Under the Baseline Scenario, numerous, but largely fragmented, efforts will be made to improve management of the coastal and marine environments of the ASCLMEs. Despite the number of Programmes underway and planned *inter alia* in the arenas of fisheries management, pollution control and integrated coastal zone management, the scale of action is being outpaced by human-induced threats to the coastal and marine environment. Countries generally lack the absorptive capacities and the financial wherewithal to take these

initiatives to scale. A number of regional initiatives are in place, nested in a regional policy framework and growing consensus on the need to work collaboratively to address the suite of threats facing marine ecosystems and their constituent resources. However, these focus heavily on the coastal zones of the participating countries. Accordingly, current and planned initiatives will not by themselves be sufficient to institute an ecosystem approach to LME management. Given the transboundary nature of many threats, their root causes and effects, the threats to the environment cannot effectively be contained through national and sectoral initiatives alone, and a holistic multi-sectoral regional ecosystem management approach is needed. There are several barriers to 'mainstreaming' an LME approach into national and regional management structures and processes which can be listed as follows:

36. **A. Inadequate data for management purposes:** Clearly, there is a strong concern regarding inadequate and insufficient data with which to inform and drive management processes. All of the countries are aware (to a greater or lesser extent) of the need for reliable information from which they can evolve integrated and sustainable marine resource management strategies. The countries are also aware of the need to address transboundary issues in relation to the LMEs and to act decisively, in a cooperative and coordinated manner, in order to better manage and conserve the high biodiversity and economic value of the associated resources. Furthermore, they are acutely conscious of the need to address the significant gaps in knowledge and in on-going data collection and monitoring that is necessary in order to both develop an effective baseline for management, and to drive a dynamic and operational management process. In this respect, it should be noted that the ODINAFRICA project, supported by KMFRI in Mombasa, Kenya is beginning to serve a facilitative role with regard to data collection and dissemination as it has begun to:

- Provide Scientists in the Western Indian Ocean Region with bibliographic information;
- Prepare and distribute various data products relevant to marine sciences of the WIO region
- Promote communication between WIO marine scientists and marine scientists globally;
- Publicize marine science of the WIO region and other parts of the world; and
- Provide information equipment, software and training.

The Wildlife Conservation Society (WCS) is also assisting the ASCLMEs project by providing a report on the Assessment, Synthesis, and Gap Analysis of Existing and Planned Activities in the Coastal Zone of countries of the Agulhas & Somali Current Large Marine Ecosystems. This will help to indicate both where existing information may be stored as well as to further refine the needs vis-à-vis missing information.

37. **B. Lack of regionally based monitoring and information systems and coordination:** To the limited extent multi-country assessment Programmes are underway at regional level, there has been little attempt to aggregate existing data, and little attention has been paid to ensuring the ready accessibility of data by end users to facilitate joint management efforts. There is a major unmet need, identified during project preparation to repatriate data that has been gathered over many years in the WIO by foreign fishing fleets and research vessels. Weak information coordination at regional level reduces the value of the information that has been gathered on ecosystem status. These factors, coupled with the fact that regional institutions have varying numbers of participating countries as members, and have fragmented mandates, present the greatest barriers to adoption of an ecosystem approach to LME management. A data and information workshop convened by the Project showed clearly that existing Programmes and institutions do not possess cross-cutting information at regional scale or, with the exception of South Africa, even across a full range of marine issues at national scale. There is at present no regional Programme or institution with the mandate to create and manage such an integrated and over-arching, regionally based information system which could be accessed by regional stakeholders. Information systems at both national and regional scale are fragmented, poorly described, lacking in synthesis, and generally unavailable to managers even at national scale. What little integrated regional information that there is exists in incompatible formats, is not centrally stored, not synthesized and thus not readily accessible to decision-makers and stakeholders.

38. **C. Lack of national and regional ecosystem level assessment capacity:** A solid understanding of oceanographic, chemical and ecological processes is necessary to manage LMEs. The understanding of energy flow and trophic interactions in marine ecosystems in the WIO is poor and connectivity studies are needed to facilitate management of shared marine resources and systems. Biodiversity patterns and ecosystem processes need to be recognized, understood, and managed effectively in order to maintain ecosystem integrity and to maintain existing, and indeed to develop future, fisheries industries. The WIO region has been the focus of a limited number of

oceanographic related ecosystem assessment efforts; however system wide understanding is rudimentary. Assessments are hampered by a lack of dedicated ship's time, lack of coordination of ship cruises to assess priority knowledge gaps, dearth of trained scientists within the region, and a lack of specialized equipment. Very limited information is available on larval transport, and on the location of spawning grounds and nursery areas.

39. Some information is available on the status of artisanal fisheries but this is very limited and frequently out of date. Its accuracy and reliability may also be questionable as there has never been an effective review and synthesis of such information for the ASCLMEs region. The baseline is characterised by numerous and fragmented national efforts to manage their artisanal and subsistence fisheries, often as part of a larger ICZM Programme or biodiversity management project. However, there is limited pooling of data between countries and the transboundary dimensions of artisanal fisheries, including information on lifecycle aspects (such as spawning, larval transport and nursery areas) remain largely unknown. Poor management, inadequate ecological information and the unknown relationship between resources fluctuations and ocean-atmosphere links present threats to both the sustainable yield for artisanal and subsistence fisheries, and the ASCLMEs's overall biodiversity. Very few of the artisanal fisheries in the participating countries are subject to management and in less than 10% is there any linkage between management and scientific information. There is a general lack of valid up-to-date statistics regarding employment within the artisanal fishing sector. This is further complicated by the lack of an accepted definition for what actually constitutes 'artisanal' fishing. Furthermore, Artisanal fishing tends, to some extent, to be seasonal (being affected by adverse weather conditions) and may also be associated with other employment activities such as farming. This difficulty with collecting reliable information on this sector makes management and monitoring somewhat difficult. Attempts have been made to encourage and organise traditional fishing communities to manage their own resources. While this has proven to be easier in geographically well-defined areas such as lakes and rivers, this is much more difficult and complex along the coast where resources are shared with other stakeholders such as the industrial fleets. These growing industrial fleets are creating tension with the traditional fishermen by taking more of the already overexploited coastal resources and destroying the stationary gear used by some artisanal fishermen. These concerns need to be addressed, to facilitate more comprehensive environmental assessments and thus to address the knowledge gaps hampering management of the LMEs. It should be noted that IOC in cooperation with the European Union is developing a Regional Programme for the Sustainable Management of the Coastal Zones of the Countries in the Indian Ocean. This will be looking at some of the problems of artisanal and subsistence fisheries within the coastal areas of the ASCLMEs and may well be able to provide more up-to-date, reliable data on this sector.

40. A number of workshops have been organized within the past two years in an attempt to document the information that is currently available. This includes a Workshop sponsored by the Royal Society of London in January of 2003 entitled "Atmosphere - Ocean - Ecology Dynamics in the Western Indian Ocean"[34]. In addition, a comprehensive multi-disciplinary review of existing, oceanographic related literature was undertaken during project preparation. The review covered 200 publications, including scientific literature and local reports and grey literature. The review shows clearly that there is a dearth of biophysical information and appropriate empirical data sets compared to other LMEs elsewhere on the globe. There is considerable asymmetry in data coverage across the region. For example, the oceanographic data sets for the continental shelves adjacent to the Agulhas Current are relatively robust. By contrast, *no* appropriate oceanographic data of any kind has been collected for certain shelves off Madagascar. Further, a detailed assessment of available hydrographic, remotely sensed and marine biological

[34] Presentations and discussions included the following subjects: improving predictions of climatic variability from rainfed agriculture, development of sustainable approaches to the use of marine resources, and the inter-relationships between physical oceanography and ocean productivity. A special session was also conducted on the research that has taken place on the Shoals of Capricorn sponsored by the Royal Society and the Governments of Mauritius and the Seychelles. Research results were presented on seafloor morphology based on one-nautical mile bathymetric mapping, much of it via satellite. Various factors that influence the meteorology of the Indian Ocean were identified. In addition to the dominant cycles of the Asian and Australian Monsoon systems, it was shown that the influence of *El Niño* on WIO meteorology is significant, leading to greater variability and accentuating upwelling in several places. Evidence was presented indicating that land structures, such as the Himalayan Plateau and the East African Highlands have a profound influence on WIO climate patterns. Combined cyclonic and anti-cyclonic eddies, together with the Mozambique eddies, play a role in triggering the shedding of Agulhas Rings into the Atlantic. The importance of circulation patterns around the Mascarene Plateau, as well as the Indonesian "throughflow" were also seen to strongly influence WIO oceanography.

data for the ASCLMEs and adjacent region was conducted during preparation[35] and verified through two multi-stakeholder workshops[36]. A number of information gaps have been identified and include a need to:

- Identify components of the offshore circulation that affect shelf regions in the West Indian Ocean and thus the distribution of marine organisms and the geographic structure of marine ecosystems.
- Help determine the extent to which circulation of the ASCLMEs region plays a critical role in local climate variability and global climate change.
- Provide information on the water characteristics, water quality indexes, and productivity on the shelf regions of the ASCLMEs that have the most marked effects on the cross-boundary ecosystems and thus national and transboundary fish stocks.
- Identify important components of terrestrial run-off that influence coastal ecosystems and their health.
- Identify aspects of the cross-boundary marine ecosystem on the shelves of the West Indian Ocean are most easily disturbed by, most vulnerable to human interference or climate variability.

41. Work undertaken for the Indian Ocean Commission (IOC) on Sustainable Management of the Coastal Zones of the Countries in the Indian Ocean[37] has identified a lack of valid, precise and up-to-date information and statistical data relating to the artisanal and coastal fisheries sector.

42. No organization is currently responsible for regional level capacity building on behalf of the participating countries, as the current array of regional organizations either lack full regional membership or have an insufficient mandate to address regional issues in an ecosystem context. In those isolated instances where there are dedicated cruises in the region's national and international waters, information gained is often not shared with the countries and participating countries have generally not received the benefit of ship board training in areas of oceanography and fisheries. A concerted focus on priority management issues is difficult as countries have a shallow layer of qualified people. These gaps will need to be addressed through a structured long-term Programme, aimed at building a cadre of experienced resource managers.

43. **D. Absence of public participation, education and stakeholder involvement schemes:** Public participation, education and stakeholder involvement Programmes are virtually non-existent at regional level. Some national level public participation and education activities through national and donor-funded projects at regional level are underway but limited mainly to coastal zone areas. No current institution has the mandate to expand public participation and related activities to regional level and to strengthen regional level capacity to undertake and sustain regionally based public participation activities. A key element to building governmental support for a regional approach to LME management and thus for SAP approval and execution will derive from growing public support for the approach. Thus the absence of regionally based public participation and education approaches is a barrier to realization of this objective. The need for a structured stakeholder awareness Programme is now recognized as a priority by NEPAD.

PART II: STRATEGY

THE ECOSYSTEM APPROACH, LARGE MARINE ECOSYSTEMS AND TRANSBOUNDARY ASSESSMENTS

44. The Convention on Biological Diversity defines 'Ecosystem' to mean a dynamic complex of plant, animal and microorganisms communities and their non-living environment interacting as a functional unit. It further defines the ecosystem approach as a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. It focuses on the essential processes, functions and interactions among organisms and their environment. It recognises that humans are an integral component of ecosystems. The Conference of Parties to the Convention has endorsed this description of the ecosystem approach,

[35] R. Roman and J.R.E. Lutjeharms, An inventory of environmental data for the West Indian Ocean. University of Cape Town, 2004

[36] Minutes of the Paarl Workshop, Paarl, SA, May, 2004; Report of the Workshop Titled Towards a Framework for Information Sharing Between Programmes and Countries in the WIO Region, Grahamstown, SA, October 2004.

[37] Landell Mills Ltd. 2004

has recommended the application of its principles, and has agreed that the priority at this time should be on facilitating implementation of the approach.

45. The GEF Operational Strategies provide guidance on addressing the need to restore and protect coastal and marine ecosystems. GEF has recommended (Operational Strategy 8) the use of Large Marine Ecosystems (LMEs) and their contributing freshwater basins as the geographic area for integrating changes in sectoral economic activities. Current GEF policy includes stabilising and reversing fisheries depletion within large marine ecosystems through ecosystem-based approaches.

46. The WSSD Plan of Implementation also encourage the application (by 2010) of the Ecosystem Approach, relating it to the development and facilitation of the use of diverse tools for the elimination of destructive fishing practices, the establishment of marine protected areas, and protection of nursery grounds.

47. Two processes are used by the GEF to engage decision makers, resource managers, the science community and other concerned stakeholders within participating countries in the establishment of ecosystem-based priorities for transboundary issues. These are the Transboundary Diagnostic Analysis (TDA) and the Strategic Action Programme (SAP). The purpose of the TDA is to scale the relative importance of sources, causes and impacts of transboundary waters problems and to identify potential preventive and remedial actions. This should be an objective assessment, based on best available verified scientific and technical information, through full consultation with all stakeholders and technical experts. The SAP enables cooperating nations to jointly determine what policy, legal and/or institutional reforms and investments are necessary to address the TDA priorities.

48. In order for a TDA to be effective in developing a SAP it requires sufficient and accurate data on a multitude of ecosystem-related parameters and issues. Where insufficient information exists then a GEF project needs to undertake necessary assessment and data capture in order to fill the strategic gaps required to affect a TDA. This is particularly pertinent to the ASCLMEs project. There is clearly insufficient data on important ecosystem elements such as productivity, nutrient distribution and fluxes, water quality parameters, larval transport, spawning and nursery areas that may require protection and/or management, artisanal fisheries (in relation to catch effort, sustainability and management needs), and definition of certain critical oceanographic processes that are driving the Agulhas and Somali Current systems that are the foundation of the LMEs. The Project strategy will be to capture and synthesise missing information along with existing information (both repatriated, and within the region) to provide an effective environmental baseline assessment suitably robust to support effective TDA and SAP processes and inform management.

THE PROGRAMMATIC APPROACH

49. The project is part of a Programme entitled the Programme for the Agulhas and Somali Current Large Marine Ecosystems (ASCLMEs) that will systematically institutionalize an ecosystem-based approach to managing the living resources and environment resources of the ASCLMEs.

50. This project aims to replicate the highly successful approach used by the Benguela Current LME (BCLME) project. BENEFIT (the Benguela Environment Fisheries Interaction and Training Programme) is a regional marine research agency for the three national research institutions of Angola, Namibia and South Africa (three countries of the BCLME Project). BENEFIT was already active in the region prior to the development of the BCLME Project and, in fact, was instrumental in designing and lobbying to get that GEF LME project endorsed and approved. BENEFIT has undertaken much of the requisite scientific data and information necessary for the development of a TDA, and subsequently helped to focus the SAP, which is now being used for regional management of the BCLME. In the ASCLMEs Project there is also a need to capture this requisite data and information to drive the TDA process and to thereby develop the SAP and move the countries closer to LME-based Management approaches.

51. The Programme will facilitate development of a long-term strategy to strengthen cooperative management of the LMEs, based on good science and underpinned by efforts to build capacity at the systemic, institutional and individual levels. An iterative approach is planned, that progressively strengthens management capacities for

regional cooperation in addressing transboundary environmental concerns in the LMEs, builds political will and leverages financing. The long-term Programme goal cannot be realized immediately, owing to gaps in essential information, limited absorptive capacities for regional co-management, and the need to build the basis of trust within the region, and between countries and sectors to effect lasting cooperation. Activities planned under the first phase will inform the preparation of a Transboundary Diagnostic Analysis (TDA) and Strategic Action Programme (SAP) for the ACLME and an interim TDA for the SCLME focussing primarily on the southern Zanzibar Current region. Subsequent phases of intervention will support the implementation of the SAP within the ACLME and will endeavour to expand the TDA in the SCLME to include the northern region as and when political stability may allow (following which consideration could be given to development of an overall SAP for the SCLME).

52. The first phase includes three inter-linked projects, drawing on the services of the three GEF Implementing Agencies: UNEP, UNDP and the World Bank. UNEP will be addressing land-based sources of pollution and providing TDA information in that thematic area through its GEF WIO LaB project, while the World Bank will be addressing offshore fisheries beyond the 150 m depth contour (but including coastal commercial crustaceans) and providing TDA material through SWIOFP (South West Indian Ocean Fisheries Project). This approach will ensure a more unified approach to environmental management in the LMEs, drawing on the comparative strengths of each of the agencies. The three Agencies have worked in close collaboration during the preparatory stages of each initiative. Measures have been agreed and institutional arrangements designed to ensure all activities are well integrated, and contribute to the common goal. Annex 5 provides a summary list of the objectives, components and outputs of the SWIOFP and WIO-LaB projects and Annex 6 shows the linkages between the three projects in relation to the LME modules.

53. In order to create a framework for adaptive management, and build capacity necessary to institutionalize an ecosystem approach to marine resource management, the ASCLMEs Project will begin to codify baseline information, and fill priority knowledge gaps needed to prepare the TDAs, and subsequently the SAPs. The ASCLMEs Project will examine the physical, chemical and biological processes, including coastal fisheries, which drive aspects of the LMEs in geographic areas, where information is lacking to finalize the TDAs and SAPs. This work will further establish the baselines against which to measure the success of future adaptive management interventions. It should be noted that the project places what appears to be a disproportionate amount of attention to the Agulhas Current LME. The reason for this is the difficulty in safely accessing large areas of the Somali LME, especially near-shore areas, given the continued political instability in Somalia, which occupies approximately two-thirds of the LME's coastline. While the project will undertake activity in the boundary areas of the two LMEs (e.g. in the Mascarene Plateau and along the South Equatorial current), and will also undertake assessment work in the Somali upwelling, more definitive work will have to await the return of conditions that would allow for safe assessments in the Somali LME region. Nonetheless, the TDA/ SAP processes will endeavour to address as full a range of issues as possible in both LMEs, and the project will seek to repatriate to the region and collate information on the Somali Current LME, and use other tools, such as satellite altimetry/ GIS to furnish inputs for the TDA/ SAP processes.

THE MODULAR ECOSYSTEM-BASED APPROACH TO LME ASSESSMENT AND MANAGEMENT

54. The Programme adopts the LME Modular Ecosystem-Based Approach (MA) to management[38]. The approach will be codified within the SAP, and operationalised during the SAP implementation phase with funds leveraged from national and international sources. The five modules are listed below in relation to planned project outputs; the matrix delineates individual project responsibilities for the delivery of each module.

[38] A five module strategy is being employed worldwide to provide science-based information for the monitoring, assessment, and management of LMEs. The modules are focused on LME: (1) productivity, (2) fish and fisheries, (3) pollution and health, (4) socioeconomics, and (5) governance.

TABLE 6: **LINKAGES BETWEEN LME MODULES AND PROJECT RESPONSIBILITIES**

Module	Description	Project Responsibility	Role of ASCLMEs Project
Productivity	Identification of productivity hotspots, trophic relationships, temporal variability, riverine and upwelling inputs, toxic tides and algal blooms, inter and intra systemic linkages, roles of gyres and eddies, and monsoon and atmospheric conditions.	This will be addressed under the ASCLMEs Project.	The ASCLMEs Project through cruises and the purchase of state of the art measuring devices will map productivity hotspots, gather necessary information to gauge temporal variability, and gain understanding of the inter and intra-systemic linkages as needed to inform management decisions at regional level.
Fish and Fisheries	Larval transport, trophic relationships, fishery interdependent surveys, systems functioning and relationship to fisheries, industrial fisheries and their relationship to artisanal and subsistence fisheries, the impact of fisheries on biodiversity, the value of non-consumptive use and the interface with consumptive use, and commercial and subsistence landings and effort.	Implementation of the activities will be shared among the SWIOFP (industrial fisheries), ASCLMEs (artisanal and subsistence fisheries) and WIO-LaB projects.	ASCLMEs Project will contribute information to the SWIOFP project on the issue of larval transport in key currents.
Pollution and Ecosystem Health	Identification of anthropogenic threats, natural perturbation, and the conjunction effects of anthropogenic threats and natural perturbation that relate to ecosystem health.	WIO-LaB project with support from ASCLMEs project (Heavy metals and POPs).	The ASCLMEs Project will address issues of pollution through assessment of heavy metal and POPs concentrations in key indicator species. It will also assist WIO-LaB, through cruises, in assessing pollution from land-based sources.
Socio-economic Module	Integrated assessments of human forcing at the LME level and attainment of long-term socio-economic benefits, tasks that are integrated into the outcomes and activities of each of the projects within the PA.	The ASCLMEs and WIO-LaB projects both have activities that address this module, including key elements of the TDA/SAP process and looking at economic benefits at the community level.	The ASCLMEs Project public participation Outcome will involve stakeholders in dialogue about measures to sustain livelihoods while sustaining the long-term productivity of marine resources.
Governance Module	Addresses Regional Governance issues including institutional development, regional and national level capacity building, stakeholder participation, and adaptive management strategies.	This module is also incorporated across the range of outcomes and activities of the three projects, particularly through the TDA/SAP process and associated governance reforms emerging from the SAP.	The ASCLMEs Project will convene representatives of the projects of the Programme, governments, regional organizations and other stakeholders as appropriate to agree on cooperative governance systems for management, as part of the process of finalizing the SAP.

PROJECT OBJECTIVE, OUTCOMES AND OUTPUTS/ACTIVITIES

55. The **Programme Goal** is **"**To ensure the long term sustainability of the living resources of the ASCLMEs through an ecosystem- based approach to management".

56. The **Project Objective** is **"**to undertake an environmental baseline assessment of the Agulhas and Somali Current Large Marine Ecosystems to fill information gaps needed to improve management decision-making, and to ascertain the role of external forcing functions (such as the Mascarene Plateau and the Southern Equatorial Current). This information will be used to develop a TDA and SAP for the Agulhas Current LME, and a TDA for the southern portion of the Somali Current LME".

57. In line with achieving this **Project Objective**, The **Overall Project Deliverables** are:

- Acquisition of data needed to support an ecosystem-based approach to management of the two LMEs as well as a better understanding of the external forcing functions and linkages to adjacent areas of the Western Indian Ocean region
- A full TDA and SAP for the Agulhas Current LME adopted at high levels
- An interim TDA and draft management plan that addresses the southern portion of the Somali current LME

58. The Project aims to address the Agulhas and the Somali Current LMEs under one initial assessment process as A. this is a more cost-effective approach for GEF and B. the two systems are closely interlinked, unlike many clearly discrete LMEs elsewhere in the world. In fact, the Project also intends to extend the assessment to include the Mascarene Plateau. There is some existing data and further strong evidence that this plateau to the east of Madagascar exerts a considerable influence on both LMEs through its effects on the South Equatorial Current (a primary driver of both the Agulhas and Somali current systems). Oceanographic cruises within the region can be effectively extended to cover this critically important region without having to commission a separate and more costly initiative. The information from this assessment and data collection phase will, however, be used to develop discrete TDAs and eventually SAPs for the ACLME and the SCLME, and possible help to confirm the presence of a possible Mascarene Plateau LME so as to allow due consideration to be given to initiating a TDA and SAP process for this area at a later date.

59. It is recognised that there may be some difficulties in undertaking the baseline assessment within the northern waters of the Somali Current LME. However, the southern area is accessible and the belief is that work should start were possible to deliver an interim TDA so that essential management strategies can be developed for the waters relating to the Zanzibar Current. At a later date it is hoped that the assessment and TDA can be extended and completed for the northern region and embraced within any existing regional SAP for the southern area of the LME. This will avoid leaving the southern area of the LME unmanaged for an unknown period, to its inevitable detriment.

60. The barriers to 'mainstreaming' an LME approach into national and regional management structures (as identified in **the baseline** discussion above) and which now drive the development of the project objectives for this GEF UNDP assistance initiatives can be summarised as:

A. Inadequate data for management purposes
B. Lack of regionally based monitoring and information systems and coordination
C. Lack of national and regional ecosystem level assessment capacity
D. Absence of public participation, education and stakeholder involvement schemes

These four barriers provide the justification for the four Project Outcomes listed below

61. The **Project Objective** will be reached through four Outcomes:

Outcome	
1	*Key ecosystem assessment and management gaps are filled as necessary to install an ecosystem*

	approach to LME management
2	*Decision-making tools are in place, to facilitate the synthesis and application of data for LME management;*
3	*Regional agreement is reached on transboundary priorities and their root causes and a suite of governance reforms and investments needed to institute a shared ecosystem-based approach to managing the LMEs in support of WSSD targets, and foundational capacities are in place for implementation.*
4	*A Comprehensive Public Participation Initiative Enables Stakeholders to Engage in Programme activities.*

OUTCOME 1: KEY ECOSYSTEM ASSESSMENT AND MANAGEMENT GAPS ARE FILLED AS NECESSARY TO INSTALL AN ECOSYSTEM APPROACH TO LME MANAGEMENT

Total Cost: US$ 18,250,000; Co-Financing: US$ 12,500,000; GEF Request: US$5,750,000

62. The project will finance a number of environmental assessments to fill critical knowledge gaps within the ASCLMEs in the arenas of physico-chemical oceanography, productivity and biodiversity. This `work will describe the inter-relationships between currents, water quality, temperature and other variables in the ASCLMEs. Biodiversity studies will seek to map food webs and biogeography, contribute to knowledge on bio-indicators, and genetics, provide information on larval transport related to nearshore fisheries and biodiversity (fish and crustacean larvae, corals, etc), and map the primary spawning grounds and nursery areas for commercial and threatened marine resources. This information is needed in order to finalize the TDAs, and enable the countries to set priorities for intervention under the LME SAPs, in turn needed to operationalise an ecosystem approach to the management of the LMEs, It will also contribute to a better understanding of the determinants of environmental variability in the ASCLMEs region. Annex 7 supplies a detailed account and summary of the information gaps that need to be addressed to facilitate LME management.

63. Offshore data will be collected using dedicated research ships, through the deployment of equipment placed on the ocean floor and through the use of drifters and satellites. Eight hundred days of dedicated ships' time will be secured, and additional ships time will be available through SWIOFP (oceanographic data will be collected during fishery cruises in order to ensure cost efficiencies)[39]. Ships will also be deployed and tasked for the purposes of assisting the WIO-LaB project to accomplish its objectives. Nearshore data needs (particularly in relation to larval transport, spawning areas and nursery areas) will be addressed through a review of existing data, identification of critical gaps, and prioritisation of activities to address those gaps for the purposes of informing the TDA process as well as developing a baseline for longer term monitoring.

64. The assessments will focus in discrete areas, where information gaps are most acute, and will seek to add to the body of existing environmental information on the LMEs. Assessment activities will be co-financed by the Governments of Norway and France and by the South African ACEP (African Coelacanth Ecosystem Programme), which will dedicate ships time, technical assistance and specialized equipment.

65. The UNDP ASCLMEs Project will undertake an assessment of the artisanal and subsistence fisheries sector to complement and complete the work that the World Bank SWIOFP project will be undertaking within the industrial fisheries sector. The SWIOFP project will limit its activities to beyond the 150 m depth contour and is dealing primarily with blue water fisheries in the high seas, although it will also look at the commercial aspects of the crustacean and molluscan fishery for the region. Clearly there are many gaps with regard to coastal fisheries at the community level, which need to be filled in order to provide a fully regional picture for an ecosystem-based management approach of fisheries *per se*. The UNDP ASCLMEs project will attempt to fill these gaps.

[39] Principal among the ships to be deployed for ASCLMEs based work are the *Dr. Fritjof Nansen*, which will be available to the projects on a cost-shared basis with the Government of Norway and managed by FAO, and the *RS Algoa*, a South African government research vessel made available to the projects in conjunction with the Government of South Africa and through the ongoing, directly related work of the ACEP. Other smaller ships, independently contracted by the ASCLME and SWIOFP, and where possible their capabilities shared between the two projects to maximize efficiencies, will also be deployed.

OUTPUTS/ACTIVITIES

1.1 Prioritised ecosystem assessment and management gaps in ecosystemic processes in key geographic areas of the ASCLMEs addressed

66. The project will undertake in-field assessments and data collection in order to address specific knowledge gaps within discrete oceanic areas of the ASCLMEs as shown in Table 7[40]: The project will further review known information on specific coastal issues directly related to LME management including larval transport and identification/mapping of important spawning grounds and nursery areas for commercial species. The project will also review regional initiatives pertinent to artisanal fishery issues in order to capture information relevant to the LMEs. This will include work undertaken for the Indian Ocean Commission (IOC) on Sustainable Management of the Coastal Zones of the Countries in the Indian Ocean[41] The IOC initiative in particular will be looking at improving data and information on the artisanal and subsistence fisheries within the ASCLMEs region. Therefore, any efforts by the currently proposed UNDP GEF LMEs project should therefore coordinate closely with such an initiative to avoid duplication but to ensure capturing the necessary information to drive the ecosystem approach TDA process.

67. The various strategies and approaches for information capture and analyses will feed two primary purposes in relation to the project's long-term contribution to LME management - A. It will provide input to the TDA and SAP processes, and B. It will create the national/regional databases necessary to develop the long-term monitoring and assessment for LME management purposes.

TABLE 7: LIST OF DATA GAPS AND PROPOSED ASSESSMENT METHODOLOGIES

Geographic Area: Somali Upwelling and Penetration of Red Sea water in the ASCLMEs	
Data Gaps: Information on environmental variability, upwelling, productivity and related fisheries. Determine how Red Sea water reaches the ASCLMEs to increase understanding of global thermohaline circulation & inter-ocean water exchange	Assessment Methodology: Cruise of the Nansen to the Somali Upwelling in conjunction with the SWIOFP project. Two cruises foreseen.
Geographic Area: Kenya and Tanzania Coasts	
Data Gaps: Mapping needed of inshore circulation patterns. Information needed on larval transport, recruitment, environmental conditions for fisheries, and pollutant dispersal	Assessment Methodology: Cruises of the Nansen and smaller vessels contracted in partnership with SWIOFP and WIO-LaB.
Geographic Area: Southwest Indian Ocean shelf regions	
Data Gaps: Knowledge of shelf circulation patterns and transport of fish larvae, dispersal of pollutants. Information on system productivity needed.	Assessment Methodology: Two cruises of the Nansen will be undertaken and work will be jointly undertaken with SWIOFP. Dispersal pollutants work undertaken in cooperation with WIO-LaB.
Geographic Area: South Equatorial Current	
Data Gaps: Information on the circulation patterns of off shore currents. Productivity and chemical oceanographic assessments.	Assessment Methodology: Two cruises by the Nansen in conjunction with the SWIOFP project.
Geographic Area: The splitting of the southern and northern branch of the East Madagascar Current	
Data Gaps: No current information on this area is available. Knowledge of shelf and coastal circulations, biodiversity, chemistry and geology virtually non-existent.	Assessment Methodology: One cruise by the Nansen in conjunction with the SWIOFP project.
Geographic Area: The forcing of the South Madagascar upwelling cell	
Data Gaps: Baseline information on coastal circulations, biodiversity, chemistry and geology.	Assessment Methodology: One cruise by the Nansen in conjunction with the SWIOFP project.
Geographic Area: Mozambique Channel	
Data Gaps: Information needed on the shedding and triggering	Assessment Methodology: Cruises will be undertaken jointly by

[40] The information that appears in this Table is a synthesized version of Annex 4??.
[41] Landell Mills Ltd. 2004
[42] Wells, S. 2005

of Mozambique eddies. Information also needed on productivity	the ASCLMEs Project, SWIOFP, and the ACEP. The Nansen and Algoa will undertake fisheries surveys through trawls.
Geographic Area: Areas of the Mozambique and SA coasts, including principally the Delagoa eddy, the point at which the Agulhas Current begins to influence shelf circulation off Mozambique and SA, the Natal Pulse, the driving of the St. Lucia and Port Alfred upwelling cells.	
Data Gaps: Information needed on eddies to determine effects on overall ecology of the areas and particularly on downstream biodiversity, influence on shelf circulation, disposition of river outflows, dispersal of pollutants and thus habitat of organisms, and potential role on health of prawn fisheries;	Assessment Methodology: Cruises will be undertaken jointly by the ASCLMEs Project, SWIOFP, and the ACEP. The Nansen and Algoa will undertake fisheries surveys through trawls.
Geographic Area: Agulhas Bank	
Data Gaps: Understanding of the hydrodynamics of the Agulhas Bank to enhance existing information on the valuable anchovy and sardine fishery spawning ground which has implications for the health of these fisheries in the Benguela Current LME.	Assessment Methodology: Placement of current meter moorings at the upwelling and one cruise of the Algoa.
Geographic Area: Mascarene Plateau	
Data Gaps: Information on the interaction of physico-chemical and biological processes in this large, shallow, mid-ocean region. Specific information needed on seagrass beds, overall climatic patterns, variability, and the potential influence of the Indian Equatorial Jet on productivity in the ASCLMEs.	Assessment Methodology: Two cruises by the Nansen in conjunction with the SWIOFP project.
Geographic Area: System Wide	
Data Gaps**:** Improved understanding of the role of the AA-Monsoon on the predictability of the global climate system.	Assessment Approach: The project will partner with the ongoing work of the CLIVAR-Goals project of the WMO/IOC/ICSU World Climate Research Programme.
Geographic Area: Region-Wide (Using indicator species in the Mozambique Channel and Seychelles)	
Data Gaps: No baseline information on loadings in key Indicator species of PTS and POPs.	Assessment Methodology: Analyses of heavy metal concentrations and POPS
Geographic Area: Region-Wide (mapping larval transport, spawning grounds and nursery/settlement areas	
Data Gaps: Poor baseline information on the distribution and location of nursery areas, spawning and settlement grounds, and on general larval transport trends and variability along coastlines	Assessment Approach: The project will undertake an assessment of current knowledge on spawning and settlement grounds as well as nursery areas and larval transport. This will identify gaps in relation to the TDA requirements, and develop a strategy for filling those gaps.
Geographic Area: Region-Wide (Distribution and catch effort of Artisanal Fisheries)	
Data Gaps: Inadequate statistics on artisanal catches and landings Poorly coordinated assessments (where available)	Assessment Approach: The project will review all known information on artisanal fisheries around the coastline within the project system boundary to inform the TDA/ SAP formulation process. Mechanism will be identified for filling gaps and to develop long-term community-based monitoring of artisanal fisheries

68. The offshore oceanographic surveying procedures will utilize a towed undulating equipment array deployed from the vessel, along with point-source sondes to collect data.[43] At the desktop level, information will be integrated, through a GIS system, onto satellite imagery. These satellite images will then provide multidimensional maps linking productivity, currents, water quality, air and sea temperatures, and climatic conditions along with seasonal trends. These products will then be available for further refinement through inputs from the other components of this UNDP project (e.g. larval transport and nursery area locations) and from the other projects in the ASCLMEs Programme addressing land-based sources of pollutants and fisheries.

69. In the early stages of Project implementation the Cruise Coordinating Group, in cooperation with the Cruise Coordinator (see **Executing Arrangements**), will develop a strategy and the associated logistics for the oceanographic surveys and cruises. This will be based on a review of the current knowledge and identification of the priority 'gaps' that need to be addressed (see Table 7 above, and Annex 7) as well as consideration of the past and on-going initiatives within the region from which appropriate data can be captured. The strategy will also

[43] See Annex ? for details of the planning and strategy for the oceanographic surveys.

address training needs for regional capacity building and the inclusion of counterpart national and regional experts and specialists. Data analyses, storage and access will be a further key component linked into Outcome 2 (below). Finally, the strategy will identify management applications for the specified data collected as well as identifying targets for the distribution of that data.

1.2 Baseline information obtained on persistent organic pollutants (POPs) within the LMEs through the use of key indicator species.

70. Apex predators and seabirds will be used as indicator species to determine the presence and effects of heavy metals and POPs on overall ecosystem health. This Programme is based on the fact that seabirds are abundant in the ASCLMEs region (>6 million pairs), are marine top predators among the most easy to study at their breeding site and have a foraging ecology highly tied to their marine environment and to surface dwelling tunas. The Programme is ongoing in the Mozambique Channel and should start during the year 2005 in the Seychelles Basin (those two areas gather >90% of the seabird community for the ASCLMEs). The Government of France will finance studies into heavy metal concentrations of mercury, selenium, cadmium, copper, zinc, magnesium, and arsenic in the muscle, liver, and kidney tissue of seabirds and fish, and in the blood and feathers of seabirds. The project will add analyses of POPs listed under the Stockholm Convention. The resulting information will establish a baseline for long-term monitoring and define management priorities to be addressed through SAP interventions, and result in a cross-Programmatic benefit between the IW and POPs Focal Areas of the GEF.

71. Table 8 (below) summarises the information that would be captured from the assessment process, shows how the information would feed into specific management applications, and how these management applications then link back to the modular ecosystem based approach to LME management. Annex 8 shows the linkages between the various project outputs, the LME modular approach and the funding sources for all three nested projects (UNEP, UNDP and the World Bank) under the Programme for the ASCLMEs.

TABLE 8: MANAGEMENT APPLICATIONS FOR NEW INFORMATION ARISING FROM ASSESSMENT PROCESS (INCLUDING LINKS TO LME MODULAR APPROACH)

NEW INFORMATION FROM ASSESSMENTS	OPERATIONAL MANAGEMENT APPLICATIONS	LINKS TO MODULAR APPROACH
Improved understanding of determinants of productivity in the ASCLMEs	Management of fishing activities in the area.	Productivity Fish and Fisheries
Improved knowledge of transboundary environmental processes associated with the current regimes	Adaptive management schemes governing artisanal fisheries and pollution reduction in the area.	Fish and Fisheries Pollution and Ecosystem Health
Improved understanding of ocean-atmosphere links in the ASCLMEs, which contributes to understanding of global climate processes.	Development of Early Warning Systems and Contingency Planning for Environmental Variability (I.e. ocean acidification, coral bleaching, El Nino events, etc). The information also has utility for inland river basin management activities (Lake Tanganyika, Orange River etc).	Pollution and Ecosystem Health Socio-economic Governance
Information on productivity and larval transport for fish and invertebrates	Development of an ecosystem based approach to fisheries management (e.g. ecosystem-based zonation and development of management/protected areas, etc)	Productivity Fish and Fisheries
Mapping of commercially important nursery areas	Zonation and management of sensitive areas	Fish and Fisheries
Offshore currents need to be better understood as they have bearing on coastal pollution, coral bleaching and productivity.	Information has application for adaptation schemes, pollution control and fisheries.	Productivity Fish and Fisheries Pollution and Ecosystem Health

NEW INFORMATION FROM ASSESSMENTS	OPERATIONAL MANAGEMENT APPLICATIONS	LINKS TO MODULAR APPROACH
Establishment of a baseline through analyses of heavy metal and POPs concentrations in key indicator species.	Future decisions on regulatory measures to be taken regarding heavy metal releases and POPs control	Pollution and Ecosystem Health
Knowledge of cross-boundary shelf and coastal circulations and biodiversity linkages (seeding, migratory patterns, invasive organisms, etc)	Development of a regional management regime to address cross-boundary concerns and transboundary management of living resources (including monitoring)	Governance
Information regarding the Mozambique eddies which carry heat and momentum, and are an unknown component within the global thermohaline circulation. Variations may effect the inter-oceanic water exchange between the Indian and Atlantic Oceans and may have further global implications	Regional and global management responses to environmental variability, especially climate change. Also management implications for larval transport and species migration	Productivity Fish and Fisheries Governance
Information on ecosystem processes on and around the Mascarene Plateau	Determination of whether Mascarene Plateau should be managed as a discrete LME	All LME Modular Areas
Overall improvements to the knowledge of transboundary ecosystem effects and functions	Elaboration of necessary TDA/SAP processes to develop a transboundary management approach for the LMEs	All LME Modular Areas

Outcome Linkages to SWIOFP and WIO LaB

In SWIOFP: Coordination of cruise plans and survey work to ensure cost-effectiveness
Capacity building and training for field scientists at sea
Linkages between artisanal, subsistence and industrial fisheries data to capture interrelationships.

In WIO-LaB: Establishing common methods, quality standards, etc.
Assessment of training needs and educational Programme requirements
Linkages to GPA Clearing House

OUTCOME 2: DECISION-MAKING TOOLS ARE IN PLACE, TO FACILITATE THE SYNTHESIS AND APPLICATION OF DATA FOR LME MANAGEMENT

Total Cost: US$ 2,775,000; Co-Financing: US$ 1,550,000; GEF Request: US$1,225,000

72. A coordinated regional framework will be developed to facilitate the acquisition, distillation and dissemination of data on the coastal and marine environments of the ASCLMEs. This will contribute to the NEPAD goal: facilitating collaboration between African countries in the arena of information management. Currently, much valuable data from past research and monitoring remains outside the ASCLMEs region and must be repatriated in order to have utility in the region. The mechanism will facilitate data repatriation, storage, synthesis and retrieval to facilitate applied decision-making in the region on LME management.

OUTPUTS/ACTIVITIES:

2.1 Facilitate establishment of a data management facility for the continuing collection, synthesis and storage of country and regional data, and the repatriation of extra-regional data and information.

73. Comprehensive data sets, keys to creation of an effective monitoring and evaluation Programme for the ASCLMEs, will be developed. The project will facilitate regional discussions to decide upon the mechanisms for synthesizing country and regional data, and repatriating and incorporating extra-regional information. This will

contribute to the design of the monitoring and evaluation component of the SAP. Information focal points will be designated by each country through which the regional project can coordinate national information. The project will also develop a regional information clearing house (most probably associated with the Project Coordination Unit, at least in the early stages), which will become part of the long-term regional institutional structure for LME coordination and management.

2.2 Establish a coordinated plan for assembling and reporting on agreed indicators for monitoring and evaluation of the status of the Agulhas and Somali LMEs.

74. Monitoring and evaluation systems needed to gauge process, stress reduction, and environmental status trends in the ASCLMEs will be developed. GEF IW M&E process, stress reduction and environmental status indicators have not been applied to any of the country or regional initiatives underway. The project will drive a participatory effort to develop a suite of stress reduction indicators (SRIs) and environmental status indicators (ESIs) to be employed during SAP implementation [44]. These will provide a basis for monitoring results during implementation[45].

2.3 Increased systems knowledge through use of GIS and predictive models.

75. GIS and remote sensing tools will be developed as decision-making aids. Interventions include the establishment of a formalized network of information managers to support the integration of a regional GIS. This network will be responsible for sourcing information, and would draw up a plan of action for GIS training in each of the countries. The project will provide funding to establish a shared GIS for the ASCLMEs. Activities include research, data mining, data digitising, data formatting, and data integration. The GIS will be used to undertake a spatial environmental assessment to provide an indication of priority areas for management intervention[46]

Outcome Linkages to SWIOFP and WIO LaB

In SWIOFP: Data gap analysis and data archiving. Establishment of regional data management system
Baseline assessment, GIS mapping of key species, assessments of marine biodiversity as alternative sources of income and identification of bio-indicator species and relationships between target species and ecosystem health (this will need to be associated with corresponding oceanographic indicators during the TDA/SAP process). This SWIOFP subcomponent will be shared with the ASCLMEs.

In WIO-LaB: Database management and decision-support systems.
Monitoring strategies
Development of Performance Indicators

OUTCOME 3: REGIONAL AGREEMENT IS REACHED ON TRANSBOUNDARY PRIORITIES AND THEIR ROOT CAUSES AND A SUITE OF GOVERNANCE REFORMS AND INVESTMENTS NEEDED TO INSTITUTE A SHARED ECOSYSTEM-BASED APPROACH TO MANAGING THE LMES IN SUPPORT OF WSSD TARGETS, AND FOUNDATIONAL CAPACITIES ARE IN PLACE FOR IMPLEMENTATION.

Total Cost US$5,580,000; Co-financing: US$2,155,000; GEF Request: US$3,425,000

OUTPUTS/ACTIVITIES:

3.1 Financial resources brokered to ensure the financial sustainability of information systems.

[44] The project will employ among other things, GEF IW Process, Stress Reduction, and Environmental Status indicators. PIs are already substantially developed and are included in the project logframe analysis.
[45] The M&E strategy is being fine-tuned and will be finalised during project appraisal. The final strategy will be circulated at the time of CEO endorsement.
[46] For instance, areas of high biodiversity value and areas vulnerable to pollution from land based and marine sources.

76. The project will dedicate resources to identify financial sources and revenue generating mechanisms within countries and at the regional level (including fishery levies) to sustain the ASCLMEs environmental information system, and provide the financial framework for the implementation of environmental assessment, information management and stakeholder participation activities spearheaded under the SAP. The project will also undertake an assessment of ecosystem and related function values and demonstrate the cost-effective advantages of cooperative LME-based management approaches as per the SAPs. This should act to encourage policy-level decision makers to buy-in to the project in the realisation that not to do so would be economically risky and could lose revenues over the mid-to short-term.

3.2 Institutional, Programme and human capacity building requirements are identified and addressed through training initiatives.

77. In its early implementation stages the Project will identify training needs in conjunction with SWIOFP. A Capacity Building and Training Programme will be drawn up as a 'Needs Assessment' exercise and will guide ensuing training activities geared to improving institutional and individual capacities for LME assessments, information management and other related disciplines. The training courses will include activities not only to empower local specialists to engage in the TDA and SAP processes (such as the recently completed Train-Sea-Coast course on the TDA-SAP approach), but also to build regional capacities for monitoring processes, and for evaluating process, stress reduction and environmental status information. Overall capacity building and training needs for the project lifetime will be elaborated into a CB&T Programme (also early in Project Implementation) based on this needs assessment. This CB&T Programme will also include the CB&T inputs from the Oceanographic Surveys Strategy (see Annex 9). This Programme will identify CB&T needs, appropriate institutes, available personnel, various levels of CB&T, counterparting options, sustainability of capacity building, 'train-and-retain' mechanisms, etc. Progress with the CB&T Programme will be reviewed through the standard project monitoring and evaluation processes (see M&E Plan) as well as at each meeting of the Project Steering Committee.

3.3 Close and regularized communication established among the IAs, the various Projects under the Programme, and other related projects and institutions in the region.

78. The project will assure a well-defined, adequately funded and functioning set of coordination and communication mechanisms among the GEF IAs, the participating countries, and stakeholders. The principal output of this activity will be creation and functioning of a Programme Coordination Committee (PCC) to assure effective synergies between projects[47].

3.4 Linkages with other GEF supported LME projects in Sub-Saharan Africa and globally are established.

79. Exchanges of country personnel involved in the project with other GEF IW projects in Sub-Saharan Africa and in other regions will be undertaken to assure the cross fertilization of good practices. The project will also facilitate the attendance of key project and other expert resources from the region to such events as the biennial IW conferences and other workshops as a means of building their capacities. Negotiations are currently underway to confirm the role of NEPAD as the coordination focal point for African LMEs. Once confirmed it is expected that a suitable website will be developed and made accessible to all African LME stakeholders (and indeed all LME stakeholders globally).

3.5 TDA and SAP finalized.

80. The Project will provide funding and assume responsibility for preparation and finalization of the TDA and SAP for the ACLME and to prepare an interim TDA for SCLME that will initially focus upon the southern portion

[47] A detailed coordination plan is being finalised defining the arrangements. This will be circulated at the time of CEO endorsement.

related to the Zanzibar Current[48]. This will include *inter alia*, country-driven definition of appropriate regional institutions to assume responsibility for coordinating the application of the ecosystem approach to management of each of LMEs. The project will facilitate discussions to bring about consensus by the participating countries on the way ahead for planning how institutions can be organized to provide the suite of services and management functions needed to carry the process forward. UNEP will catalyse early discussions, using as a basis for those discussions previous work in TDA and SAP development undertaken in previous UNEP preparation activity, and utilizing earmarked funding from the WIO-LaB project to convene early discussions among the countries. In fulfilment of its role as the overall ASCLMEs Programme coordination mechanism, the UNDP project will capture all information and assessment data from the three projects under the ASCLMEs Programme (UNDP, UNEP and World Bank Implemented) and feed this information into the TDA/ SAP process to undertake a single approach for each LME. Each project would identify policy, legal and institutional reforms and needed investments to address transboundary priorities, in their respective areas of focus. In this context, UNEP would provide the requisite information on land-based sources of pollution for the TDA/SAP process along with some initial recommendations and guidance for the SAP process as it relates to LBS. The World Bank would provide fisheries related inputs on industrial fisheries (on crustaceans, demersals, and non-tuna pelagics) to UNDP for inclusion in the TDA/SAP process, also with any recommendations that their project may wish to make regarding other fisheries aspects of the SAP process. UNDP would then be responsible for capturing all of these areas of assessment and information gathering into the TDA process for each LME and into the SAP process for the ACLME (and later hopefully the SAP process for the SCLME). It should be noted here that capacity building and training will be necessary both to drive the TDA and SAP process from the national and regional level (country ownership) as well as to evolve a longer term environmental monitoring and ecosystem assessment process that can sustain effective management responses and decision-making at the policy level.

Outcome Linkages to SWIOFP and WIO LaB

In SWIOFP:	TDA and SAP inputs Strengthening the regional management structure. The development of the longer-term resource management model accommodates a revenue-generating scheme based on the use of EEZ marine resources in an environmentally and socially sustainable way.
In WIO-LaB:	TDA and SAP inputs Determine and satisfy training needs in the region

OUTCOME 4: A COMPREHENSIVE PUBLIC PARTICIPATION INITIATIVE ENABLES STAKEHOLDERS TO ENGAGE IN PROGRAMME ACTIVITIES

Total cost: US$3,400,000 Co-financing: US$1,600,000; GEF Request: US$1,800,000

OUTPUTS/ACTIVITIES:

4.1 A Distance Learning and Information Sharing Tool (DLIST) is developed and implemented

81. The project will set up an interactive electronic information sharing system, known as DLIST[49] which will provides a web based platform for disseminating information on marine and coastal management issues to a broad array of stakeholders (particularly at the local level). The system will engender a two-way flow of information from

[48] Initial funding for TDA/ SAP completion is provided under the WIO-LAB project. This activity is intended to complete the TDA/ SAP by adding oceanographic and fisheries data, collected through ASCLME and the. The provision is needed to ensure that the TDA/ SAP fully cover the 5 LME management modules.

[49] DLIST was first piloted along the coastline of South –western Africa, including South Africa, Namibia and Angola, where it is playing a critical role in connecting coastal stakeholders and role players to the activities of the GEF Benguela Current LME Programme. The initiative was developed as an activity of IW LEARN, the International Waters Learning Exchange and Resource Network through the World Bank Group and Eco Africa, a South African based non-government company. The DLIST activity for the ASCLMEs will be implemented by EcoAfrica.

end users of information to data providers and vice versa, ensuring that it is demand driven. *A* help function will be established for this purpose, allowing stakeholders to pose queries to managers and scientists. It will provide a mechanism for sharing information collected through the various assessments under taken by the three ASCLMEs projects to a large constituency. All project reports and scientific studies will routinely be made available in formats accessible to end users (i.e. information digests available in English, French and Portuguese). The platform will provide space for stakeholders to discuss the assessments and share information. This will provide a vital mechanism for engendering broad based stakeholder participation in the SAP preparation process, and inculcating a sense of regional ownership. A Distance Learning course will be developed, dealing with coastal and marine management issues specific to the ASCLMEs, to enable coastal players to more systematically improve their capabilities. DLIST aims to demonstrate how local communities can generate sustainable livelihoods once they gain access (and are empowered by) information and knowledge on coastal and marine resources. It connects coastal stakeholders with grass root solutions and local knowledge. DLIST is also transforming conservation by providing local communities with the knowledge and tools necessary to value and benefit biodiversity. DLIST has recently published an 'assessment of how Coastal Communities can become involved and benefit from the BCLME Programme'. This will provide a template for DLIST's contribution to the Programme for the ASCLMEs. Further information on how DLIST can reach out to communities can be found on the website at www.dlist.org.

4.2: A set of public involvement, participation, and environmental education initiatives are developed and implemented in the region.

82. Activities will include: development of networking opportunities between environmental education practitioners; development of resource materials on marine related topics sensitive to the social and cultural milieu; and the provision of targeted training opportunities for environmental educators; and execution of a media outreach drive in the region, in English, French and Portuguese. The Project will also organise and host a Partnership Symposium in the second half of the project lifecycle. The purpose of this Symposium will be to highlight the achievements of all 3 sister projects under the Programme umbrella for the ASCLMEs, to identify next steps in relation to operationalising the SAPs, developing management approaches, and continuing to monitor selected indicators and parameters necessary to sustainably guide ecosystem-based management and policy in the region. This Symposium will also help to develop the necessary working relationships with and between public and private sector partners and NGOs which will be crucial to the implementation of the SAP.

Outcome Linkages to SWIOFP and WIO LaB

In SWIOFP:	Stakeholders from all member countries are participating in the project, including fisheries-related ministries, research institutes and associations, fisheries operators or processors, NGOs and local communities
In WIO-LaB:	Develop educational Programmes at all levels Develop regional/governmental/private sector/ public sector partnerships

INTER-LINKAGES BETWEEN PROGRAMME INTERVENTIONS

83. Specific interlinkages between the GEF UNDP ASCLMEs project, the SWIOFP and WIO-LaB are identified at the end of each **Outcome** description above. In addition, the three projects will be cooperating closely in regard to development of the TDAs, development of regional management strategies at the ecosystem level,

[50] For instance, areas of high biodiversity value and areas vulnerable to pollution from land based and marine sources.
[51] Initial funding for TDA/ SAP completion is provided under the WIO-LAB project. This activity is intended to complete the TDA/ SAP by adding oceanographic and fisheries data, collected through ASCLME and the. The provision is needed to ensure that the TDA/ SAP fully cover the 5 LME management modules.
[52] DLIST was first piloted along the coastline of South –western Africa, including South Africa, Namibia and Angola, where it is playing a critical role in connecting coastal stakeholders and role players to the activities of the GEF Benguela Current LME Programme. The initiative was developed as an activity of IW LEARN, the International Waters Learning Exchange and Resource Network through the World Bank Group and Eco Africa, a South African based non-government company. The DLIST activity for the ASCLMEs will be implemented by EcoAfrica.

coordination of field-work, training and capacity building, and stakeholder participation. Annex 5 provides a summary list of the objectives, components and outputs of the SWIOFP and WIO-LaB projects.

84. The SWIOFP regional PMU will have some functions in common with its sister project, the ASCLMEs Project, which will allow cost-sharing between these two ASCLMEs components. The two projects have been designed to be complementary, with data and activities generated from one project feeding into and impacting the Programme of the other. The harmonized implementation structure agreed to by both the ASCLMEs and SWIOFP Project preparation teams includes shared staffing whereby both Projects would take advantage of the ASCLMEs Cruise Coordinator and the Information Systems Officer. In addition, the two projects have agreed to joint planning arrangements, and will hold their detailed Programme Annual Work Programme meetings together. There will also be a common ASCLMEs Programme Coordination Committee whose membership will include the National SWIOFP Manager of each SWIOFP country and the Regional Executive Secretary and the senior member of the ASCLMEs Steering Committee from each ASCLME country and its regional coordinator.

85. The projects within the Programme have also been analysed in relation to the overall "fit" of all activities of the three projects, and in relation to specific modules of the LME approach to management (See Annex 8)

3. The TDA and SAP processes will be carefully coordinated between the three projects with UNDP taking ultimate responsibility for the individual TDAs and SAPs for the ecosystem approach within each LME.

86. The SWIOFP project will develop fisheries based, country specific SAPs related directly to the scope and content of their fisheries assessments. SWIOFP will also contribute to the Programmatic TDA and SAP process at the LME level (as coordinated by UNDP) hat will combine the outputs of the three IA ASCLMEs projects. The principle contribution of the SWIOFP to the TDA and SAP will be differentiation between major environmental and anthropogenic factors that impact migratory and shared fish resources, the establishment of a baseline for key fish species, estimates of commercial fishing pressure and the evaluation of the impact of fisheries on marine resources as a whole.

87. UNEP will be providing the UNDP-implemented project with the necessary TDA/SAP elements relating to land-based sources of pollutants for UNDP to incorporate into an overall TDA/SAP for each LME, as relevant.

Risks

88. The risks confronting the project were evaluated during the project preparation stage, and risk mitigation measures have been internalised into the design of the project. Five risks have been identified and are discussed in detail in Table 9 below. Assumptions are elaborated in the Logical Framework for the Objective and Outcomes.

TABLE 9: RISK AND RISK MITIGATION MEASURES

Risk		Risk Mitigation Measure
Conflict between coastal states with different political agendas results in an inability of countries participating in regional activities to cooperate at the level needed to achieve results.	L	All participating countries are taking steps to strengthen collaboration in managing shared marine resources. A number of regional protocols and Programmes are in place, including the IOC, IOTC, SADC, NEPAD, the Nairobi Convention, and the emerging SWIOFC. The ASCLMEs project, WIO-LaB, and SWIOFP will include activities that allow close liaison with regional Programmes. Close Programmatic links will be established with NEPAD through the NEPAD Coastal and Marine Programmes Coordination Unit.
Pressing domestic economic and social issues such as poverty and human health issues imply that regional environmental concerns receive sub-optimal attention and investment.	S	Countries have already accepted, through their endorsement of the ASLME Programme, through their ratification of the Nairobi Convention and their participation in regional Programmes, an understanding of the links between ecosystem health, food security, and the over-arching challenge of poverty alleviation. The dependence of coastal populations on marine resources for subsistence and income generation, amplifies the importance of maintaining the ecological integrity of the LMEs. The Programme and Project will establish applied information management systems, to inform decision makers of the relationships between environmental variability in

Risk		Risk Mitigation Measure
		the LMEs and economic welfare. The TDAs will chart the causes and effects of threats to each of the LMEs, enabling decision makers to gain a better understanding of the links between socio-economic and ecological systems. The domestic benefits/ costs of regional action/ inaction will be established during SAP preparation in order to build political support.
There will be insufficient numbers of regionally based, trained oceanographers and other experts to fulfil training needs necessary to build individual capacities in the region.	S	Capacity-building requirements will be assessed through as part of the development of a Capacity Building & Training Programme to be developed jointly by the ASCLMEs/SWIOFP Projects. The assessment will take into consideration existing expertise and capacity needs within regional Centres of Excellence. Institutions that can address regional training needs will be identified and their capacity to undertake training strengthened. Links will be established with international centres of excellence (Norway/ France/ USA/ UK), to support this effort.
Participating countries will not be able to agree on the mechanisms necessary to achieve sustainability.	L	A number of regional organizations currently exist and already perform some of the functions necessary to ensure sustainability. The Nairobi Convention will play an instrumental role within this context. Mechanisms to guarantee the financial and institutional sustainability of LME management interventions will be incorporated into the SAP. The ASCLMEs Programme will partly underwrite the transactions costs associated with the requisite discussion/negotiations leading to agreement on these mechanisms. The planned economic assessments will underscore the benefits of regional cooperation to countries over the long-term.
Important local level stakeholders (artisanal fishers, others) will see ecosystem based management efforts as being detrimental to their interests, jeopardizing their application at local scale.	M	The DLIST Programme and additional public participation initiatives led by the Projects within the Programme, ACEP, the countries, and regional organizations will serve to build community support. DLIST will provide a mechanism for community outreach, allowing a two-way flow of information from communities to resource managers. Information will be disseminated using locally appropriate tools (i.e. radio)
Overall Rating	**M**	Risk Rating: L - Low; M – Medium; S – Substantial

EXPECTED GLOBAL, NATIONAL AND LOCAL BENEFITS

89. The ASCLMEs harbour biodiversity of global significance, characterized by high regional endemism. Moreover, the region sustains the World's second largest tuna industry, and there is mounting evidence that the tuna stocks are at risk of being over-fished and thus declining. Finally, the ASCLMEs place a critical, though yet not fully understood role in global climate regulation, and the ocean–atmosphere interface regulates weather patterns, including the Monsoons. The ASCLMEs thus supply a number of ecological goods and services to the global community. These stand threatened by human induced pressures, including increased fishing effort and anthropogenic climate change, the regional consequences of which will be sizable. As the genesis of these threats is transboundary in nature, they cannot be effectively abated through stand-alone national initiatives and there is a need for concerted regional responses. The main global benefit of the project is enhanced understanding of LME functioning necessary as input to LME management through TDA/SAP processes. Global benefits at Programme level will be secured through the institution of a regional ecosystem management framework, allowing countries to strengthen management of living marine resources, and address land based and marine pollution. Over the long term, the overall result of the suite of interventions planned will be to reduce coastal pollution, restore damaged habitats, prevent fish stock collapses, and recover depleted stocks. While these benefits will only be secured once the management framework is functional, the project will make an important contribution to their realization by putting in place building blocks: information systems, capacities and mechanisms to ensure stakeholder participation. Second, enhanced knowledge of the oceanography of the ASCLMEs will assist countries on the Indian Ocean rim to adapt to climate change. Uncertainty regarding ocean-atmosphere links is presently shackling such national efforts[53].

[53] The Asian-Australian (AA) monsoon affects the livelihood of more than 60% of humanity. Better predictions of the monsoon will greatly benefit the social and economic well-being of this large segment of the world's population. There is strong linkage of the AA monsoon system to the global climate system, and thus improved understanding and prediction of the AA monsoon is not only crucial to the WIO countries but to the world as a whole. Past studies have shown that the AA-

90. At the national level, the Programme will also assist participating countries to meet the Millennium Development Goals, in particular MDG #1, Eradicate Poverty and Hunger, and MDG #7: Ensure Environmental Sustainability and MDG#8**:** Develop a Global Partnership for Development. By helping to assure the sustainability of subsistence and artisanal fisheries, the project will contribute directly to poverty prevention. For the large majority of households involved in fishing activities (full-time or occasional fishers) in the ASCLMEs, fishing and related activities do not generate high economic returns but instead help them to sustain their livelihoods and prevent them from falling deeper into deprivation. Small-scale fisheries provide a safety net when the head of a household loses his or her job or when crops fail or when the local economy deteriorates. The recent drought in Southern Africa has had a pronounced impact on crops and local economies. Civil wars, coup-d'etats and natural disasters in the region have in the past, disrupted economic activity, including tourism, and created circumstances where those affected turned to fisheries as an alternative source of income, or to provide food security. The ability of the sector to provide a social safety net is threatened by over exploitation of fish stocks, pollution and habitat degradation (especially of coral reefs, mangroves and sea grass beds). The Programme will play a key role in ensuring the future sustainability of the fisheries sectors. MDG 7 will be satisfied by building foundational capacities and putting in place Strategic Action Programmes, to address transboundary environmental concerns in the LMEs through ecosystem-based approaches. MDG 8 will be addressed by addressing the needs of Small Island Developing States, through the Programme of Action for the Sustainable Development of Small Island Developing States.

91. The WSSD Plan of Implementation makes several references that relate to LMEs and marine resources. Those that are particularly pertinent to the ASCLMEs Project are listed as follows:

- Encourage the application by 2010 of the ecosystem approach, noting the Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem and decision V/6 of the Conference of Parties to the Convention on Biological Diversity;
- Promote integrated, multidisciplinary and multisectoral coastal and ocean management at the national level and encourage and assist coastal States in developing ocean policies and mechanism on integrated coastal management;
- Assist developing countries in coordinating policies at Programmes at the regional and subregional levels aimed at the conservation and sustainable management of fisheries resources and implement integrated coastal activities and, where appropriate, the development of related infrastructures;
- Strengthen donor coordination and partnerships between international financial institutions, bilateral agencies and other relevant stakeholders to enable developing countries, in particular the least developed countries and small island developing States and countries with economies in transition, to develop their national, regional and subregional capacities for infrastructure and integrated management and the sustainable use of fisheries:
- Maintain the productivity and biodiversity of important and vulnerable marine and coastal areas, including in areas within and beyond national jurisdiction;
- Develop and facilitate the use of diverse approaches and tools, including the ecosystem approach, the elimination of destructive fishing practices, the establishment of marine protected areas consistent with international law and based on scientific information, including representative networks by 2012 and time/area closures for the protection of nursery grounds and periods, proper coastal land use and watershed planning and integration of marine and coastal area management into key sectors;
- Improve the scientific understanding and assessment of marine and coastal ecosystems as a fundamental basis for sound decision-making.

---

monsoon is linked to inter-annual variability of the tropical ocean-atmosphere system, such as the El Niño Southern Oscillation (ENSO) and the tropical biennial oscillation, and other studies suggest that the AA-monsoon may strongly impact the climate outside the monsoon region, including extra-tropical North America. Indeed, a primary goal of the CLIVAR-GOALS project of the WMO/IOC/ICSU World Climate Research Programme is to better understand ". . . the role of the AA-monsoon on the predictability of the global climate system, in particular those parts related to ENSO." Efforts will be to cultivate a close working relationship with CLIVAR during implementation, to the mutual benefit of the Programmes.

92. It is well established that the ASCLMEs are some of the most dynamically varying LMEs on Earth[54]. An important objective of the Project is to help establish the reasons for and implications of the very significant levels of *environmental variability* evident in these two LMEs. The project will play a major role in assisting countries to assess vulnerability to and cope with environmental variability, especially that caused by anthropogenic climate change. This is expected over the longer term, to have significant benefits for the agricultural sectors, and will assist countries to improve food security and predict and cope with drought. The region is particularly prone to drought, which can have profound consequences on local economies. Rained agricultural production constitutes about 90% of GDP for many African countries and crop yields can vary ten-fold from year-to-year; many water distribution systems in African countries fail during multiyear droughts. Thus the ability to predict drought will be critical to elevating the development prospects of many countries within the ASCLMEs region and beyond.

93. Finally the damage being wrought on coral reefs by rising sea surface temperatures is a major threat to food security, and the growing nature tourism industry. However, not all coral reefs are equally affected by this phenomenon, and areas affected by upwelling cells, for instance, are likely to be less prone to coral beaching and mortality. The ability to protect these areas, however, is compromised by a dearth of information on the dynamics of currents and upwelling cells. By helping to fill data gaps, the project will enable countries to take responsive measures to ensure that such refugia are well protected.

COUNTRY OWNERSHIP, COUNTRY ELIGIBILITY AND COUNTRY DRIVENNESS

Country Eligibility

94. As recipients of UNDP technical assistance, the participating countries are eligible for GEF funding under para. 9 (b) of the GEF Instrument. Furthermore, planned interventions meet the eligibility criteria for GEF sponsorship inscribed in the GEF Operational Strategy for International Waters, Operational Programme 8: Waterbody-based Programme and Strategic Priorities for GEF finance. The Operational Strategy will be realized by building capacities amongst a group of countries to plan, implement and adapt a suite of measures to protect the transboundary ASCLMEs. GEF finance will offset the incremental costs of a) establishing a common understanding of the environmental problems manifest in the ASCLMEs, and their complex determinants; b) building capacity in the region to address these problems; and c) reinforcing political will to implement and sustain a common Programme of action. The Programme will provide resources for the preparation of comprehensive TDAs and SAPs for the Agulhas and Somali LMEs. These will be key Outcomes of the three projects, each focused on generating information and commitments in their respective areas of focus. In addition, steps will be made to ensure broad based participation in interventions, straddling a range of Government and private stakeholders.

95. The ASCLME is consistent with OP #8 of the GEF, the Water-Body based Operational Programme. Further it is consistent with Strategic Priority IW-2 of the GEF for the International Waters focus area. This focuses on the expansion of GEF foundational capacity building work in priority African waterbodies. Moreover, the project stresses south-south learning opportunities, and technology transfer, particularly within the ASCLMEs region, where great asymmetries in institutional capacities are evident. The project will use institutions with high capacity to build capacity where it is weak[55]. In addition to the provision of GEF finance, the Programme will catalyse investments in LME management from other financing bodies. As the project targets two mainland LDCs and four SIDS[56], it helps achieve the goal of ensuring project coverage in 90% of LDCs and 90% of SIDs. Finally, the ASCLMEs Programme further satisfies the IW Strategic Priorities by enabling countries to achieve targets agreed at the World Summit on Sustainable Development (Johannesburg WSSD, 2002). These include strengthened regional cooperation frameworks for sustainable management of the oceans, adoption of an ecosystem approach to fisheries management, and the maintenance or restoration of fish stocks on an urgent basis, and where possible by

[54] A. Bakun, S. Lluch-Cota and C. Roy. 1998. Coastal upwelling and other processes regulating ecosystem productivity and fish production in the western Indian Ocean. p. 103-141. In: K. Sherman, E. Okemwa and M. Ntiba, (eds.) Large Marine Ecosystems of the Indian Ocean: Assessment, Sustainability, and Management. Blackwell Science Inc. Malden, MA. USA.

[55] This approach, undertaken within the construct of the NEPAD Africa Process seeks to engender South-South links in the region, allowing the region to work collectively to address common problems.

[56] Two of the SIDS (Madagascar and Comoros) are also classed as LDCs. The mainland LDCs are Mozambique and Tanzania. Mauritius and Seychelles make up the remaining SIDS.

2015.

Country Drivenness

96. Each of the participating countries, through the endorsement of their GEF Focal Points, have reviewed and approved their participation in this Project. National support is further demonstrated by the following facts: (i) Participating countries are party to the Nairobi Convention, aimed at ensuring the judic ious use of the ASCLMEs resources; (ii) Membership of the participating countries in such regionally based organizations as the Indian Ocean Tuna Commission, Indian Ocean Commission, and Southwest Indian Ocean Fisheries Commission; (iii) Membership in NEPAD and, through the NEPAD process, agreement to foster sustainable development in marine and estuarine areas, taking an ecosystem based approach to management; and (iv) Endorsement of and active participation in activities undertaken during the preparatory stage of the project, including, among other things: participation in three expert workshops to frame overall project design, participation in decision making through meetings of the Project Steering Committee, and participation in activities aimed at strengthening Programme inter-linkages.

LINKAGES WITH UNDP COUNTRY PROGRAMMES

97. Most of the ASCLMEs countries have identified poverty reduction as a priority issue for cooperation with the UNDP. UNDP is working to ensure that all environmental and sustainable development initiatives contribute to this agenda. The project will play a major role in sustaining the natural resource base, on which poor coastal communities in the ASCLMEs region depend for their sustenance. DLIST will make available scientific and other information generated through the ASCLMEs Programme to numerous stakeholder groups, engaged in the fight against poverty. This assistance, will, *inter alia* assist countries to adapt their poverty alleviation strategies, to incorporate measures that specifically address their specific vulnerability to environmental variability, fisheries depletion, etc. UNDP will ensure that the findings of the project inform efforts to update Poverty Reduction Strategies. The project is also clearly in line with UNDP regional priorities. Specifically, the project emphasis upon strengthening regional Programmes links closely with the Regional Cooperation Framework for Africa where Strategic Area of Support 1: Strengthening democratic and participatory governance result (e) aims specifically at ensuring: "sustainable development frameworks (are) in place in most countries and cross boundary water resources and energy resources (are) managed more effectively". The project will make a major input towards UNDP's efforts to strengthen NEPAD initiatives, through strengthening facilities for regional cooperation.

98. In addition, the project's emphasis upon the sustainable management of the overall resource associated with these two marine ecosystems, including elements related to agriculture, land degradation and climate change, clearly links into global, regional, and country priorities of the UNDP in Africa, particularly as these relate to the UNDP focus on the achievement of the MDGs. There are close links to the work being supported by UNDP through the Nairobi based Dryland Development Centre, which assists countries to gauge vulnerability to drought and enhance drought preparedness. This is assisting countries to identify communities most at risk from drought, and take steps to reduce their vulnerability. This assistance has been identified as a priority in the National Action Plans (NAPs) to combat Desertification that the Centre has assisted several ASCLME countries to prepare. The project will contribute to these efforts by helping to improve drought prediction capabilities. The ASCLMEs region is prone to extreme weather events, which include severe tropical storms and flooding. Crisis prevention and recovery constitutes one of UNDP's core focus areas, and UNDP has established a Disaster Reduction Unit, which is supporting countries in the ASCLMEs to prepare disaster risk assessments and improve their coordination capacity, in responding to natural disasters. Information on environmental variability generated through the ASCLMEs Project will allow countries to refine their disaster risk profiles and strengthen their accompanying disaster response strategies and activities. UNDP will work to ensure the findings are accommodated in national response measures, and make available information through its well established knowledge management networks.

LINKAGES WITH GEF FINANCED PROJECTS

99. In addition to the linkages established among the three projects within the Programme, the project will

establish key linkages with other GEF financed projects within the region. Annex 10 summarizes related GEF projects in Sub Saharan Africa that are relevant to the ASCLMEs project. It is expected that NEPAD will provide a focal point for linking the various African LME projects directly to one another. IW:LEARN will also serve to provide linkages between the relevant GEF projects at both the regional and global level.

SUSTAINABILITY

100. The project is part of a long-term Programme, with discrete phases: 1] TDA / SAP formulation, 2] SAP implementation. Phase 1 is designed to generate information and create foundational capacities, monitoring systems and knowledge management systems needed to set the ground for SAP implementation. As information needed to prepare the TDAs / SAPs and effect management is sparse in the ASCLMEs, the project marks a departure from traditional TDA/ SAP projects, by making a major up-front provision for environmental assessment. This is necessary in order to set technically robust priorities for the SAP. It is not intended that the project, in and by itself will establish a sustainable ecosystem management framework for the ASCLMEs. Provisions to ensure the creation and measures to ensure the sustainability of such a framework will be engendered during the SAP implementation phase. The SAP will contain provisions for needed policy reforms and institutional strengthening that will ensure the sustainability of interventions and ensure that targets embodied within the WSSD Plan of Implementation concerning coastal and marine ecosystems are realised and sustained. The project will ensure that foundational capacity is in place, and data gaps that hitherto have hampered development of ecosystem-based approaches to management of the LMEs will be addressed. This will improve fundamentals for ensuring the sustainability of interventions during the SAP implementation phase. A number of measures are planned during this phase, to set the grounds for ensuring the long-term institutional, political and financial sustainability of interventions during SAP implementation.

101. The phased approach allows interventions to be scheduled within the absorptive capacities of the participating countries. There is considerable asymmetry in institutional capacities to plan, execute and interpret LME assessments in the region. A key strategy of the project in engendering institutional sustainability in these circumstances is to create partnerships at regional levels between institutions. National institutions responsible for continuing the activities that will be started under the project will be identified, as will regional centres of expertise, which will provide the locus for training activities. The strategy aims at pairing high capacities with weaker capacities to effect capacity transfer between institutions in the region. This approach, undertaken within the construct of the NEPAD Africa Process seeks to engender South-South links in the region, allowing the region to work collectively to address common problems. The strategy is expected to greatly enhance prospects for assuring institutional sustainability, building on existing regional competencies. The Capacity Building and Training Programme, to be developed collaboratively by ASCLMEs and SWIOFP will identify training needs for national institutions, which will provide the basis for the development of a training curriculum. This will be updated periodically, based on the outcomes of post-course questionnaires and independent evaluation. Formal training will be supplemented through indirect training, such as participation in cruises, and information exchange between institutions, facilitated through a dedicated kiosk, established under the auspices of DLIST.

102. A number of on going political processes within the region provide the foundations for ensuring the political sustainability of interventions, and level of confidence that an ecosystem management framework for the ASCLMEs will be operationalised as part of SAP implementation. These processes include those related to NEPAD, the Nairobi Convention, SADC, and the SWIOFC. The NEPAD has membership on the Project Steering Committee, as does the SADC. The Programme has established early linkages with the SWIOFC, and while the ASCLME and SWIOFP projects will be able to assist the SWIOFC over the period of project implementation by fulfilling many of the objectives that are foreseen by the SWIOFC, the SWIOFC will continue to exist beyond the life of the Programme and thus will be an instrument of sustainability over the longer term. The Nairobi Convention will also be a key vehicle for assuring the longer-term sustainability of the outcomes, outputs and activities of each of the projects under the overall Programme. Owing to the fact that many country representatives sit on the various Steering Committees of the three ASCLMEs projects, there is an immediate and effective linkage built in between the ASCLMEs Programme and Convention related processes. Finally, the Programme will help leverage resources from national budgets, and multi-lateral and bilateral funders to implement the activities identified as priorities in the SAP. Interventions will help match funding needs with prospective funding sources. Economic evaluations of

the costs and benefits of LME management will provide a basis for justifying budgetary appropriations to the Programme including from fishery license fees. This will be further facilitated through efforts to mainstream Programme activities within Poverty Reduction Strategies and Disaster Mitigation Programmes, which influence budget allocations, as well as donor funding.

REPLICABILITY

103. The Programmatic Approach, through its use of the three IAs to undertake specific projects within the Programme based on comparative advantage, and the use of the three IAs to cooperatively define and finalize the TDAs and the SAPs are promising approaches for replication in other, future GEF IW projects. The iterative approach being taken for TDA and SAP development, using environmental baseline assessments to capture missing information to better inform the TDA and SAP development, is also an experiment that could well lead to more comprehensive and science driven TDAs and SAPs in future. Further, the emphasis on establishing strong scientific baselines across a broad range of oceanographic and biodiversity values in the ASCLMEs is also an approach that could be replicated in other developing regions where an ecosystem based approach is being applied to the management of LMEs. It is foreseen that the ASCLMEs project will result in establishment of a comprehensive scientific information base that will have utility, not only for the purposes of TDA and SAP development but will also serve as a platform for informing long-term management decisions for shared waters, fisheries and biodiversity. It is an approach that could well be of use for other GEF IW initiatives. The Programmatic approach to public participation and community education, through the incorporation of DLIST and other stakeholder involvement activities across a range of GEF projects in the ASCLMEs region, is also an approach that could lend itself to useful replication in other development regions where the GEF has cross-Programmatic interventions planned or underway. Last, the Project will also take advantage of IW:LEARN to develop training courses at the regional level and will be used to help both disseminate and harvest lessons/ good practices to and from other Projects. The project will develop a web site consistent with IW LEARN guidance, will participate in IW LEARN events and e forums and makes funding provision to allow countries to participate in the biennial IW conferences.

STAKEHOLDER PARTICIPATION

104. The ASCLMEs project includes a discrete outcome and attached outputs and activities aimed specifically at engendering broad based stakeholder participation in planned activities. A major vehicle for engendering public participation and community and institutionally based environmental education activities will be secured through the use of the Distance Learning and Information Tool (DLIST). The DLIST will allow scientific information to be demystified, and made relevant to the needs of different stakeholder groups. This will have bearing, beyond the management of fisheries and other marine resources for national development strategies and Programmes, disaster preparedness schemes, and adaptation initiatives, responding to climate change. DLIST is designed to be demand driven, and will provide a two-way information exchange system between scientists, managers and communities. This will allow the SAP to be progressively informed by and to respond to local needs, and take these into account when prioritising interventions for future implementation. Other interventions include: development of networking opportunities between environmental education practitioners, development of resource materials on marine related topics, sensitive to the social and cultural milieu, the provision of targeted training opportunities for environmental educators, and the design and execution of a broad based media outreach initiative in the region. The costs of these activities will be shared between the GEF and ACEP, with funding from South Africa. Table 10 lists the key activities, products, and targets[57].

TABLE 10: PARTICIPATION PLAN – PRODUCTS AND TARGETS

Output	Activity	Product	Target
PP Project	Facilitation and coordination of PP activities in the region	Coordination of activities in each country	6 months from project start
	Meetings and workshops	Documentation and plans for PP in the	6 months from start of

[57] Of the US$ 3,100,000 the GEF increment will be US$ 1,500,000 while ACEP will co-finance US$ 900,000 and EcoAfrica US$ 500,000.

Output	Activity	Product	Target
		region	project and annually
	Stakeholder consultations	Workshop/meeting proceedings and documents	7 months from start of project and annually
	Documentation of existing courses and EE Programmes/projects	Report and database	End 2006
Networking	Stakeholder analysis	Stakeholders list	
	Creation of ICT tool & Knowledge Management	DLIST	18 months from start of project
	Stakeholder communication	Website contributions; newsletter (print); media releases (print, TV); public presentations	Ongoing Bi-annually Ongoing Ongoing
	Capacity building	Support structures for education and public awareness practitioners Annual meeting of coordinators	1 year from start will there be support structures and ongoing contributions First one 6 months from start of project then annually
	Representation at different networks and forums	Conference presentations and contributions to meetings	Ongoing, at least 2 annual international/regional conferences/meetings
Product development	Creation and documentation of short films and television Programme inserts	Films • Educational • public interest	 2 annually from 2007 - 2009 4 annually from 2006 - 2008
	Development, documentation and showing of environmental theatre	Environmental theatre piece	12 month from start of project and updated annually till 2008
	Creation and documentation of distance course	Courses on coastal zone management	9 months after the start of the DLIST website
	Creation and documentation of EE school based materials	Books, CD-ROMs for schools based education	Annually 2 products developed in each country from 2007 till 2009
	Creation of display material and development of a culture of expositions	Models	6 models per country 2 years from project
	Creation and distribution of interpretive signage and posters	Posters	9 per country start 8 months from project start, 4 per country annually from 2007 till 2009
	Creation and documentation of field guides	Field/sampling guides	2 from 2007 till 2009
Training	Presentation of Coastal Zone course	DLIST course trainees/graduates	From 2007 -
	Educator training	trainees	10 000 till 2009
	Supervising and mentoring graduates	MED graduates PhD graduates Environmental Education certificate holders	8 at the end of 2009 4 at the end of 2009 20 at the end of 2009
	Experiential educator training	Educators exposed to first hand ocean research	45 by the end of 2009
Public Participation and Awareness	Experiential learning	Learners exposed to research vessels through on-board visits	4000 by the end of 2009

Output	Activity	Product	Target
	Communication	Articles, newsletters, public workshops, community presentations	Widespread through out the life of the project
	Information sharing	DLIST outreach component DLIST Maintenance Informed stakeholders Community aware of marine environment School outreach Museum/expo displays	After completion of course development and initial tool development 2007-2010 Ongoing Ongoing 2 annual events 2 annual events
TOTAL			

PART III: MANAGEMENT ARRANGEMENTS

IMPLEMENTING AGENCY CONSULTATIONS, LINKAGES, AND COOPERATION

105. The Implementing Agencies (UNDP, UNEP and the WB) have been and will continue to work collaboratively toward the realization of the overall objectives of the ASCLMEs Programme. Each of the three IAs has been represented at most of the preparation sessions for the respective projects of the Programme. The WB implemented SWIOFP project and the UNDP implemented ASCLMEs project were developed in close collaboration between the respective Project Managers and other expert resources associated with the two projects. These two projects have collaborated closely in developing their respective baselines and logical frameworks. The latter accommodates outputs of the WIO-LaB project.

106. The **Programme Coordination Committee (PCC)** would be comprised of members from each of the projects. Overall responsibility for coordination will be assumed by the UNDP implemented ASCLMEs project. Each of the projects within the Programmatic approach would be represented on the PCC by the respective task team leaders for the IAs, Project Managers, and two members from each of the respective Project Steering Committees. The PCC would meet not less than once annually, and will meet at the call of any of the project managers. Among other things, the PCC would focus on a unified approach to capacity building, LME module coverage, TDAs and SAPs development, donor recruitment and other issues to ensure long-term Programme sustainability. The UNDP, working through the PCC would also ensure that projects in combination, and in relation to other related projects and Programmes within the region.

107. The UNDP ASCLMEs project will also assume ultimate responsibility for the development of the TDAs and SAPs that will be a principal product of the Programmatic approach. It is foreseen that two TDAs and two SAPs will be required within the Programmatic approach for the two LMEs, one for the Agulhas LME and a separate TDA and SAP for the Somali LME[58]. The UNDP ASCLMEs project will utilize TDA and SAP inputs from the WIO-LaB and SWIOFP projects in final TDAs and SAPs preparation, utilizing also Interministerial Committees (IMCs) and technical workgroups as necessary to assure a comprehensive TDA and SAP for the Agulhas LME and an interim TDA for the Somali LME. A harmonized implementation structure for the projects has been agreed to by the IAs:

- Each of the Project Managers will sit on the respective Project Steering Committees established under the Programme, to assure a continuing and effective set of Programmatic linkages, the avoidance of activity duplication, and the creation of cost efficiencies at the administrative level.
- The Regional Management Office of SWIOFP will house the Cruise Coordinator (A ship coordination specialist). This expert will be an ASCLMEs Programme officer and the funding to support the position,

[58] As previously mentioned, it will not be possible to do a comprehensive TDA and SAP for the Somali LME due to the continuing instability in Somalia, which comprises a large shoreline area for the Somali LME. Emphasis at the early stages would be on the Zanzibar Current area.

including provision of office space and support, will be assumed by SWIOFP.

- The Regional Management Office of the UNDP ASCLMEs project will house the ASCLMEs Information Systems Officer. This expert will be an ASCLMEs Programme officer and funding to support the position, including provision of office space and support, will be assumed by the UNDP ASCLMEs project.
- Annual Work Programmes for the three projects will be prepared jointly, using the vehicle of an annual Programme meeting. The responsibility for hosting this meeting will alternate among the projects, and the UNDP ASCLMEs project will be responsible for overall coordination. Further, the annual Programme meetings will include comprehensive reports from each of the projects on the status of information gathering pursuant to TDAs and SAPs preparation.
- EcoAfrica will execute the DLIST project on behalf of the UNDP ASCLMEs project and for the benefit of the three projects within the ASCLMEs Programme as a whole. EcoAfrica has successfully assumed such a role for the GEF supported Benguela Current Large Marine Ecosystem project.

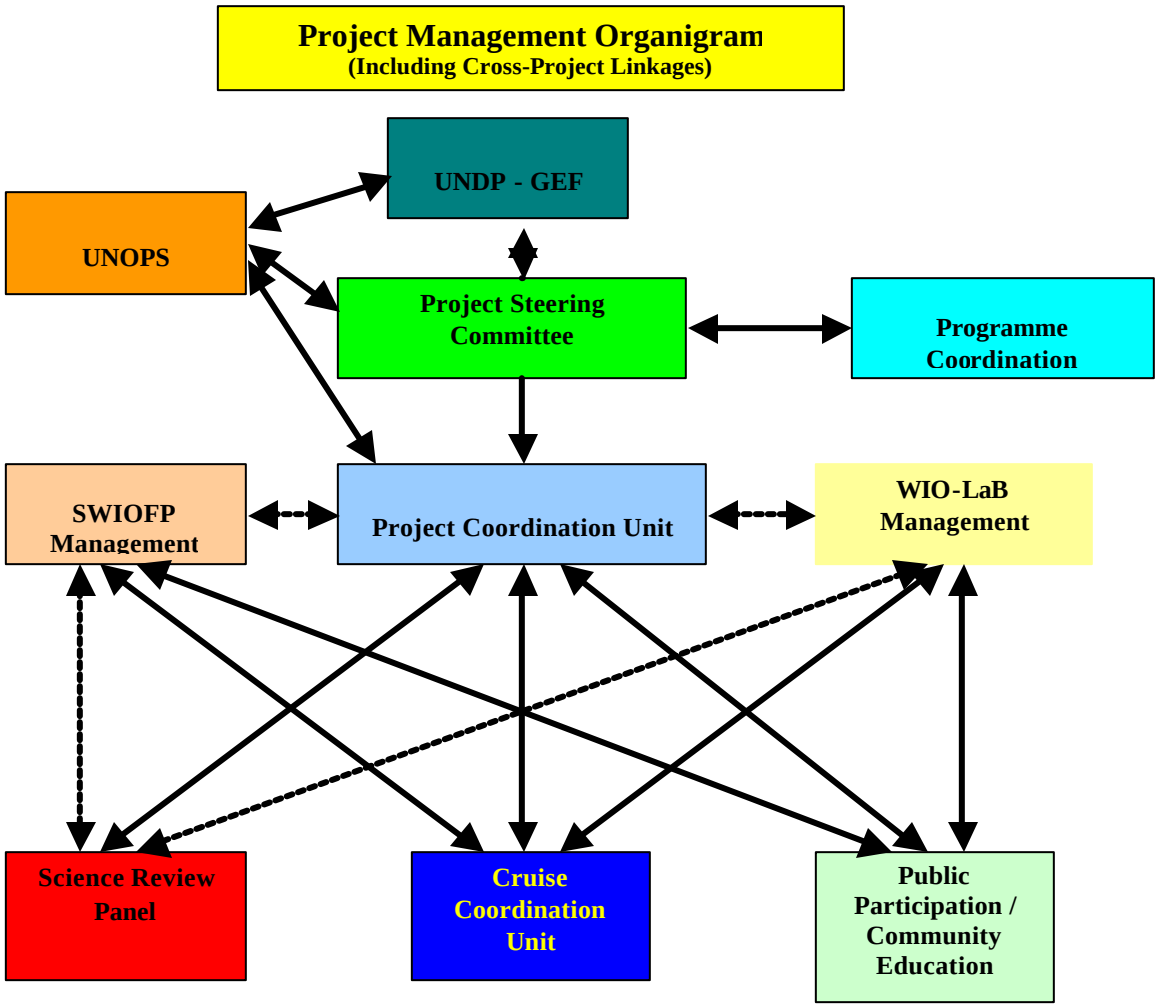
EXECUTING ARRANGEMENTS

108. **Project execution** for the UNDP ASCLMEs project will be the responsibility of the United Nations Office of Project Services (UNOPS), through its Global and Inter-Regional Division in accordance with standard operational, financial guidelines and procedures. UNOPS will remain accountable to UNDP for the delivery of agreed outputs as per agreed project work plans, and for financial management, and ensuring cost-effectiveness.

109. The Project will be driven at policy and strategic level by a **Project Steering Committee.** The PSC will be comprised of one representative from each of the three projects; one representative from each of the participating countries; one member from France; one member each from the SADC and NEPAD; and one representative from UNOPS. The PSC will meet annually to monitor progress in project implementation, provide strategic and policy guidance, and review and approve work plans and budgets. PSC meetings will be chaired by the national representative in the country hosting the meeting. The PSC will retain the authority to amend its membership as it deems necessary.

110. There will be a small Project Coordination Unit (PCU) located in South Africa. The PCU will consist of an internationally recruited Project Manager, an Administrative Assistant, and other administrative and secretarial personnel retained on a full-time or contractual basis, as needed. International and National consultants will also be retained as needed, with the provision that nationally based expertise will be sought in the first instance. The PCU will also be a meeting site for, and serve a secretariat function on behalf of a Project Science Review Panel. The Science Review Panel will be comprised of three core members chosen from the PSC. Finally, the Project will assist in supporting a Cruise Coordinating Group (CCG). The CCG will, in cooperation with SWIOFP and WIO-LaB, be charged with the scheduling and careful coordination of each of the cruises associated with project work, including make-up of country expertise and trainees, specific functions, locations, etc. The projects will hire a professional Cruise Coordinator to manage the very complex logistics of the various ships and numerous cruises that the projects will be undertaking jointly and singly. They will possess the scientific credentials necessary to evaluate the scientific soundness of project activities and will report to the full PSC. The Project Science Review Panel may, at its discretion and consistent with available resources, strike specific sub-committees of experts to peer review ongoing or completed activities. The Project Manager through the PCU will ensure the requisite level of communication and coordination with the other Projects that are part of the ASCLMEs Programme, and other GEF supported LME projects, non-GEF related projects and Programmes, donors, and other groups and individuals as may be necessary to ensure successful implementation. Figure 2 shows the planned project management arrangements.

FIGURE C: ORGANIGRAM OF PROJECT MANAGEMENT STRUCTURE



PART IV: MONITORING AND EVALUATION PLAN AND BUDGET

111. The Monitoring and Evaluation Plan provides for a series of linked activities, including annual Project Implementation Reviews (PIR), Tripartite Reviews, Quarterly Project Reports, Work Plans, and independent mid-term and final project Evaluations (see Table 11). A number of process indicators (PIs) to guide monitoring and evaluation activities are provided in the Log frame. PIs may be further partitioned into two types: the first relates to processes necessary to achieve the outcomes of the project, while the second type aims at measuring progress in ensuring the long term sustainability of management. In the first category PIs include, *inter alia*, such indicators as the establishment and successful functioning of the Project Steering Committee, establishment of the DLIST Programme, the ability of project management, through the countries, to successfully incorporate country expertise into cruises, GIS work, and other exercises related to the filling of identified science gaps. Examples of the second category of PIs would include, among others, the establishment of mechanisms that would enable the countries to consolidate and manage over the long-term a data management centre. While the first category of PIs have already been selected, the second would be determined upon project inception and might include the establishment of more effective regulations for regional and country-based fisheries based on improved scientific understanding of the large marine ecosystems, enactment and implementation of improved policy and legislation for fisheries and coastal zone management to protect vulnerable coastal habitat and enhance the sustainability of fisheries,

112. Environmental status and stress reduction indicators (SRIs), consistent with GEF IWM&E strategies will

be identified at a Programme level, by the three projects as part of the process of preparing the SAP[59]. The latter could include, *inter alia*, protection of critical spawning habitat with consequent, measurable benefits for artisanal and commercial fishers, measures for the protection of watershed catchment areas, and quantification of benefits deriving from increased, environmentally friendly behavioural practices in coastal zone areas. These indicators will provide a basis for monitoring performance towards agreed outcomes and the impacts of activities during SAP implementation.

PROGRESS AND ON-GOING EVALUATION REPORTS

113. Project objectives, outputs and emerging issues will be regularly reviewed and evaluated annually by the PSC. Reporting (annual and quarterly) will be done in accordance with UNDP, UNOPS and GEF rules and regulations. The Annual Programme/Project Report/Project Implementation Review (APR/PIR) is designed to obtain the independent views of the main stakeholders of a project on its relevance, performance and the likelihood of its success. The APR/PIR form has two parts. Part I asks for a rating of project relevance and performance as well as an overall rating of the project. Part II asks for a textual assessment of the project, focusing on major achievements, early evidence of success, issues and problems, recommendations and lessons learned. The APR/PIR will be prepared by the Project Manager, after consultation with the Steering Committee and relevant Stakeholders, and will be submitted to UNDP for review and approval. Quarterly progress reports will be prepared using the same procedures. The project will be subject to the various evaluation and review mechanisms of UNDP, including the Tri-Partite Review (TPR) and periodic supervision and evaluation missions. The project will also participate in the annual Project Implementation Review (PIR) of the GEF. The PIR is mandatory for all GEF projects that have been under implementation for at least a year at the time that the exercise is conducted. Particular emphasis will be given to emerging GEF policy guidance in the context of the IW focus area.

MID-TERM AND TERMINAL EVALUATIONS

114. Independent monitoring of the project will be undertaken through contract, using a balanced group of experts selected by UNDP, in collaboration with UNOPS. The extensive experience of UNDP in monitoring large regional projects will be drawn upon to ensure that the project activities are carefully documented. There will be two evaluation periods, one at mid-term and another at the end of the Project. The mid-point review will focus on relevance, performance (effectiveness, efficiency and timeliness), and issues requiring decisions and actions and initial lessons learned about project design, implementation and management. The final evaluation will focus on similar issues as the mid-term evaluation but will also look at early signs of potential impact and sustainability of results, including the contribution to capacity development and the achievement of global environmental goals. Recommendations on follow-up activities for Phase 2 implementation will also be provided. Last, monitoring and evaluation at the scientific level will be undertaken on an as needed basis through the Project Science Advisory Board.

EXTERNAL REPORTING

115. The monitoring and evaluation process for the project are summarized in Table 11 below:

TABLE 11: MONITORING AND EVALUATION TEMPLATE

Activity	Responsibilities	Timeframes
Drafting Project Planning Documents: ProDoc, LogFrame (including indicators), M&E Plan	UNDP staff and consultants and other pertinent stakeholders. Steering Committee Review	During project design stage
M&E Plan	UNDP, project development specialists	During project design stage
Work Plan	Project Manager, with UNDP	Annually (first year: inception report)
Quarterly Operational Reports (QORs)	UNDP and PPR	Quarterly

[59] The strategy for establishing such indicators will be codified in the M&E Plan available at CEO endorsement.

Activity	Responsibilities	Timeframes
Annual Programme/ Project Reports (APRs) Project Implementation Review (PIR)	The Steering Committee, working closely with UNDP and the Project Manager in consultation with Project stakeholders UNDP, project team, S.C., GEF M&E team	Annually Annually, between June and September
Tripartite Review (TPR)	Governments, UNDP, project team, Steering Committee, beneficiaries and other stakeholders	Annually
Mid-term and Final evaluations	UNDP, project team, S.C., independent evaluators	At the mid-point and end of project implementation.
Terminal Report	UNDP, Project Manager, S.C.	At least one month before the end of the project
Post-Project Sustainability Evaluations	UNDP, Project Team and GEF, S.C.	Toward end of 3rd. year after Project Inception

116. UNDP, as the Implementing Agency, shall also be responsible for monitoring Project performance to ensure conformity with Project objectives and advising UNOPS on implementation issues.

BUDGET

117. The total cost of the project is estimated to be US$ 30,005,000, with GEF funding in the amount US$ 12,200,000 (excluding preparatory assistance). Co-financing has been secured from the Participating Countries, South Africa/ACEP, the Government of Norway, France, UNEP, FAO, and EcoAfrica. The Full project would be implemented over a period of 4 years. A number of activities (e.g. cruises and preparation of the TDAs and SAPs) will be undertaken on a cost-shared basis with SWIOFP and WIO-LaB.

TABLE 12: OUTPUT BUDGET FOR PROJECT

Project Outcomes/Activities/Outputs	**Amount (US$)**		**Total US$**
	GEF	**Total Co-finance**	
Outcome 1:			
1.1. Prioritised information gaps in ecosystemic processes in key geographic areas of ASCLMEs are addressed	5,500,000	9,000,000(SA/ACEP); 2,100,000 (Norway); 250,000 (Governments); 350,000 (UNEP); 150,000 (FAO)	17,350,000
1.2. Baseline information obtained on persistent organic pollutants (POPs) within the LMEs through use of key indicator species	250,000	500,000 (France); 100,000 (UNEP); 50,000 (Governments)	900,000
Total Outcome 1	5,750,000	12,500,000	18,250,000
Outcome 2:			
2.1 Facilitate establishment of a data management facility or facilities for the continuing collection, synthesis and storage of country and regional data, and the repatriation of extra-regional data and information.	200,000	50,000 (Governments); 100,000 (UNEP)	350,000
2.2 Establish a coordinated plan for assembling and reporting on agreed indicators for monitoring and evaluation of the status of the Agulhas and Somali LMEs	200,000	100,000 (Governments); 100,000 (UNEP)	400,000
2.3 Increased systems knowledge through the use of GIS and predictive models	825,000	1,000,000 (ACEP); 100,000 (Governments); 100,000 (UNEP)	2,025,000
Total Outcome 2	1,225,000	1,550,000	2,775,000
Outcome 3:			
3.1. Financial resources brokered to ensure the financial sustainability of information systems	150,000	150,000 (ACEP); 100,000 (Governments)	400,000
3.2 Institutional, Programme and human capacity building requirements are identified and addressed through training initiatives.	900,000	200,000 (Governments); 1,000,000 (ACEP); 100,000 (FAO)	2,200,000
3.3 Options for and final selection of a regionally-based	100,000	100,000 (Governments);	300,000

Project Outcomes/Activities/Outputs	Amount (US$)		Total US$
	GEF	Total Co-finance	
entity or entities that would continue the work begun as part of Preparation activities and Programme and Project implementation are considered and decided upon.		100,000 (ACEP)	
3.4 Close and regularized communication established among the IAs, the various Projects under the Programme, and related GEF supported biodiversity projects, and other related projects and institutions in the region	400,000	50,000 (Governments); 155,000 (ACEP)	605,000
3.5 Linkages with other GEF supported LME projects in Sub-Saharan Africa and globally are established and maintained, and project personnel are enabled to attend relevant workshops and conferences regionally and globally.	375,000	100,000 (Governments)	475,000
3.6 TDAs and SAPs finalized.	1,500,000	100,000 (Governments)	1,600.000
Total outcome 3	3,425,000	2,155,000	5,580 ,000
Outcome 4:			
4.1 A distance learning and information-sharing tool (DLIST) is developed and implemented for the Programme.	1,400,000	450,000 (EcoAfrica); 100,000 (Governments)	1,950,000
4.2 New and enhanced existing public involvement, participation, and environmental education initiatives are developed and implemented in the region.	400,000	900,000 (ACEP); 100,000 (Governments); 50,000 (EcoAfrica)	1,450,000
Total Outcome 4	1,800,000	1,600,000	3,400,000
Total full project	12,200,000	17,805,000	30,005,000
Project Preparation	723,000	457,500	1,157,500
GRAND TOTAL (FULL PROJECT + PREPARATION)	12,923,000	18,262,500	31,185,000

SECTION II: STRATEGIC RESULTS FRAMEWORK AND GEF INCREMENT

PART I: INCREMENTAL COST ANALYSIS

118. The ASCLMEs are strategically important as sources of local livelihoods, and for the provision of ecological services. A number of national and international initiatives are underway to facilitate the sustainable use of coastal and marine resources. These activities form a set of baseline activities that can be characterized as generally beneficial, in terms of their contribution towards fulfilling management needs, but insufficient to achieve an ecosystem based approach to management. The incremental cost analysis below provides greater detail on baseline activities currently underway and sets out the incremental costs attached to planned project interventions.

Baseline

119. A joint baseline scenario was developed by the ASCLMEs and SWIOFP projects. The baseline represents an assessment of the current and planned national and international investment in the ASCLMEs region in activities complementary to the components of the two projects, namely: marine and coastal research, monitoring, and management. This includes support to relevant activities within Government ministries and departments, externally funded donor projects, and regional initiatives. Only expenditures related to the activities identified in the GEF alternative to be incurred over the lifetime of the projects were included in the baseline assessment. A breakdown of baseline activities and costs is presented in the Incremental Cost matrix and attached tables. Of the total calculated baseline of US$ 194.5 million, approximately US$111.5 million serves as the baseline for SWIOFP and US$ 83 million for ASCLMEs.

120. The principal threats facing the region have been described above and in Annex 4. Under the baseline scenario a number of interventions, primarily nationally based are being financed to improve country specific coastal zone resource management. Further, international organizations such as the IOTC and the IOC, and multi-

lateral and bi-lateral donors such as the EU and France are financing measures largely aimed at managing the region's offshore tuna fishery. While insufficient to address the number and severity of threats described in the Threats table (Table 4) these initiatives give the region at least a rudimentary basis that can be built upon by the combined activities of the ASCLMEs Programme. Successful mitigation of the identified threats will be determined, in part by the extent to which outstanding knowledge gaps are filled in the areas of oceanography, fisheries, pollution from land-based sources, and open ocean pollution (oil). These knowledge gaps need to be filled to formulate TDAs and SAPs for the Agulhas LME and Somali LME, to direct management effort and funding to dealing with the most potent pressures.

121. Priority environmental knowledge gaps are filled. The total baseline investment under this Outcome is estimated at US$ 60,000,000. This amount includes the budgets of dedicated, government run and university sponsored oceanographic institutes and departments in the participating countries and portions of other ministerial budgets, primarily fisheries, related to this Outcome. Virtually all the country specific baseline is dedicated to national level effort (approximately US$ 23 million). The overall donor baseline is estimated to be US$ 37 million. A substantial part of this donor baseline is committed to the coastal zone areas of the participating countries, and a much smaller percentage of the total derives from multi-lateral (EU) and bi-lateral (France) assistance that does address regional level oceanographic research (largely in relation to the tuna fishery). While limited in human and financial terms, some of the baseline activities at national level, within government ministries and departments and universities will be helpful to the project and overall Programme by making available personnel and graduate students whose paid and/or academic time can be invested in regional activities.

122. A long-term Programme is established for data and information collection, synthesis, storage, and dissemination and system monitoring. Baseline funding for this Outcome is estimated to be US$ 5,000,000. Ecosystem level monitoring (coastal, riparian, shallow and deep water) even within national boundaries is not common and many countries face difficulty monitoring commercial marine resources. Many fisheries departments engage in limited MCS activity within the EEZ, but even this modest level of activity is limited by resource constraints. Donor financed MCS projects to increase the capacity of national governments to monitor their national waters (Madagascar, Tanzania, and Seychelles) are underway. The majority funding for this baseline at national level derives from country specific funding in government departments for national data and information collection and storage, and universities and regional institutions such as IOTC and IOC which contain national as well as regional data information. No baseline funding is currently committed to data and information collection, storage, and synthesis across the entire region, nor is there any baseline funding for stakeholder access to regionally based information. Additionally, each country has to varying degrees established GIS capability and funding committed to GIS effort (approximately US$ 2,000,000 over four years) will serve as a basis for projects and Programme related activities to regionalize GIS efforts.

123. Measures to ensure the financial and institutional sustainability and application of information management systems. The baseline amount for this Outcome is estimated to US$ 10,000,000. Approximately half of this amount is in-kind government contributions to meet responsibilities of membership in the various regional institutions, including travel costs, salaries, communications, and subsistence expenses. These regional organizations include NEPAD, the Indian Ocean Tuna Commission, the Indian Ocean Commission, the new Southwest Indian Ocean Fisheries Commission, the Nairobi Convention, and SADC. The remainder of the baseline derives from country assumed training and attendance at extra-regional conferences and workshops and the application of country specific data to inform national level management decisions concerning coastal zone management and near and off shore fisheries.

124. A comprehensive Programme of public participation to enable stakeholders to participate in Programme activities. The baseline for this project Outcome is estimated to be US$ 3 million. This total includes country specific investments in public participation in coastal areas and for national objectives. No baseline finance is committed by the countries or by the existing array of international donors for regionally based public participation or environmental education initiatives dealing with LMEs as a unit.

125. A table summarizing the regional baseline and gaps follows:

TABLE 13: REGIONAL BASELINE AND GAPS

Baseline Activity	Organization/Project/ Programme	Gaps
Oceanographic Assessment Country EEZ based oceanographic research, data and information creation, collection and storage	Government Oceanographic Institutes or oceanographic departments in environment or fisheries ministries	Little or no emphasis on transboundary issues. Very shallow layer of trained oceanographers and limited budgets limit the number of ship cruises and purchase of specialized equipment for non-ship based activities such as GIS based modelling. Limited opportunity for extra-national training. Data and information is nationally based and not generally shared at regional level. Public participation generally not emphasized.
Training (Physical and Chemical Oceanography and related Ecology/ Biology disciplines) Training of oceanographers Training marine scientists	University based oceanographic and marine sciences advanced degree Programmes	With the exception of South Africa, very low enrolments and limited or no oceanographic or marine sciences Programmes offered in curricula. Retention of university trained scientists very difficult. Limited ability for professional advancement (connected to low retention rates).
Applied Research Marine ecology Bio-indicators Ecosystem modelling Fish inventories Mascarene Plateau	French IRD (THETIS Programme), ECOMAR, IFREMER Shoals of Capricorn Project (RGS). Training in scientific, practical and marine safety skills, in order to support research	Entry level is large pelagic fisheries giving limited breadth to ecosystem based, LME approach. Limited geographic range of interest across the ASCLMEs due to limited membership of project participating countries. Country and regional capacity building emphasis limited in scope. Data and information not generally available at regional level and more narrowly targeted to tuna and other large pelagic fish. Specific focus on Mauritius and Seychelles rather than region as a whole.
Information Management Establishment and maintenance of marine sciences data and information bases. Electronic access to four main gateways of ocean related information	UN Atlas of the Oceans	Data and information fragmented across institutions. Data sets are not consistent across the region. There is no regional database. Serves as a repository of selected marine based data and information. No operational capacity in the WIO.
Integrated Coastal Zone Management (ICZM) Management of marine biodiversity and natural resources Awareness activities in the CZ Regional Training and Excellence Centres Negotiating capacity Pilot CZM projects	EU IOC/COMESA National activities in Kenya, Madagascar, Mauritius, Mozambique, Seychelles South Africa, Tanzania	No emphasis on offshore areas as needed to ensure LME level management. Data and information will be limited primarily to coastal areas and covering coastal marine resources, as will training and public participation initiatives including awareness building.
Pollution Abatement Coastal zone and EEZ based pollution abatement	Ministries of Environment and related Departments and Agencies	Lack of accurate data baselines to measure relative levels of pollution makes much activity reactive in nature. A shallow layer of trained staff, poor training opportunities, and limited budgets make monitoring and enforcement activity difficult. There is very little interaction among ministry personnel at the regional level, and correspondingly, limited sharing of data sets.

Baseline Activity	Organization/Project/ Programme	Gaps
Fishery Management (Stock Assessment) Tuna resource assessment and management including research on and monitoring of stocks, tagging, targeted to tuna and related, large pelagic species	IOTC	Focus is on tuna stocks and no significant emphasis on LME approach. Limited representation of participating countries, as many are not IOTC members. No near-shore emphasis. Limited emphasis on country capacity building for LME based investigations. Data and information targeted to tuna and related species. Some data and information likely to be proprietary.
Artisanal Fisheries Improve understanding of small scale fisheries Address destructive fishing practices	Jakarta Mandate (NORAD and IUCN)	No overall emphasis on LME wide science and LME wide management approaches.
Fisheries Management: Control Improved management of fisheries through institutional capacity building in monitoring, control and surveillance	SADC MCS Programme (EU)	Emphasis limited to fisheries resources. Not all participating countries are members of the SADC thus limited geographic scope. Little data and information collected.
Environmental Variability Exploration of causes and effects of coral bleaching and mass mortality of corals in seven countries of the WIO Scattered research on Ocean-atmosphere links and meteorology of the Indian Ocean	CORDIO-SIDA Project	Activities confined to coral reefs and no overall emphasis on LME based management. Information not codified and available to the region
Conservation of Biodiversity Creation of a participating network of MPAs Creation of a working network of MPA managers	WIO-MPA (WWF/FFEM/CI)	Narrow focus on marine and coastal protected areas. Some capacity building but again targeted to MPA personnel. Capacity building and stakeholder involvement primarily tied to coastal zone related management and resource issues.
Awareness Raising Increase public awareness on related issues Plan and conduct targeted research activities of national and regional importance Disseminate information and data aimed at helping to achieve sustainable use	Marine Science for Management Programme (SIDA) and administered by WIOMSA Shoals of Capricorn Project (RGS)	Restricted to coastal environment and no significant emphasis or focus on LME wide management issues or the filling of LME wide knowledge gaps. Project reach limited to Seychelles and Mauritius and limited emphasis on coastal and coral reef based ecology.

The GEF Alternative

126. The overall global environmental objective of the ASCLMEs Programme is to ensure the long-term sustainability of the living resources of the ASCLMEs through an ecosystem based management approach. The goal is being pursued through a set of related GEF interventions (the UNEP sponsored WIO-LaB, the World Bank sponsored SWIOFP, and the UNDP sponsored ASCLMEs Project) as well as nationally and internationally supported projects in marine research and ecosystem management that are closely aligned to SWIOFP and ASCLME objectives. The objectives of the SWIOFP and ASCLMEs project are to: (i) establish the status of existing exploited resources and improve understanding of transboundary marine resources of the ASCLMEs region; and (ii) improve capacity for ecosystem management at community, national and regional levels. The expected outputs of the two projects are establishment of baseline data and information on oceanographic parameters, fish and fisheries, productivity, oceanography, geoscience, biodiversity, and persistent organic pollutants. The projects will further establish information systems, to facilitate decision support, and build foundational capacities that can be applied in future to regional ecosystem management endeavours. Work undertaken through the two projects will result in significant inputs to the development of a Transboundary Diagnostic Analysis (TDA) and Strategic Action Programme (SAP) for each of the two LMEs respectively. The

ASCLME contribution to this will be: identification of oceanographic and biological characteristics of the LMEs; establishment of baselines for key bio-physical characteristics; estimates of anthropogenic and environmental factors affecting overall ecosystem health, particularly coastal zones and marine areas beyond EEZ boundaries; persistent organic pollutants, biodiversity, and environmental variability.

127. GEF funds will be used to finance the incremental costs associated with regional and sub-regional activities designed to promote sustainable management of shared resources in the Agulhas and Somali LMEs. More specifically the GEF will finance the incremental costs of: (i) assisting groups of countries to better understand the environmental concerns of their international waters and work collaboratively to address them; (ii) building capacity of existing institutions, or through new institutional arrangements, to utilize a more comprehensive approach for addressing transboundary water-related environmental concerns; and (iii) putting in place SAPs to guide implementation of sustainable measures that address such environmental concerns.

Incremental Costs

128. Outcome 1: Key ecosystem assessment and management gaps are filled as necessary to install an ecosystem approach to LME management (Baseline: US$ 60 million; Incremental Cost: US$ 18.250 million out of which GEF financing is US$ 5.750 million). The ASCLMEs project will build on existing scientific knowledge by consolidating and evaluating existing data on oceanographic and biological characteristics of the LMEs and financing targeted research to fill information gaps and inform subsequent management decisions. The GEF alternative will finance efforts to consolidate information related to the ASCLMEs. GEF funds will also finance targeted assessments likely to include, among others, assessments of certain oceanic features and anomalies, factors affecting variability in LMEs, understanding of LME interfaces, productivity, larval transport, mapping of key fish nursery and spawning areas, energy flows and food webs, and provide spatial data on ecosystems, marine habitats (including sea mounts), ecosystem connectivity, and improve understanding of the downstream impacts of land based and marine pollution (including of POPs and heavy metals).

129. Outcome 2: Decision-making tools are in place, to facilitate the synthesis and application of data for LME management; (Baseline: US$ 10 million; Incremental Cost: US$ 2.775 million out of which GEF financing is US$ 1.225 million). The GEF Alternative will support development of a set of GEF IW based process, stress reduction, and environmental status indicators for the ASCLMEs project and build on baseline monitoring efforts by supporting identification, establishment and operation of institutional and participatory mechanisms for assembling and reporting on indicators for monitoring and evaluation of ecosystem. GEF funds will finance the process of establishing agreed upon indicators including training, technical assistance, workshops, and pilot monitoring activities.

130. Outcome 3: Regional agreement is reached on transboundary priorities and their root causes and a suite of governance reforms and investments needed to institute a shared ecosystem-based approach to managing the LMEs in support of WSSD targets, and foundational capacities are in place for implementation. (Baseline: US$ 10 million; Incremental Cost: US$ 50580 million out of which GEF financing is US$ 3.425 million). The GEF alternative will support the transaction costs necessary to the development of regional mechanisms for management of the ASCLMEs. GEF funds will finance development and refinement of the TDA and SAP, regional coordination activities between ASCLME countries, and human and institutional capacity building related to building capacity for regionally based ecosystem assessments and information management.

131. Outcome 4: A Comprehensive Public Participation Initiative Enables Stakeholders to Engage in Programme activities. (Baseline: US$ 3 million; Incremental Cost: US$ 3.4 million out of which GEF financing is US$1.8 million). The ASCLMEs project will engage in an active public participation and awareness-raising effort through development of distance learning and information sharing tools (DLIST). GEF funds will finance development of learning and information tools, documentation of project outputs, networking, and development of an internet based learning platform to reach different constituencies.

Co- Financing

132. Co-financing for the GEF alternative will be provided by the South Africa/ACEP Programme, the Participating Countries, Norway (research vessel time), France, UNEP, FAO, and EcoAfrica.

TABLE 14: PROJECT INCREMENTAL COST MATRIX

ASCLMEs Project Component	Cost Category	US$ Million	Domestic Benefit	Global Benefit
ASCLMEs				
Outcome 1: *Key ecosystem assessment and management gaps are filled as necessary to install an ecosystem approach to LME management*	Baseline	60.0	A number of ongoing initiatives in oceanographic research provide some base of knowledge for management of national resources.	Incomplete knowledge of overall Agulhas and Somali LME systems; current knowledge base gives partial picture of large scale processes and dynamics of the LME systems, key oceanographic characteristics unknown.
	GEF Alternative	78.250	Improved understanding of ecosystem status and threats within national boundaries; more comprehensive knowledge of ecosystem health to underpin national decision-making.	Identification of data gaps in oceanographic and associated environmental data sets across region, including specific data on anthropogenic threats, natural perturbations and their interactions within the LME systems.
	Incremental Cost	18.250	GEF: US$ 5.750 million; SA/ACEP: US$ 9 million; FAO .150 million: France: US$ .5 million; UNEP: US$ .450 million Gov. of Norway: US$ 2.100 million Govt. Contribution: US$ .0.3 million.	
Outcome 2: *Decision-making tools are in place, to facilitate the synthesis and application of data for LME management;*	Baseline	10.0	Functioning national monitoring system for specific resources such as key marine processes, artisanal and deep-water fisheries, and coastal zone related information at national scale.	National monitoring systems insufficient for adequate, integrated monitoring of entire Agulhas and Somali LME systems, particularly for off-shore and shared resources.
	GEF Alternative	12.775	National monitoring systems strengthened for overall ecosystem and inclusive of marine and coastal resources.	Establishment of regional monitoring system and repository for data and information, and creation of a funded institutional and procedural approach for LME level monitoring, evaluation and reporting. Regional data and information system helps create base for regional approach to LMEs management. Repatriation of data enhances regional know ledge base and enhances regional approach to management.
	Incremental Cost	2.775	GEF: US$ 1.225 million; ACEP: 1 million; UNEP: US$ .300 million; Govt. Contribution: US$ 0.05 million	
Outcome 3: Regional agreement is reached on transboundary priorities and their root causes and a suite of governance	Baseline	10.0	Ongoing national Programmes and participation in regional bodies provide national benefits in terms of more sustainable management of national resources. Opportunity created for greater national level access to donors.	Participation in regional bodies such as Nairobi Convention and NEPAD generates some ecosystem benefit, however coordination of ASCLMEs is in early stages. Limited environmental benefit from current national management activities.

ASCLMEs Project Component	Cost Category	US$ Million	Domestic Benefit	Global Benefit
reforms and investments needed to institute a shared ecosystem-based approach to managing the LMEs in support of WSSD targets, and foundational capacities are in place for implementation.				
	GEF Alternative	15.580	Improved capacity for management of national marine and coastal resources through stronger institutions, increased resource mobilization, training of national level experts.	Well developed coordination mechanism for regional management; increased resources mobilized through a variety of financial and economic mechanisms to sustain regional management activities; trained experts integrated into work of regional institutions thus increasing regional level capacity and cross-boundary cooperation. Human and financial resource base created for SAP implementation.
	Incremental Cost	5.580	GEF: US$ 3.425 million; ACEP: US$1.405 million; FAO: US$.100 million; Govt. Contribution: US$ .65 million	
Outcome 4: *A Comprehensive Public Participation Initiative Enables Stakeholders to Engage in Programme activities.*	Baseline	3.0	Some awareness building and participation in ecosystem management activities through ICZM projects.	ICZM and other ecosystem management projects provide some regional ecosystem benefits but focus is generally national rather than regional level.
	GEF Alternative	6.4	Improved community and national awareness of and improved participation in management of marine resources.	Wider, national and regionally based stakeholder awareness and participation in the management of regional marine resources through outreach and participation Programme.
	Incremental Cost	3.4	GEF: US$ 1.8 million; SA/ACEP: US$.9 million; EcoAfrica: US$.5 million; Governments US$.2 million	

TABLE 15: BASELINE ACTIVITIES BY COUNTRY*

Country	Source of funds	Project/Agency	Baseline Total (US$ ' 000s)	Year
Kenya	Govt.	Kenya Marine and Fisheries Research Institute	7,500	2004-2007
	Govt.	Kenya Fisheries Dept. (MOLFD)	2,848	2004-2007
	IUCN	Jakarta Mandate Project	350	2002 – 2005
	USAID	Marine Programme/Coast Development Authority	814	2004-2005
Madagascar	AFD (France)	Management of Shrimp resources Project	586	2002-2007
	Af.DB	Artisanal Fisheries support	126	2002-2007
	Af.DB	Stock evaluation	150	2002-2007
	ICBG	Centre National de la Recherche Océanographique	79	2003-2005
	Donor	Centre National de Recherches Sur l'Environnement	170	2000-2004
	European Union	MCS Project for Madagascar Fisheries Dept.	1,200	1999-2007
	Govt.	Fisheries budget, fisheries projects, staffing	668	2004-2007

Country	Source of funds	Project/Agency	Baseline Total (US$ ' 000s)	Year
	WCS/ Am. Museum of Nat.History	Cetacean Conservation and Research Programme (CCRP)/ Marine Programme	100	current
	AFD/IRD (France)	National Shrimp Research	68	2002-2004
Mauritius	IFAD	Rural Diversification Project	1,400	2000-2005
	Japan	Fisheries Training and Extension	6,500	2003-2004
	Government	Mauritius Oceanographic Institute	1,000	current
Mozambique	NORAD	Fisheries Research Institute	258	2002-2008
	CDE - EU	Fisheries Research Institute	57	2002-2008
	IFAD	Fisheries Research Institute	42	2002-2008
	World Bank	Coastal and Marine Biodiversity Project	260	2004
	France	Fisheries Research Institute	23	2002-2008
	Portugal	Fisheries Research Institute	3	2002-2008
	SADC/EU	Fisheries Ministry	2,000	2001-2006
	JICA	School of Fishery	3,985	
	Spain	School of Fishery	81	2002-2004
	EU	Fisheries Ministry	641	2003-2004
	Government	Fisheries Research Institute	301	2004
Regional	COI/COMESA	Sustainable Management of Coastal Zones of the Countries of the Indian Ocean	26,000	2005-2010
	EU	Fisheries Data System	358	current
	EU/IOTC	Tuna Tagging Programme	677	current
	France	Monitoring of whales, dolphins and dugong	260	2004-2008
	SIDA	Coral Reef Degradation in the Indian Ocean (CORDIO)	1,056	2004-2008
	France/EU	OSIRIS	2,535	2004-2006
	EU, COI, IOTC	IOTC budget	18,200	
Reunion	France	THETIS	2,340	2005-2008
	France	CEDTM (Centre d'Etude et de Découverte de Tortues Marines)	874	2004-2007
	France	ECOMAR	156	
	France (IRD, IFREMER)	CAPPES	228	2004-2006
	France/EU	Pelagic ecosystems	358	On going
Seychelles	Donor	Reef fish study	100	2002-2006
	France, Belgium, Univ. of Hawaii	FADs As Instruments for Observation (FADIO)	1,430	2002-2006
	Gov. maybe donor	Forestry Coastal Rehabilitation	37	2004
	Seychelles Fishing Authority	Artisanal and Industrial Fisheries Research	1,600	2004
	Donor	SCMRT-MPA	165	2005
	Donor	SCMRT-MPA	233	2005
	UNESCO	Beach Monitoring Programme	3	
	USA	Mooring buoys/marine park	6	
Somalia	UNDP	Fisheries feasibility assessment	-	2004
South Africa	Donor	Universities (Cape Town, Kwazulu Natal Rhodes, Stellenbosch, Western Cape, Port Elizabeth)	420	2004
	Donor	Survey of Deepwater Crustaceans - MCM	50	2004/2005
	Donors	SANCOR Sea and Coast Programme	1,512	2004
	France	IRD researchers	625	2004
	Govt.	Overall Fisheries budget	43,848	2005/2006
	Govt.	Fisheries budget - MCS, Marine patrol	16,065	2005/2006
	Govt.	Fisheries Budget - Research	13,406	2005/2006
	Govt.	CSIR Coast Programme	1,344	2004
	NORAD	NORSA Bilateral assistance to MCM	1,680	2006-2010
Tanzania	Donor	Regional Fisheries Arrangement	805	2006
	Govt.	Tanzania Fisheries Research Institute (TAFIRI)	1	2005
	Govt/IDA	MACEMP (Marine and Coastal Env. Management Programme	26,730	2005-2010
	DfID	Fisheries Management for Sciences Programme - FADs and Participatory Fisheries Stock Assessment	160	2004-2005
		Total (ASCLME and SWIOFP)	194,469	

* Note: The Baseline was calculated for both ASCLME and SWIOFP, the baseline costs associated with SWIOFP activities are approximately US$111.5 million and approximately US$ 83 million for ASCLME.

PART II: LOGICAL FRAMEWORK ANALYSIS

Long Term Programme/Project Goal
To ensure the long-term sustainability of the living resources of the two LMEs through an ecosystem based approach to management of the ASCLMEs.

Project Objective (Purpose)	**Performance Indicators (GEF IW Based)**	**Means of Verification**	**Assumptions and Risks**
to undertake an environmental baseline assessment of the Agulhas and Somali Current Large Marine Ecosystems to fill information gaps needed to improve management decision-making, and to ascertain the role of external forcing functions (such as the Mascarene Plateau and the Southern Equatorial Current). This information will be used to develop a TDA and SAP for the Agulhas Current LME, and a TDA for the southern portion of the Somali Current LME	• Application of GEF Process, Stress Reduction, and Ecosystem Status Indicators.	• Agendas, meeting minutes, publications, and other documentary evidence form the PCU, PSC, PCC, Cruise Coordinating Committee, Science Review Panel, and stakeholder meetings.	Pressing domestic economic and social issues such as poverty and human health issues imply that regional environmental concerns receive sub-optimal attention and investment. Important local level stakeholders (artisanal fishers, others) will see ecosystem based management efforts as being detrimental to their interests.
Outcome 1: Key ecosystem assessment and management gaps are filled as necessary to	▪ One training cruise on the *Fritjof Nansen* in 2007. ▪ Four ASCLME funded cruises in key geographic areas of the ASCLMEs, two each in calendar years 2008-09. ▪ One *Fritjof Nansen* cruise in calendar year 2010. ▪ Ten cruises of the SA based *Algoa* from 2007-2010. ▪ Over 100 country personnel will have received training in	• Cruise Data Report in library and pdf files on web site; • Records relating to working groups and approved work plans; • Written agreements on joint approaches and methodology for data collection,	Assumes countries continue to see the value in providing the personnel and in-kind support resources necessary to accomplish the activities in this

Project Objective (Purpose)	Performance Indicators (GEF IW Based)	Means of Verification	Assumptions and Risks
install an ecosystem approach to LME management	various oceanographic and marine sciences based activities over the life of the project. ▪ Approximately 250 country personnel will have received ship/shore-based training in various oceanographic and marine sciences based expertise. *Baseline for the above: At present no ship with the capabilities of the Nansen is available to the countries of the ASCLMEs. No oceanographic and marine sciences based training Programme at regional level, or in many of the participating countries, exists.* Knowledge gaps in the LME based modules of productivity, fish and fisheries, and pollution and ecosystem health will have been filled in the following geographic areas: ▪ The Kenyan and Tanzanian coasts; ▪ The Somali Current upwelling; ▪ The Mascarene Plateau; ▪ The SIDS influenced by the South Equatorial Current; ▪ The east coast of Madagascar; ▪ The Mozambique Channel; and ▪ Other geographic areas to be determined in further consultation with the SWIOFP and WIO-LaB projects as they determine areas to be the subject of cruise activity. *Baseline for the above: There are no plans for country or regionally based efforts to fill existing key knowledge gaps in these areas.* • Knowledge gaps in the LME based modules of productivity, fish and fisheries, and pollution and ecosystem health in relation to larval transport, spawning grounds, settlement areas and nurseries will have been filled • Knowledge gaps in the LME based modules of productivity, fish and fisheries in relation to artisanal and subsistence fisheries will have been filled ▪ By 2010 data and information form the cruises and other activities in this Outcome will synthesize and made available to all stakeholders. ▪ By 2009 baseline information will have been gathered on Stockholm related POPs loadings in key indicator species.	storage and dissemination; • Written documents on biodiversity and MPA methodologies and training; • Proceedings of workshops • Internationally peer-reviewed documents and publications; Agenda and meeting minutes of PCU, PSC, Cruise Coordinating Committee, Science Review Panel, and stakeholder meetings; Copies of Annual; • Oceanographic Reports on progress addressing oceanographic gaps; Written documents on oceanographic methodologies and training; • Proceedings of workshops • Internationally peer-reviewed documents and publications; • Scientific papers, conferences and reports; • Specific reports on the location and status of spawning, settlement and nursery areas and larval transport trends within the ASCLMEs region • Specific reports on the status and impacts of artisanal and subsistence fisheries • Protocols developed for the measurement of POPs in indicator species. • Written reports of the results of POPs measurements in indicator species. • Incorporation of results of POPs levels in indicator species in Stockholm Convention related reports of the countries.	Outcome (countries have committed themselves to these in-kind costs). Assumes estimated costs of research vessels are not overtaken by inflation or exchange rate fluctuations (the project has built in adjustments for these).

Project Objective (Purpose)	Performance Indicators (GEF IW Based)	Means of Verification	Assumptions and Risks
	▪ By 2010 data and information from the POPs related activity will have been synthesized and made available to all stakeholders. *Baseline: No marine related POPs work is currently undertaken in the ASCLMEs. France is undertaking work related to heavy metal concentrations in seabird populations. This activity will complement the effort of France.*		
Outcome 2: Decision-making tools are in place, to facilitate the synthesis and application of data for LME management purposes	• By 2010 GIS capability in the region will have been increased by 25% • By 2010 over 100 country personnel will have been trained in GIS techniques and developed a range of products for the project, Programme and for the general benefit of the countries and region. • By 2010 GIS products will have been stored in the country-selected repository for general use by all stakeholders. *Baseline: The ACEP has been active in promoting and using GIS technology within the countries of the ASCLMEs and to the general benefit of the region. Countries have limited GIS country-based capacity. No regional integration of GIS products is being undertaken by any stakeholders in the region.* • Development of clear and agreed upon protocols (PI). • *Baseline: As there is no integrated and comprehensive regionally based ASCLMEs effort no regionally based M&E protocols exist.* • Establishment of specific arrangements for coordinated M&E activities with SWIOFP, WIO-LaB, ACEP, and other entities involved in related M&E activities (PI). *Baseline: There is no regional level coordination of M&E efforts within the ASCLMEs.* • Definitive set of GEF IW based PI indicators are developed and refined (PI indicators largely developed during preparation and reflected in this LogFrame). *Baseline: As above, there is no integrated M&E effort.* • Clearly defined set of SRIs and ESIs developed by month 18 of project implementation. *Baseline: As above.*	• Membership lists of key committees and sub-committees. • Copies of Terms of Reference for committees and sub-committees • Minutes of meetings • Committee and sub-committee reports and recommendations • Copies of agreements and minutes of joint meetings with other Programme projects and related entities undertaking Programme and project related M&E activities. • Agenda and meeting minutes of PCU, PSC, Cruise Coordinating Committee, Science Review Panel, and stakeholder meetings	An assumption is that related Programme projects, and the related projects of the countries themselves and of other bi-lateral and multi-lateral donors will see it in their best interest to cooperate in M&E activities (A broad range of M&E stakeholders regionally and internationally have been actively consulted during preparation). A risk is that countries will not have the requisite political will and/or resources to continue ecosystem based M&E activities post-Programme and project.

Project Objective (Purpose)	Performance Indicators (GEF IW Based)	Means of Verification	Assumptions and Risks
Outcome 3: Regional agreement is reached on transboundary priorities and their root causes and a suite of governance reforms and investments needed to institute a shared ecosystem-based approach to managing the LMEs in support of WSSD targets, and foundational capacities are in place for implementation.	• Establishment of Project Steering, Programme Coordination, and other Project level committees and establishment of a PCU (PI). • *Baseline: No "hands-on" regional coordinating mechanism exists, as the Nairobi Convention is not an operational entity.* • Provision for coordinated funding of donor recruitment activities (PI). • *Baseline: At present donor activities in the region are ad-hoc and fragmented.* • CB&T is refined and approved (PI). • *Baseline: There is at present no regionally based. CB&T strategy* • Workshop to determine institutional and organizational capacity building needs (PI). • *Baseline: There has been no overview assessment of regional organizations and institutions and none are planned with exception of the Project.* • Workshop to determine human (training) capacity needs (PI). • *Baseline: No overall determination of human capacity building needs has been undertaken in the region or in any of the participating countries.* • Deliberate training (human capacity building) is scheduled (PI). • *Baseline: Training is ad-hoc both at national and regional levels.* • Options paper for selection of regional entity or entities to assume regional level responsibility for post SAP related work. • *Baseline: At present there is a plethora of regional organizations with fragmented mandates and incomplete or absent operational responsibilities.* • Regularized meetings of the PCC to assure strong IA collaboration as a base for ensuring strong Programme coordination with governments, related GEF projects, and other regional stakeholders (PI). • *Baseline: No such activity has taken place nor is one scheduled.*	• Committee membership lists and copies of committee meeting minutes. • Reports of the PCU regarding the extent and results of specific donor and other funding related consultations. • Copies of course training manuals. • Lists of country participants and training targets as part of each cruise plan. • Copies of Workshop agendas, invitation lists, and written workshop reports. • Numbers of people trained. • Copies of country approaches to retain trained personnel. • Written records of discussions leading to eventual adoption of funding mechanisms aimed at sustaining post-SAP activity. • Specific provisions in the SAP to assure post-Programme and post project funding to ensure sustainability. • Changes in or additions to existing Programmes such as fish levies to demonstrate country commitment to sustainability.	Conflict between coastal states with different political agendas results in an inability of countries participating in regional activities to cooperate at the level needed to achieve results. There will be insufficient numbers of regionally based experts to fulfil training needs necessary to build individual capacities in the region

Project Objective (Purpose)	Performance Indicators (GEF IW Based)	Means of Verification	Assumptions and Risks
Outcome 4: a comprehensive public participation initiative enables stakeholders to engage in Programme activities.	• Distribution of "lessons learned" to other Programme projects and related organizations (PI). • Distance courses developed and distributed (PI). • ICT platform designed and running (PI). • Development of 100 information nodes at Universities in the region and within CBOs (PI). • Modules and courses prepared and distributed (PI). • Pilot Phase implemented in 50 nodes (PI). • Database creation made available on project website (PI). • Production of 10 educational and public interest films related to the project and Programme (PI). • 6 project/Programme related travelling exhibitions (PI). • 4000 students given tours and basic science overview on research vessels (PI). • 10,000 teachers will have received project and Programme related instructional materials (PI). *Baseline: No comprehensive public participation Programme exists for the region.*	• Copies of reports of "lessons learned" • Hiring of IT staff • Written M&E plan including explicitly identified indicators. • List of participating universities. • Written description of portal design and written verification of portal locations. • Training manuals for IT staff and numbers and locations of IT staff trained. • Written course books. • Initiatives review document. • Published list of coastal stakeholders and description of methodology used in identification of stakeholders. • List of designated DLIST partners. • List of DLIST focal points.	An assumption is that related projects and organizations will be amenable to cooperation with the DLIST activity. A risk is that coastal players will not have trust levels in the Programme and projects sufficient to become engaged.

SECTION III. ATTACHMENTS

ANNEX 1: MAP OF PARTICIPATING COUNTRIES WITH EEZ MAPPING.

Map of ASCLMEs Countries showing political boundaries and their 200-mile Exclusive Economic Zones.

ANNEX 2: A SUMMARY OF OCEANOGRAPHIC KNOWLEDGE IN THE AGULHAS AND SOMALI CURRENT LMEs

Introduction

The oceanographic conditions in the Agulhas and Somali Current LMEs (ASCLMEs) are distinctly disparate. In the southern part of the West Indian Ocean the Agulhas Current system dominates. This current is one of the largest western boundary currents in the world and is fed from a range of complex sources. The Somali Current in the northern part of the West Indian Ocean is by contrast a shallow current that has the unusual characteristic that it reverses direction with season. The currents that carry water past the islands of the South-west Indian Ocean in turn form part of the typical, wind-driven, subtropical gyre.

Knowledge on the oceanography of these different systems; physical, chemical, biological and geological, is equally diverse. Parts of the Agulhas Current system have been comprehensively studied; others - particularly in the Mozambique Channel and around Madagascar - remain largely unknown. Aspects of the Somali Current have been relatively thoroughly observed in the past, but studies close inshore have ceased for security reasons. Few dedicated studies have been undertaken in the vicinity of most of the islands of the South-west Indian Ocean. The influence of all these currents on the circulation over adjacent shelves, the local chemistry, biology and the sediment movement has all been extremely sparsely investigated.

This compact summary of what is known about the oceanography of the West Indian Ocean is strongly skewed towards physical oceanography. The reason for this is easily explained. Considerably less is known about the chemistry, the biology and the geology of the region than about the physics. In many coastal regions no observations in support of these non-physical sub-disciplines have to date been made.

Full, detailed and up-to-date reviews of all that is known about the coastal oceans of the ASCLMEs region have just been published in the international journal *The Sea* and extend and complement this brief synopsis for the interested reader.

Agulhas Current system

The Agulhas Current system may be considered to consist of three components: a source region, the northern Agulhas Current proper and the southern Agulhas Current. The sources of the Agulhas Current are the subtropical gyre of the South Indian Ocean, the region east of Madagascar and the Mozambique Channel. Of these the subtropical gyre is the main contributor by volume. The flow through the Mozambique Channel consists largely of intense, anti-cyclonic eddies that are formed in the narrows of the channel and that move poleward from there. These eddies may be 200 km in diameter and extend all the way to the sea-floor. Their influence on adjacent shelf regions is not known.

Between the narrows of the channel and the Comores Islands the flow seems to be in the form of an anti-cyclonic gyre, but this conclusion is based on very few observations and the flow may in fact be quite variable. The currents on the eastern side of the channel, outside the direct influence of the Mozambique eddies, are unknown. There are some observations that suggest a net southward movement, but other measurements indicate a northward movement. Remote sensing data have shown the presence of weak eddies in this region that draw water off the shelf. Whether this is an important process from a chemical and biological point of view is not yet known. In fact, there are no published observations of currents on this shelf region whatsoever.

The flow along the east coast of Madagascar is equally poorly known. A fast and intense current, the East Madagascar Current, carries water along the edge of the narrow continental shelf. The southern part of this current goes poleward; the northern component equatorward. The location of the bifurcation is not known with any degree of accuracy. Since the shelf is so narrow it may be assumed that the water on the shelf moves in sympathy with the juxtapositioned current, but to date there are no observations to adequately support this hypothesis. Both along the shelf of Mozambique and the shelf of Madagascar upwelling cells with enhanced nutrient contents have been observed. These include a cell at Angoche on the Mozambican coast and along the southeast coast of Madagascar. The intensity and the persistence of these cells, as well as their biological impact, remain to be determined.

The northern Agulhas Current seems to start somewhere between the cities of Durban and Maputo, according to evidence gleaned from the movement of sediments on the adjacent shelf. The current is strong,

intense and increases in depth and in volume flux downstream. Maximum velocities exceed 2 m/s on its inshore side; the current being 60 to 100 km wide with an intense inshore edge but a more disperse offshore border. The current follows the shelf edge quite closely, diverging from the coastline where the continental shelf is wide, such as at the Natal Bight. In general the trajectory of the current is unusually stable for a current of this nature, the exception occurring during the passage along the current of a Natal Pulse. This singular meander commences at the Natal Bight and from there moves down the current at about 20 km/day, growing in amplitude. The coastal effect of the passage of a Natal Pulse is a sudden, but short-lived reversal in current directions. On the whole the water movement on the adjacent shelf is parallel and in the same direction as the northern Agulhas Current. There are two exceptions: directly south of Durban and over the Natal Bight. South of Durban there is a persistent lee eddy that may be carried off in an incipient Natal Pulse; on the Natal Bight the water movement may be largely dependent on the reigning wind.

At the northern tip of the Natal Bight there is a concentrated and persistent upwelling cell that probably supplies a major part of the bottom water for this part of the shelf. It enhances the local nutrient supply and leads to a marked increase in local phytoplankton density. The precise role of this point source of nutrients for the ecosystem of the region has not been studied.

The path of the southern Agulhas Current – downstream of the city of Port Elizabeth - is much less stable, exhibits meanders as well as attendant shear edge eddies and plumes. It flows past the wide Agulhas Bank and has a decisive influence on this shelf's water masses. At the eastern corner of the Agulhas Bank there is a persistent upwelling cell. It has been inferred that this cell supplies all the nutrient rich bottom water for the bank. It also enhances the seasonal thermocline. This process may be crucial for the successful spawning of the major pelagic fish species that have been shown to preferentially produce their eggs on this bank. From here the larvae and sprat move to the Benguela upwelling system of the South Atlantic Ocean to support the largest fisheries of the region – therefore a true transboundary ecosystem.

Somali Current

Directly north of the Mozambique Channel, the northward setting current along the coast of the African continent is called the Zanzibar Current. It has as its main source the northern part of the westward flowing South Equatorial Current. During the North-east Monsoon season the Zanzibar Current is opposed by the southward flowing Somali Current and this meeting point usually shifts southward as the season progresses. It is only the surface expression of the Zanzibar Current that is prevented from moving northward; at depth the current continues as an undercurrent below the Somali Current. The North-east Monsoon occurs during the months of December to April, being strongest in February. During the opposite wind phase, the South-west Monsoon season (June to October, maximum in August), the Zanzibar Current is strengthened considerably and forms the main tributary to the Somali Current which during this period carries water northward in an intense coastal jet. Speeds in this jet may reach very high values of up to 3.5 m/s. The southern part of the current is shallow. Farther to the north it deepens.

The northward flow of the Somali Current during the South-west Monsoon season is not simply alongshore. The flow turns offshore at about 3 º N. North of this point a strong upwelling cell has been observed to develop. The biological effect of this transitory upwelling cell has not been adequately studied. Two coastal gyres are then created at the sides of this upwelling cell. These gyres seem characteristic of the flow during the beginning of this season. As the season advances, these upwelling gyres shift northward, join together and by the time of the most intense part of the South-west Monsoon in August the Somali Current is established as a continuous western boundary current from the Zanzibar Current in the south to the East Arabian Current in the north.

The monsoonal wind patterns vary somewhat from year to year and so will, in consequence, the seasonal development of the Somali Current. This inter-annual variability may have a decisive influence on the shelf circulation, on the marine ecosystem of the region and also on the success of the local fisheries. This variability has not been studied in a multi-disciplinary way. In general the coastal currents and the effect of offshore currents on the shelf area inshore of the Somali system have also been investigated in a very patchy and inadequate way. Long-term monitoring of currents, water masses and biota has been deficient.

Islands

The islands of the South West Indian Ocean that lie east of Madagascar (i.e. excluding those in the Mozambique Channel and the Comores) all basically lie in the path of the South Equatorial Current. This wind-driven current is shallow and is considered not to change much in strength or direction, either seasonally of inter-annually. However, this conclusion may be the consequence of insufficient observations in the region. The effect of the passing water masses on the narrow shelf regions of most of the islands is not well known, but can be assumed to be a function of their offshore bathymetry and the absence or presence of coral reefs. The flow of the South Equatorial Current over the Mascarene Ridge that lies between Mauritius and the Seychelles has been established only recently. This shallow obstruction to the westward flow causes the current to be concentrated into a number of narrow jets through the deeper parts of the ridge. A seasonal phytoplankton bloom commences along the eastern coast of Madagascar with the onset of winter and progresses as a productivity wave eastwards as the seasonal thermocline deepens and nutrients from below are made available in the euphotic zone.
There is another important perturbation to the envisaged steady and invariant nature of this component of the ASCLMEs. It has been shown that meridional meanders in the South Equatorial Current travel westward as Rossby waves. Embedded in them are eddies. These eddies intensify as they move westward and may have a decisive influence on the ocean circulation of the islands they pass. It has been demonstrated that they, and eddies that come from the Mozambique Channel, may eventually reach the Agulhas Current and trigger Natal Pulses with all the attendant affects of current changes.

Climate impacts and climate change

One of the reasons why international interest in the ASCLMEs region has grown over the past decade has been the general recognition that this ocean region plays a key role in global climate. The leakage of warm water from the Agulhas system into the South Atlantic Ocean is the mechanism that has attracted most attention. This leakage seems to be controlled by mesoscale processes in the source regions of the Agulhas Current about which insufficient information is currently available. Coastal currents also affect the rainfall over the adjacent continental landmasses and changes in these currents will therefore have an impact on such terrestrial precipitation. This process is currently under investigation using numerical models.

Climate change may furthermore affect the frequency and intensity of extreme events such as hurricanes. This will be of crucial importance for ASCLMEs countries such as Madagascar and Mozambique. Sea level rise will cause increased erosion of soft coastal plains and may have therefore have substantial effects on low lying areas such as a major part of central Mozambique. Last, but not least, increased acidification of sea water as more carbon dioxide is absorbed may cause increased bleaching of corals that could have lasting effects on coastal regions of a number of ASCLMEs countries.

Conclusions

The transboundary ecosystems of the West Indian Ocean, their dependence on their physical, chemical and geological environment and the possible effect of climate change on these interrelated systems all remain largely unknown. This holds true for the Agulhas Current system, the Somali Current system as well as the Mascarene Plateau and the associated islands of the South-west Indian Ocean. In order to establish some criteria for the proper management of these ecosystems, exploratory investigations are required to establish essential baseline information.

ANNEX 3: LINKAGES BETWEEN ASCLMEs PROJECT AND NATIONAL DEVELOPMENT PLANS

Country	Development Plans, Strategies and Legislation	ASCLME Linkages
Comoros	• Comoros National Environment and Policy and Environmental Action Plan under development • National Biodiversity Strategy and Action Plan	• Regional Commissions for sustainable development being established on each island. • Programmes under development to monitor the state of coral reefs and monitor eco-toxicity levels in marine environment.
Kenya	• National Economic Recovery Plan (ERP), 2003/2004 • Environmental Management Plan • Maritime Zones Act, 1991 • Fisheries Act, 1991 • Fisheries Regulations, 1991	• Contributes to ERP objectives of increasing economic growth through sustainable management of resources. • Complements on-going fisheries management initiatives and objectives, which include: i) general encouragement of responsible fishing practices and co-management structures; ii) curtailment of destructive fishing methods; iii) further development of Marine Protected Areas (MPAs) with both park (non-fishing) and reserve (fishing restrictions) sectors; and iv) resolution of local conflicts related to use of fisheries resources
Tanzania	• Poverty Reduction Strategy Paper, 2000 • Tanzania Vision 2025 • Fisheries Policy and Strategy, 1997 • National Integrated Coastal Environmental Strategy Act, 2003 • Blueprint 2050, 2005	• Contributes to Government policy to exploit fishery resources in a sustainable manner in order to enhance food security by increasing the availability of animal protein on local markets, and to create employment for local populations. • Meets objectives recently elaborated in coastal and marine management strategies to improve coastal management, increase co-management and community involvement, and expand the networks of MPAs
Mauritius	• The Fisheries and Marine Resources Act • Environment Protection Act (EPA) • Continental Shelf Act	• Provides general enforcement and compliance measures for protection of the aquatic ecosystem against pollution, exploitation of mangroves, construction of any structures etc; deals with marine protected areas in Mauritian waters including associated land area (new); and establishes an MPA Fund and conservation measures. • Establishes management plans, monitoring coastal waters and creates management plans and monitors coastal waters. Also provides for measures to prevent pollution in CZ. • Provides for measures for the protection of living marine resources.
Mozambique	• Programmea do Governo 2000 – 2004 • Política Pesqueirae Estratégias de Implementação (PPEI) • Law of Fisheries, 1990	• Promotes overall goal of national fisheries management of ensuring the preservation of the fishery resources while maximizing economic income for the country • Will help improve the knowledge base that underpins national fisheries regulation by providing more information for the Government's existing system of fishing quotas • Will complement national efforts to promote the involvement of the coastal communities in the exploitation and management of living aquatic stocks in order to take advantage of local management know-how and facilitate the introduction of biologically sustainable natural resources usage patterns that can be both socially and economically efficient.

Country	Development Plans, Strategies and Legislation	ASCLME Linkages
Seychelles	Environment Management Plan for Seychelles (EMPS 2000-2010) Fisheries Policy, adopted in March 2005	• Integrated ecosystem conservation approaches, management of MPAs, management of coastal pollution • Promotion of sustainable and responsible fisheries development and optimising the benefits from the sector. Facilitating management to ensure responsible fishing and the effective protection of the marine ecosystem.
South Africa	• Marine Living Resources Act, 1998	• Provides for the conservation of the marine ecosystem, the long-term sustainable use of marine living resources and the orderly access to exploitation, utilization and protection of certain marine living resources; and also to exercise control over harvesting marine living resources in a fair and equitable manner to the benefit of all the citizens of South Africa. • Contributes to higher goal of national marine fisheries policy, which is to contribute to the long-term vision for a democratic South Africa through a competitive, fast-growing economy which creates sufficient jobs for all work-seekers; a redistribution of income and opportunities in favour of the poor • Improve the knowledge base underpinning management of commercial fisheries operations, particularly as fishing effort has increased substantially after restructuring of the industry in the1990s • Complements national efforts to assess vulnerable stocks and designate Marine Protected Areas (MPAs) for the purposes of scientific study, experimental fishing or conservation.
Madagascar	• Poverty Reduction Strategy Paper 2003 • Fisheries and Aquaculture Ordinance 1993 • Rural Development Action Plan (PADR)	• Contributes to overall goal of national fisheries management which is to contribute to: i) improvement of rural livelihoods; ii) the fight against poverty; iii) improvement in food security, particularly deficits in animal protein; iv) improved export receipts and volumes; and v) employment creation • Supports national efforts to establish a management system based on analysis of sustainable catch • Complements efforts to renew overexploited stocks and monitor fishing pressure

ANNEX 4: THREATS MATRIX

Threats	Management Issues/ Key Barriers	Solutions: Interventions from Programme Barrier Removal Activities (PRE / SAP Implementation)
Human induced habitat destruction and alteration of the marine environment including destruction of mangroves, coral reefs, and sea grass beds	**Ultimate Causes (beyond scope of Programme)** Marine environment under stress due to: Increased population and rapidly developing coastal cities, commercial ports and industrial centres and infrastructure (ultimate cause, beyond project scope); **Intermediate Causes (for pre SAP/ SAP intervention)** Incomplete knowledge of type, scale and consequences of threats facing marine environment, and basic lack of understanding of oceanographic processes making difficult or impossible creation of adaptive management regimes (i.e. conservation of critical habitats providing source populations for recruitment of fish and invertebrates throughout the region). National management regimes, with some exceptions, lack capacity, both financial and human, to effectively manage marine resources Regional management of resources emerging but not yet fully functional due to institutional issues, legal framework, coordination problems, and lack of capacity Numerous but uncoordinated management efforts to address different aspects of the marine environment	Improved knowledge of status of marine resources and identification of key threats through filling of priority data and information gaps; Improve knowledge base on the determinants of habitat degradation in the SWIO and the scale of the problem Development of more effective regional coordination and management mechanisms to build regional capacity and create adaptive management strategies at regional level Adoption of an ecosystem approach to management of marine resources Improve interactive public awareness and participation in management of marine environment and create effective environmental education and marine science based educational initiatives
Pollution of the Marine Environment Decreased water quality as a result of pollution generated by runoff from agricultural lands and discharge of sewage, industrial effluents and other harmful substances into waterbodies. Reduced flow of freshwater into rivers and estuaries due to increased demand for freshwater resources for human	**Ultimate Causes (beyond scope of Programme)** Low levels of socio-economic development that prevent coastal communities from adopting more sustainable economic or settlement practices (ultimate cause, beyond project scope) **Intermediate Causes (for pre SAP/ SAP intervention)** Lack of cooperation at the regional level to address human causes of habitat degradation that affect the regional environment.	Adoption of management and coordination mechanisms to reduce pollution within and across national boundaries

Threats	Management Issues/ Key Barriers	Solutions: Interventions from Programme Barrier Removal Activities (PRE / SAP Implementation)
settlements. Changes in the physical structure of coastal and marine areas affecting rates of siltation, and nutrient availability caused by deforestation	Lack of planning and poor integration of various public institutions with mandates covering use or management of marine and coastal environment. Unplanned urbanization and lack of appropriate infrastructure Information on biodiversity in the ASCLMEs including habitats, threats, connectivity, taxonomy etc is incomplete. Poor implementation of or lack of appropriate regulatory tools to better manage marine and coastal environment. Lack of awareness or low level of public involvement in management	Identification of pollution hotspots and adoption of strategies to address hotspots Awareness raising and identification of strategies to reduce stress on important marine and coastal habitats
Overexploitation of nearshore and offshore fisheries resources Commercial fisheries not constrained by sustainable catch limits in some countries Valuable offshore fisheries are harvested predominantly by distant-water fishing fleets from Europe and eastern Asia and the proportion of unreported catches is largely unknown. As fish stocks elsewhere in the world are diminishing, more fleet operators are certain to turn their attention to the commercial fish stocks along the east African coast until these stocks have been exhausted and catches are no longer economically viable.	**<u>Ultimate Causes (beyond scope of Programme)</u>** Low levels of socio-economic development that cause countries and communities to exploit resources for short-term gain (Strong incentive to fully exploit fisheries resources as they provide significant source of revenue, employment and food to ASCLMEs countries) **<u>Intermediate Causes (for pre SAP/ SAP intervention)</u>** Incentives to manage transboundary stocks within national waters low without reciprocal and coordinated actions by other countries Regional management structures are beginning to emerge but not yet fully functional. Transactions costs to regional management are high and resources to engage in management activities are limited Inadequate information about the species composition, distribution, behaviour and migration patterns of non-commercial and commercial fish stocks in the SWIO. Inadequate information on the extent to which commercial marine resources are fully exploited within the EEZs of SWIO countries Lack of appropriate regulations and enforcement power to establish sustainable yields in commercial fisheries Management and research are not always integrated – management decisions sometimes not underpinned by scientific findings	Improve knowledge base of ASCLMEs by establishing baseline indicators and stock dynamics for key fisheries. Define elements of sustainability for key stocks Improve capacity for national management of fisheries resources by linking management and science, improving national monitoring capacity, and building up human resource capacity Improve capacity for regional management by identifying institutional and legal framework for effective coordination Promote adoption of ecosystem approach to fisheries management

Threats	Management Issues/ Key Barriers	Solutions: Interventions from Programme Barrier Removal Activities (PRE / SAP Implementation)
	Short term or species specific perspective used in managing fisheries resources – lack of ecosystem approach	
Unnecessarily high by-catch and incidental mortality of marine fauna in commercial fisheries operations Commercial fisheries rely on gear technology and fishing practices that result in excessive levels of by catch and incidental mortality. Fisheries operators have little incentive to reduce by catch or incidental mortality, particularly as efforts to do so may reduce overall fisheries catch	**Intermediate Causes (for pre SAP/ SAP intervention)** Inadequate information about the extent of by-catch or mortality of various species Regulations protecting threatened species or areas under pressure are weak Monitoring capacity low and regulatory enforcement power weak Limited availability of appropriate technology s uch as excluding devices	Gear design and improved technology dissemination Awareness raising and identification of mitigation strategies for species under threat Development of baseline for key species under threat Adoption of ecosystem approach in fisheries management
Adverse consequences related to poor understanding of environmental variability within LMEs High level of environmental variability and complexity in Agulhas and Somali LMEs result in environmental interactions and perturbations that affect living resources and marine habitats. Inability to differentiate between anthropogenic and environmental impacts can result in poor decision-making and ineffective targeting of management efforts. Negative impacts of environmental induced changes to ecosystem from likely anthropogenically induced climate change (sea level changes, increased ocean temperature, alteration of salinity levels, coral bleaching events) not fully understood making adaptive management impossible.	**Ultimate Causes (beyond scope of Programme)** Anthropogenic climate forcing and sea level rise **Intermediate Causes (for pre SAP/ SAP intervention)** Incomplete information about environmental variability within the ASCLMEs - key data gaps still exist in areas of oceanographic dynamics: Remote sensing, size fractionation of chlorophyll a, primary production, food webs, bathymetry, geology and sedimentology, and geophysical characteristics of the ASCLMEs. Inadequate differentiation between environmental and anthropogenic impact on the marine environment within framework of national and regional management initiatives Partial understanding of climate change and its impact on ASCLMEs	Improve understanding of environmental variability in ASCLMEs Distinguish between anthropogenic and environmental impacts on ecosystem health in national and regional management efforts Raise awareness and publicize link between climate change related threats to marine environment and anthropogenic threats Create interactive capability among stakeholders as a means of identifying and mitigating environmental threats and aiding in creation of adaptive management capability at national and regional levels

ANNEX 5: SUMMARY OF SWIOFP AND WIO-LaB PROJECTS

GEF-WORLD BANK- SOUTHWEST INDIAN OCEAN FISHERIES PROJECT

Global Objective: To promote the environmentally sustainable use of fish resources and adoption of an ecosystem approach to fisheries management in the Agulhas and Somali LMEs.

Development Objectives:

i) To identify and study exploitable offshore fish stocks within the SWIO, and more specifically to become able to differentiate between environmental and anthropogenic impacts on shared fisheries
ii) To develop institutional and human capacity through training and career building.
iii) To develop a regional fisheries management structure and associated harmonized legislation in collaboration with the Southwest Indian Ocean Fisheries Commission (SWIOFC).

Outputs and Activities

Component 1: Data gap analysis, data archiving and information technology

This component will establish a regional data management system managed by staff of the Regional Coordination Unit (with skills specific to this task) to underpin management of regional fisheries and undertake a gap analysis to identify the specific research activities to be supported by the project. **Outputs** include:

A. An analysis at national and then at a regional level of data relevant to components in which it will participate and identification of specific gaps in existing data that would collectively form the gap analysis used to identify the data collection Programme facilitated by SWIOFP; and
B. A workshop consisting of all SWIOFP countries at which a conceptual, harmonized, data gap analysis (by type of fishery, i.e. demersal, pelagic, invertebrate) will be undertaken leading to synthesis of a year-by-year data collection Programme.

Component 2: Assessment and sustainable utilization of crustaceans

This component will undertake an assessment of the stock dynamics of shallow and deep-water crustaceans and their fisheries. Using ship-based surveys, baseline assessment of crustacean stocks and fisheries will be undertaken. **Outputs** include:

A. Transboundary diagnostic identifying the current status of important species, threats matrix, and regional/sub-regional management issues and needs; and
B. Preparation and adoption of a Strategic Action Plan for each fishery detailing how each relevant country will address issues identified in the component TDA
C.

Component 3: Assessment and sustainable utilization of demersal fishes (excluding crustaceans)

This component will support assessment of the stock dynamics of demersal species and their fisheries. Ship-based surveys will be used to undertake a baseline assessment of demersal stocks and fisheries and evaluate demersal fisheries by-catch, discard impacts, exclusion devices, and ecosystems. **Outputs** include:

A. Transboundary diagnostic identifying the current status of important species, threats matrix, and regional/sub-regional management issues and needs; and
B. Preparation and adoption of a Strategic Action Plan for each fishery detailing how countries will address issues identified in the component TDA.

Component 4: Assessment and sustainable utilization of pelagic fish

This component will assess the stock dynamics of large, small, and mesopelagic species and develop strategies to optimise small- and large-scale pelagic fisheries, including fish aggregating devices (FADs). Activities will

include ship-based surveys to assess the potential of new and existing pelagic fisheries, studies on migration and movement of selected large pelagic species (including sharks), and research on optimisation and development of FADs for large and small-scale pelagic fisheries. **Outputs** include:

A. Transboundary diagnostic identifying current status of important species, threats matrix, and regional/sub-regional management issues and needs; and
B. Preparation and adoption of Strategic Action Plan for each fishery detailing how each relevant country will address issues identified in the component TDA.

Component 5: Monitoring of fishing effort and catch, existing value, and exploitation conflicts

This component will build capacity for regional management by developing and testing fisheries monitoring techniques. The component will support training of scientific observers at sea; monitoring of commercial landings and establishment of land-based monitoring and data verification systems; linkage of communication infrastructure; and development of coordination mechanisms and verification systems to establish a regional Vessel Monitoring System. It will also support an assessment of the financial value of exploited fisheries and use conflicts that might exist because of exploitation, development of an understanding of the social needs and structures of national stakeholder groups exploiting marine resources, and use of such information to guide management and maximize benefits from fisheries. **Outputs** include:

A. A contribution to the overall Project output leading to agreements between countries sharing fishery resources that improve harmonized MCS actions; and
B. Agreements between countries that each will recognize regional pressure and the need to consult as a precursor to setting exploitation limits on a fishery (particularly regarding licensing of foreign fishing fleet access to its 200 mile EEZ).

Component 6: Fisheries impact on non-consumptive resources

This component will undertake an assessment of the interaction between non-commercial marine resources (such as sea-birds, turtles and other species) and commercial fisheries. Studies will be funded out of a research grant fund and would generate a baseline assessment, GIS mapping of key species, assessments of marine biodiversity as alternative sources of income and identification of bio-indicator species and relationships between target species and ecosystem health. **Outputs** include:

A. A Biodiversity map; and
B. An Action plan (as part of TDA/SAP process) detailing issues and actions related to fishery exploitation impacts on non-target species.

Component 7: Strengthening regional and national fisheries management

This component will support the emerging regional fisheries management framework in the SWIO and build capacity in regional and national fisheries management bodies. The project will establish a working relationship and technical interface between SWIOFP and the SWIOFC, and establish a regional project management unit (PMU). The project will also assess national fisheries regulations and identify areas where harmonization is needed. **Outputs** include:

A. Legal agreements and memoranda of understanding between two or more SWIOFP countries facilitating regionally harmonized resource management; and
B. A stronger regional management structure for management of shared or straddling fisheries resources.

GEF – UNEP - ADDRESSING LAND-BASED ACTIVITIES IN THE WESTERN INDIAN OCEAN (WIO-LAB)

Broad Development Goal: To contribute to the environmentally sustainable management and development of the West Indian Ocean region, by reducing land-based activities that harm rivers, estuaries, and coastal waters, as well as their biological resources.

Objectives and Components:

1: Reduce stress to the ecosystem by improving water and sediment quality

1.A. Establish common methods for assessing water and sediment quality, including bioassays of coastal biota

1.B. Fill gaps in knowledge of priority pollutants (contaminant levels) in water and sediments, and major sources of pollutants (contaminant inputs)

1.C. Estimate the carrying capacity of the coastal waters, using an ecosystem-based approach

1.D. Determine coastal hot spots of pollution, building on the outcome of the African Process

1.E. Establish regional Environmental Quality Objectives and Environmental Quality Standards (EQO/EQS) for water and sediment quality

1.F. Develop compliance and long-term trend monitoring protocols and reporting (requires data base management and decision-support systems)

1.G. Implement demonstration projects for major land-based activities and pollutant sources, building on the African Process results which identified specific hot spots requiring intervention

1.H. Develop guidelines on best practices and procedures to address wastewater and implement demonstration projects

1.I. Implement action in specific locations to reduce and prevent the degradation of the coastal and marine environment caused by physical alteration and destruction of habitats, using the African Process results as a starting point

Objective 2: Strengthen regional legal basis for preventing land-based sources of pollution, including through the implementation of the Global Programme of Action for the Protection of the Marine Environment from land-based Activities

2.A. Review gaps in national legislation/ regulatory/ institutional frameworks

2.B. Review status of ratification of appropriate international conventions by countries, and assist countries in developing plans for ratifying those not yet ratified

2.C. Implement effective regional EIA processes

2.D. Assist countries in developing realistic and regionally integrated National Programmes of Action for land-based sources and activities

2.E. Develop and obtain approval for Protocol to the Nairobi Convention with Annexes, on Land Based Activities and Sources of Pollution

2.F. Promote and enhance the integrated management of river basin and coastal zone through application of the ICARM principles

Objective 3: Develop regional capacity and strengthen institutions for sustainable, less polluting development, including the implementation of the Nairobi Convention and its action plan as approved by participating Governments

3.A. Establish small GEF project unit within Nairobi Convention Secretariat in Nairobi for managing the GEF/UNEP/Norway project

3.B. Strengthen the EAF/RCU as the recognized and effective Regional Seas coordinating Unit for all regional policies and activities related to coastal and marine resources

3.C. Determine and satisfy training needs in region for LB activities and sources

3.D. Develop educational Programmes at all levels on LB activities and sources

3.E. Develop Regional/ Governmental/ Private Sector/ Public Sector partnerships on LB activities and sources

3.F. Identify, strengthen, and involve Stakeholders in LBS issues in the Region, including Monitoring and Evaluation, development of performance indicators

3.G. Implement small-grants Programme for broader stakeholder participation

3.H. Update TDA and SAP

3.I. Develop an East African regional node of the GPA Clearinghouse Mechanism

ANNEX 6: PROGRAMMATIC LINKAGES (ASCLMES PROJECT/ SWIOFP/ WIO-LAB)

The Table below maps the substantive Linkages among the Projects of the ASCLM Es Programme. ASCLMEs emphases appear in tandem with those of its major co-financing partner, the ACEP, as this gives a more inclusive picture of the full range of marine related activities that will be undertaken by the Programme.

Key The interests and responsibilities of the projects within the Programme are represented by:

+++……..A primary activity

++ ……. An important secondary activity

+ …….An activity of importance, but not main line

Discipline: Geoscientific Studies. Mapping of the ocean floor to understand topography and structural habitat, identify trawl grounds, provide area species estimates, provide basal layers for GIS decision-making, and provide topographic information for oceanography and biology.				
Activities	**ASCLMEs Project / ACEP**	**SWIOFP**	**WIO-LaB**	**LME Module Linkage**
Satellite Imagery	+++	++	+	Fish and Fisheries; Productivity
Bathymetry maps (coast drop-off, area species relationships, impact of fisheries)	+++	+	+	Fish and Fisheries; Productivity
Geology and Sedimentology	+++	+	+	Fish and Fisheries; Productivity; Pollution and Ecosystem Health
Geophysical Information	+++	+	+	Fish and Fisheries; Productivity
Use of Maps and GIS for public awareness and interactive education	+++	+	+	Socio-economic
Discipline: Oceanography. The unifying force that drives and governs the ASCLMEs. Physical and chemical oceanography describes impacts of currents, water quality, temperature, and conductivity on ecological processes. Understanding of Oceanographic processes is fundamental to management of fisheries, conservation, and sustainability.				
Activities	**ASCLMEs Project/ACEP**	**SWIOFP**	**WIO-LaB**	**LME Module Linkage**
Physical and Chemical	+++	+	+	Fish and Fisheries: Productivity; Pollution and Ecosystem Health
Biological	+++	+	+	Fish and Fisheries: Productivity; Pollution and Ecosystem Health
Discipline: Biology and Fisheries Science. Overall ecosystem health can be more effectively measured and managed if there is an understanding of the relationships of animals and plants to one another and to the physical environment in which they live.				
Activities	**ASCLMEs Project/ACEP**	**SWIOFP**	**WIO-LaB**	**LME Module Linkage**
Bio-indicators of System State	+++		++	Pollution and Ecosystem Health
Life Histories	+++	+++	+	Fish and Fisheries; Productivity; Pollution and Ecosystem Health
Biogeography and Habitat Definitions, Connectivity	+++	+++	+++	Fish and Fisheries; Productivity; Pollution and Ecosystem Health
Biodiversity Surveys (Taxonomy, Identification of "diversity hotspots")	+++	+++	+++	Fish and Fisheries; Productivity; Pollution and Ecosystem Health
Biotelemetry (tagging)	+++	++	+	Fish and Fisheries; Productivity; Pollution and Ecosystem Health
Genetics Genome Studies	+++ +++	+++	+ +	Fish and Fisheries; Productivity Fish and Fisheries; Productivity
Fisheries (SWIOFP Activities)	++	+++		Fish and Fisheries; Productivity; Socio-Economics and Pollution and Ecosystem Health

FADs		+++	+	Fish and Fisheries; Productivity
Discipline: <u>Capacity Building (Education).</u> Sustainability of the objectives of the Projects and Programme cannot be achieved absent a concerted effort to build permanent and regionally based capacity.				
Activities	**ASCLMEs Project/ACEP**	**SWIOFP**	**WIO-LaB**	**LME Module Linkage**
PhD Training	+++	++	+	All LME Modules
MSc Training	+++	++	+	All LME Modules
Undergraduate Training	+++	++	+	All LME Modules
Primary and Secondary School Involvement				All LME Modules
Discipline: <u>Public Awareness and Environmental Education</u>. Necessary to bridge the gap between science and the broader communities and community level stakeholders science must serve.				
Activities	**ASCLMEs Project/ACEP**	**SWIOFP**	**WIO-LaB**	**LME Module Linkage**
Public Awareness	+++	+	++	Governance; Socio-Economics; Pollution and Ecosystem Health
Environmental Education	+++		++	Governance; Socio-Economics; Pollution and Ecosystem Health
Public Participation	+++	+	+++	Governance; Socio-Economics; Pollution and Ecosystem Health
Discipline: <u>Socio-Economics, Indigenous Knowledge, Communities.</u> Poverty alleviation, food security, sustainability, conservation and general improvement of human lives are of paramount importance to coastal zone communities. A thorough understanding of the socio-economic context of coastal communities is imperative to management approaches.				
Activities	**ASCLMEs Project/ACEP**	**SWIOFP**	**WIO-LaB**	**LME Module Linkage**
Socio-Economics	+++	+++	+++	Governance; Socio-Economics; Pollution and Ecosystem Health
Indigenous Knowledge Systems	+++	+	+	Governance; Socio-Economics; Pollution and Ecosystem Health
Communities	+++	+	+++	Governance; Socio-Economics; Pollution and Ecosystem Health
Discipline: <u>Data Management, Information and GIS Decision Making</u>. All Programmes must build on previous work, obtain, synthesize and manage new data and ensure the availability of information and data to stakeholders in useable form.				
Activities	**ASCLMEs Project/ ACEP**	**SWIOFP**	**WIO-LaB**	**LME Module Linkage**
Data and Information Acquisition and Management	+++	+++	+++	All LME Modules
Data Sharing	+++	+++	+++	All LME Modules
Regional GIS Development	+++	++	++	All LME Modules
Discipline: Modelling: Interpretation of ecosystem processes, particularly those associated with physical, chemical and biological oceanography and their impacts on fisheries production and with fisheries management decisions can be dramatically advanced through modelling.				
Activities	**ASCLMEs Project/ACEP**	**SWIOFP**	**WIO-LaB**	**LME Module Linkage**
Ecosystem	+++	+	+	Fish and Fisheries; Productivity; Pollution and Ecosystem Health
Fisheries	+	+++	+	Fish and Fisheries; Productivity; Pollution and Ecosystem Health
Bioeconomics	+	+++	+	Fish and Fisheries; Productivity; Pollution and Ecosystem Health

N.B. SWIOFP will be addressing open ocean (beyond the 150 m depth contour) industrial sector fisheries whereas the ASCLMEs Project will be capturing information on artisanal and subsistence fisheries at the coastal level

ANNEX 7: IDENTIFIED PRIORITY AREAS FOR ASSESSMENT AND MAIN DATA GAPS

A. SUMMARY OF DATA GAPS, ASSESSMENT METHODOLOGIES AND MANAGEMENT APPLICATIONS

This summary is a synopsis of the information provided in detail below – **B. Detailed Priority Areas for Assessment.** Table 7 & 8 in the main text break this information into more logical presentation of the gaps and then the management applications.

Geographic Area: Somali Upwelling and Penetration of Red Sea water in the ASCLMEs		
Data Gaps: Information on environmental variability, upwelling, productivity and related fisheries . Assessments need to determine how Red Sea water reaches the ASCLMEs to increase understanding of global thermohaline circulation as well as inter-ocean exchanges of water masses.	Assessment Methodology: Cruise of the Nansen to the Somali Upwelling in conjunction with the SWIOFP project. Information collected on phytoplankton growth rates, population and size distribution of zooplankton, available light for photosynthesis, conductivity, temperature, salinity, chlorophyll concentrations, dissolved oxygen, pH, sea surface height and current velocity measurements. Measurements to also include sea floor mapping, bathymetry, wind speed and direction, solar radiation, sediment and benthos sampling, and acoustics. Two cruises foreseen. Remote sensing and GIS systems will also be utilized.	Management Application: Improved understanding of determinants of productivity in the Somali Current LME needed to manage pelagic fishing activities in the area.
Geographic Area: Kenya and Tanzania Coasts		
Data Gaps: Mapping needed of inshore circulation patterns. Management is impeded by information gaps on the movement of fish larvae, recruitment, environmental conditions for fisheries, and the dispersal of pollutants.	Assessment Methodology: Cruises of the Nansen and smaller vessels contracted in partnership with SWIOFP and WIO-LaB. Information gathered would include phytoplankton growth rates, population and size distribution of zooplankton, available light for photosynthesis, conductivity, temperature, salinity, chlorophyll concentrations, dissolved oxygen, pH, and sea surface height and current velocity measurements. Measurements to also include sea floor mapping, bathymetry, logging of wind speed and direction, solar radiation, sediment and benthos sampling, and acoustics. Remote sensing and GIS systems will also be utilized.	Management Application: Improved knowledge of transboundary environmental processes allows the countries to plan and adapt management schemes governing artisanal fisheries and pollution reduction in the area.
Geographic Area: Mascarene Plateau		
Data Gaps: The interaction of physical, chemical and biological processes in this large, shallow, mid-ocean region needs to be better understood to inform management practices. Specific information needed on seagrass beds, overall climatic patterns and variability, and the potential influence of the Indian Equatorial Jet on productivity in the ASCLMEs.	Assessment Methodology: Two cruises by the Nansen in conjunction with the SWIOFP project. Information collected on phytoplankton growth rates, population and size distribution of zooplankton, available light for photosynthesis, conductivity, temperature, salinity, chlorophyll concentrations, dissolved oxygen, pH, and sea surface height and current velocity measurements. Measurements to include sea floor mapping, bathymetry, logging of wind speeds and solar radiation, sediment and benthos sampling, and acoustics. Remote sensing and GIS systems will be also utilized.	Management Application: Information needed to define whether the Mascarene Plateau should be managed as a discrete LME.
Geographic Area: System Wide		
Data Gaps: Improved understanding of the role of the AA-Monsoon on the predictability of the global climate system.	Assessment Approach: The project will partner with the ongoing work of the CLIVAR-Goals project of the WMO/IOC/ICSU World Climate Research Programme.	Management Application: Improved understanding of Ocean-atmosphere links in the ASCLMEs contributes to understanding of global climate processes. The information also has

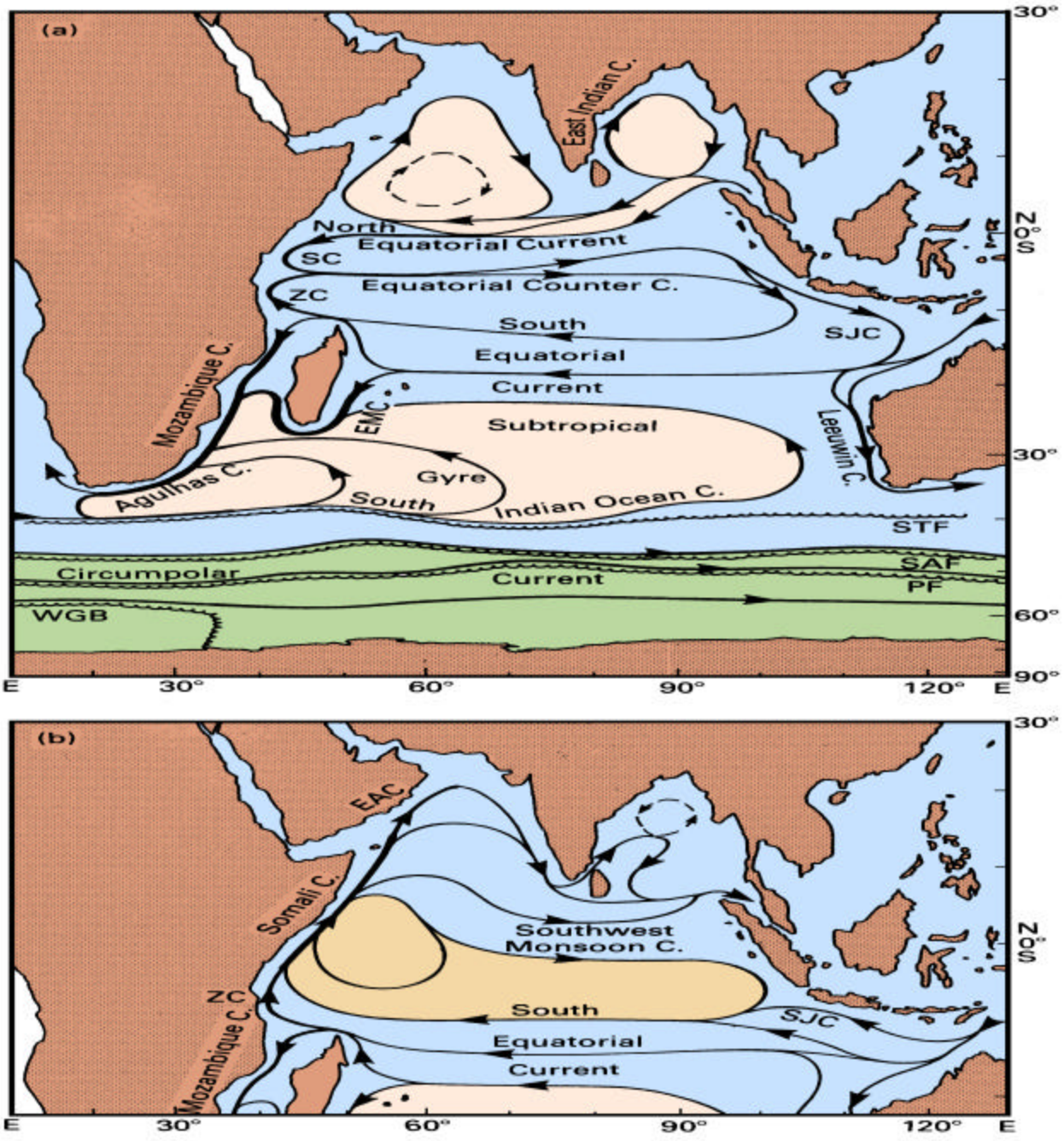
		utility for inland river basin management activities in SSA (Lake Tanganyika, Orange River etc).
Geographic Area: Southwest Indian Ocean shelf regions		
Data Gaps: Knowledge of shelf circulation patterns to better understand movement of organisms such as fish larvae, dispersal of pollutants. Information on system productivity needed.	Assessment Methodology: Two cruises of the Nansen will be undertaken and work will be jointly undertaken with SWIOFP. Information collected on phytoplankton growth rates, population and size distribution of zooplankton, available light for photosynthesis, conductivity, temperature, salinity, chlorophyll concentrations, dissolved oxygen, pH, and sea surface height and current velocity measurements. Measurements to include sea floor mapping, bathymetry, logging of wind speed and solar radiation, sediment and benthos sampling, and acoustics.	Management Application: Information on productivity and larval transport for fish and invertebrates is needed to institute an ecosystem-based approach to fisheries management.
Geographic Area: South Equatorial Current		
Data Gaps: Information on the circulation patterns of off shore currents is incomplete. Productivity and chemical oceanographic assessments also need to be undertaken.	Assessment Methodology: Two cruises by the Nansen in conjunction with the SWIOFP project. Information collected on phytoplankton growth rates, population and size distribution of zooplankton, available light for photosynthesis, conductivity, temperature, salinity, chlorophyll concentrations, dissolved oxygen, pH, and sea surface height and current velocity measurements. Measurements to include sea floor mapping, bathymetry, logging of wind speed and solar radiation, sediment and benthos sampling, and acoustics. Remote sensing and GIS systems will be utilized in addition to cruises.	Management Application: Offshore currents need to be better understood as they have bearing on coastal pollution, coral bleaching and productivity. Information has application for adaptation schemes, pollution control and fisheries.
Geographic Area: Region-Wide (Using indicator species in the Mozambique Channel and Seychelles)		
Data Gaps: No baseline information on loadings in key Indicator species of PTS and POPs.	Assessment Methodology: Analyses of heavy metal concentrations of mercury, selenium, cadmium, copper, zinc, and analyses of POPs that are listed under the Stockholm Convention and heavy metal concentrations of mercury, selenium, cadmium, copper, zinc, and arsenic in the muscle, liver, and kidney tissue of seabirds and fish, and in the blood and feathers of seabirds.	Management Application: Future decisions on regulatory measures to be taken re. heavy metal releases and POPs will require establishment of a baseline, which the project will provide through analyses of heavy metal and POPs concentrations in key indicator species.
Geographic Area: The splitting of the southern and northern branch of the East Madagascar Current		
Data Gaps: No current information on this area is available. Knowledge of shelf and coastal circulations, biodiversity, chemistry and geology virtually non-existent.	Assessment Methodology: One cruise by the Nansen in conjunction with the SWIOFP project. Information collected on phytoplankton growth rate, population and size distribution of zooplankton, available light for photosynthesis, conductivity, temperature, salinity, chlorophyll concentrations, dissolved oxygen, pH, and sea surface height and current velocity measurements. Measurements to include sea floor mapping, bathymetry, logging of wind speed and solar radiation, sediment and benthos sampling, and acoustics.	Management Application: Proper environmental management will require knowledge of shelf and coastal circulations as well as biodiversity (which is largely non-existent). Shelf water and organisms of this shelf area are known to be moved by vortex dipoles from the southern branch of this current into the Mozambique Channel and to the Agulhas Current; there is seeding potential for organisms of

		the latter regions and thus there are cross-boundary aspects thus making need for regional management highly likely.
Geographic Area: <u>The forcing of the South Madagascar upwelling cell</u>		
<u>Data Gaps:</u> Habitat classifications, resource identification and taxonomic work, and work related generally to establish baseline information on coastal circulations, biodiversity, chemistry and geology.	<u>Assessment Methodology:</u> One cruise by the Nansen in conjunction with the SWIOFP project. Information collected on phytoplankton growth rate, population and size distribution of zooplankton, available light for photosynthesis, conductivity, temperature, salinity, chlorophyll concentrations, dissolved oxygen, pH, and sea surface height and current velocity measurements. Measurements to include sea floor mapping, bathymetry, logging of wind speed and solar radiation, sediment and benthos sampling, and acoustics. Remote sensing and GIS systems will be utilized in addition to cruises. Current mooring array to be utilized. Remote sensing and GIS systems will also be utilized.	<u>Management Application</u>: Management application at national and regional level as there are indications that the organisms and larvae from this region may supply recruits for parts of the Mozambique Channel and for the shelves adjacent to the Agulhas Current proper, thus making this region of cross-boundary importance for the management of living resources.
Geographic Area: Mozambique Channel		
<u>Data Gaps:</u> Information needed on the shedding and triggering of Mozambique eddies. Information also needed on system primary/ Secondaryproductivity.	<u>Assessment Methodology:</u> Cruises will be undertaken jointly by the ASCLMEs Project, SWIOFP, and the ACEP. The Nansen and Algoa will be deployed and will undertake fisheries surveys through trawls. Information collected on phytoplankton growth rate, population and size distribution of zooplankton, available light for photosynthesis, conductivity, temperature, salinity, chlorophyll concentrations, dissolved oxygen, pH, and sea surface height and current velocity measurements. Measurements to include sea floor mapping, bathymetry, logging of wind speed and solar radiation, sediment and benthos sampling, and acoustics. A current meter array is also to be maintained and sondes deployed.	<u>Management Application</u>: Management application at regional and global scale. These eddies carry heat and momentum that are a component of the global thermohaline circulation. An increase or decrease in the shedding frequency of these eddies therefore may have global implications. Furthermore, these eddies have been implicated in triggering Natal Pulses and thus in the inter-ocean exchanges of water between the Indian and Atlantic Oceans. The work is therefore of substantial importance to regional and global CC management.
Geographic Area: Areas of the Mozambique and SA coasts, including principally the Delagoa eddy, the point at which the Agulhas Current begins to influence shelf circulation off Mozambique and SA, the Natal Pulse, the driving of the St. Lucia and Port Alfred upwelling cells.		
Data Gaps: Information needed on eddies to determine effects on overall ecology of the areas and particularly on downstream biodiversity, influence on shelf circulation, disposition of river outflows, dispersal of pollutants and thus habitat of organisms, and potential role on health of prawn	Assessment Methodology: Cruises will be undertaken jointly by the ASCLMEs Project, SWIOFP, and the ACEP. The Nansen and Algoa will be deployed and will undertake fisheries surveys through trawls. Information collected on phytoplankton growth rate, population and size distribution of zooplankton, available light for photosynthesis, conductivity, temperature, salinity, chlorophyll concentrations, dissolved oxygen, pH, and sea surface height and current velocity measurements.	Management Application: Information needed to map pollution transport, to establish priorities for pollution control. Information on larval transport and productivity is necessary to protect recruitment areas for

fisheries;	Measurements to include sea floor mapping, bathymetry, logging of wind speed and solar radiation, sediment and benthos sampling, and acoustics. Remote sensing and GIS systems will be utilized in addition to cruises.	fisheries.
Geographic Area: Agulhas Bank		
Data Gaps: A proper understanding of the hydrodynamic workings of the Agulhas Bank is needed to enhance existing information on the valuable anchovy and sardine fishery spawning ground, which has implications for the health of these important fisheries in the Benguela Current LME.	Assessment Methodology: Placement of current meter moorings at the upwelling and one cruise of the Algoa.	Management Application: Management of transboundary resources of the BCLME.

B. DETAILED DISCUSSION OF PRIORITY AREAS FOR ASSESSMENT & DATA GAPS

Technically, LMEs are defined using criteria such as bathymetry, hydrography, productivity and trophodynamics. The Somali LME (figure 2) extends geographically south-to-north from the Comoros Islands and the northern tip of Madagascar to the horn of Africa. The ocean circulation system here is largely dominated by the Indian Monsoon regime and exhibits a unique reversal of ocean currents with season. The Agulhas LME (see Figure 1) includes the Agulhas Current proper along the east coast of South Africa, as well as its source regions in the Mozambique Channel and east of Madagascar. This is a typical western boundary current system, the largest of its kind in the world. The island States included in this proposal (Mauritius, Comoros, Seychelles and Madagascar) are all influenced by the South Equatorial Current that carries water from the east Indian Ocean to the west. For illustrative purposes maps depicting the ASCLMEs are included below



Note: The circulation South of 20^{O} latitude remains relatively unaltered seasonally.

The environmental assessments that will be commissioned under the project are aimed at improving understanding of the physical, chemical and biological characteristics of the ASCLMEs. The information is needed to finalize the Transboundary Diagnostic Analysis and Strategic Action Programme for these LMEs, enabling the participating countries to institute adaptive management regimes for these systems. This annex summarizes the target areas for the assessments, both in terms of geographic focus and thematic coverage. The targets have been arrived at following an iterative process of prioritisation and stakeholder validation. Three workshops have been convened to inform this process, namely: 1) workshop held in Maputo, Mozambique (September 2002), 2) a Science Planning Workshop in Dal Josafat, South Africa (May 2004); and 3) a Regional Information Workshop in Grahamstown, South Africa (October 2004). The targets were further informed based on an exhaustive review of available information on the LMEs (Roman and Lutjeharms, 2004). The priorities were informed 1] based on management needs, including the reduction of coastal pollution, management of fish stocks, restoration of damaged habitats and achievement of economic benefits; and 2] based on the extent to which they add to understanding of transboundary threats and effects that need to be mitigated at the regional level, and ecosystem functioning (at the scale of the LMEs)[60].

Generic Assessment Areas

A key issue that needs to be addressed, in instituting an ecosystem approach to LME management is: what aspects of the marine ecosystem of the ASCLMEs and thus the cross-border fisheries are most easily disturbed by human interference and climate variability? This is a cross cutting concern, the answers to which require a solid understanding of the oceanographic conditions of the region, and their relationships to ecosystem dynamics, and ultimately, to the health of the region's fisheries. A number of generic questions will need to be addressed in order to establish these understandings:

a) What are the inshore circulation patterns in the ASCLMEs and how do these affect local habitats?
b) Does the circulation of Eastern Africa, Madagascar and the islands of the Indian Ocean play a critical role in global thermohaline circulation and thus in climate variability and global climate change?
c) What components of the offshore circulation affect the circulation of shelf regions in the ASCLMEs and thus the distribution of marine organisms?
d) What are the water characteristics, water quality indexes and water circulation patterns on the shelf regions of the ASCLMEs that have the most marked effects on trans-boundary ecosystems, and thus living marine resources?
e) What are the most important components of terrestrial run-off that influence coastal ecosystems and their health?

A number of specific issues have been identified within each of the above generic assessment areas.

Specific Priority Assessment Areas

A. WHAT ARE THE INSHORE CIRCULATION PATTERNS IN THE ASCLMES AND HOW DO THESE AFFECT LOCAL HABITATS?

1. **What is the inshore circulation pattern along the coasts of Kenya and Tanzania and how does this affect the ecosystems?** The offshore currents along the coasts of Kenya and Tanzania have been extensively studied as part of previous international oceanographic investigations. The fisheries of both these countries are largely artisanal and include prawn fisheries. Information gaps on environmental conditions and their variability in space and time are most significant in inshore

[60] The following criteria were established in defining the assessment priorities. First, they must be scientifically defensible. Second, they must fill the most critical knowledge gaps that currently preclude management of trans-boundary LMEs and their constituent living resources. Third, they must provide socio-economic benefits for all the countries of the region (i.e. contribute to efforts to maintain food security, or plan response measures to natural disasters). Fourth, they must add value to existing information. Fifth, they must be cost effective and achievable.

regions. The inshore circulation may play a defining role in many of the processes that affect artisanal fisheries, including the movement of fish and fish larvae, recruitment, and environmental conditions.

2. **What components of the inshore circulation affect the circulation on shelf regions in the SWIO and thus the distribution of marine organisms and the geographic structure of marine ecosystems?** The inshore circulation, i.e. at the shelf edge, has a decisive influence on most shelves of the South West Indian Ocean (Lutjeharms, 2004), particularly where the shelf is narrow (see Figures 1 and 3). An understanding of shelf circulation in turn is crucial for an understanding of the movement of organisms, such as fish larvae, and the dispersal of pollutants. Such circulation occurs across boundaries and carries marine organisms with it. Lack of knowledge as well as data on the effect of onshore currents on shelf circulation is one of the major gaps that need to be filled if the trans-boundary living resources are to be managed effectively. Studies of these processes will help build local scientific and management capacity and create skills in areas most useful to LME management.

3. **What are the shelf and coastal circulation patterns along the East Madagascar shore line?** The narrow shelf east of Madagascar (see Figure 3) is one of the least studied shelf regions in the world's oceans. Only one partial investigation of fish resources has been undertaken on part of the shelf, and that was 20 years ago. The knowledge of shelf and coastal circulations as well as biodiversity is largely non-existent, making proper environmental management impossible. A baseline study of hydrodynamics and biodiversity is clearly urgently called for. This coastline is in many respects ideal for tourism and this is being considered for the future. A thorough investigation will establish a reference level against which possible future pollution and environmental degradation can be measured. A first, proper hydrographic survey of this current and its variability will give a very solid understanding on the effect of the ocean environment on this coastal region. This may at first glance seem a problem of national importance, but based on limited current knowledge, this seems not to be the case. Shelf water and organisms of this shelf area are known to be moved by vortex dipoles from the southern branch of this current into the Mozambique Channel and to the Agulhas Current; there is seeding potential for organisms of the latter regions and thus there are cross-boundary aspects.

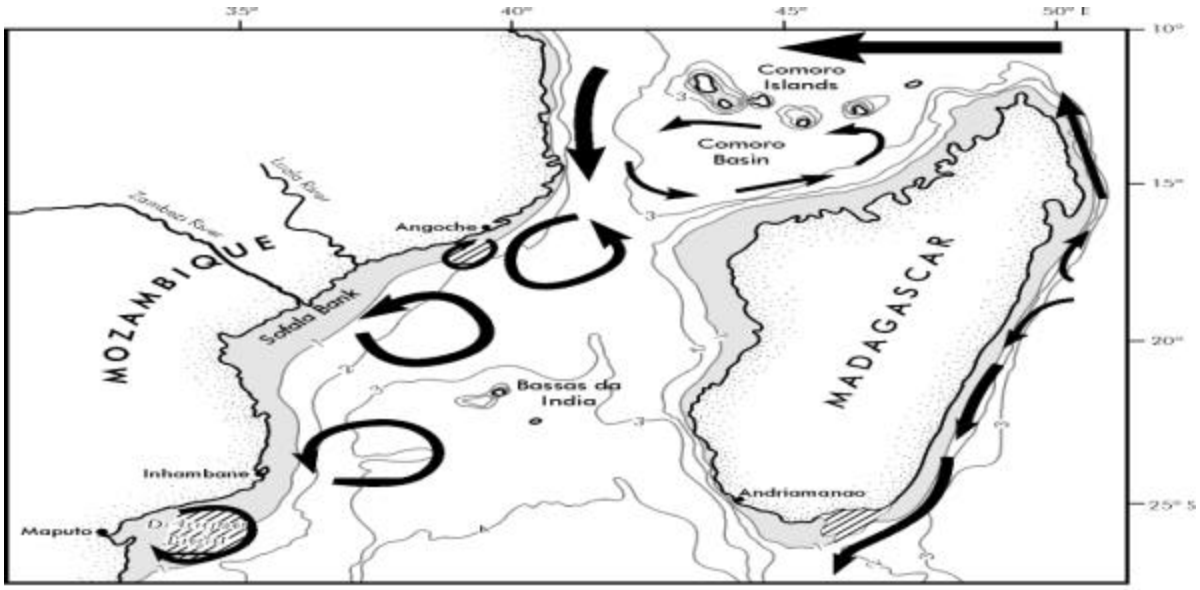


Figure 3. The general circulation in the vicinity of Madagascar and the Mozambique Channel. Shaded areas denote the continental shelves shallower than 1000 m. Lined regions indicate upwelling cells. The bathymetry is given in km.

B. DOES THE CIRCULATION OF EASTERN AFRICA, MADAGASCAR AND THE ISLANDS OF THE INDIAN OCEAN PLAY A CRITICAL ROLE IN GLOBAL THERMOHALINE CIRCULATION AND THUS IN CLIMATE VARIABILITY AND GLOBAL CLIMATE CHANGE?

4. **What are the implications of the Somali Current upwelling on issues related to environmental variability?** It is well established that the Western Indian Ocean is the site of some of the most dynamically varying LMEs that exist on the planet[61]. The Somali Current develops during the southwest monsoon to become the fastest open-ocean current in the world[62], and the coastal upwelling that occurs along the African coast during the intensified phase of the Somali Current constitutes the most intense large-scale seasonal coastal upwelling system in the world. The Findlater Jet (that extends from the Somali coast out over the Arabian Sea) is the strongest low-level atmospheric jet that exists as a regular feature anywhere in the world[63]. In addition, the northwestern Indian Ocean has been identified as a major zone of methane emissions (methane being a particularly potent greenhouse gas, some 21 times as effective as carbon dioxide, per unit weight, in driving global warming)[64]. However the dynamics underpinning these processes and environmental variability remain poorly understood.

5. **What are the more precise linkages between the Asian-Australian monsoon and the global climate system?** The Asian-Australian (AA) monsoon, which is a highly significant factor within the Somali and Agulhas LMEs, is a key component of the earth's climate system and affects the livelihood of more than 60% of humanity. Better predictions of the monsoon will greatly benefit the social and economic well-being of this large segment of the world's population[65]. In addition, there is strong linkage of the AA monsoon system to the global climate system, and thus improved understanding and prediction of the AA monsoon is not only crucial to the WIO but also globally. Past studies have shown that the AA-monsoon is linked to interannual variability of the tropical ocean-atmosphere system, such as the El Niño Southern Oscillation (ENSO) and the tropical biennial oscillation, and other studies suggest that the AA-monsoon may strongly impact the climate outside the monsoon region, including extratropical North America[66]. Indeed, a primary goal of the CLIVAR-GOALS project of the WMO/IOC/ICSU World Climate Research Programme is to better understand ". . . the role of the AA-monsoon on the predictability of the global climate system, in particular parts related to ENSO." The project will accordingly develop a close working relationship with CLIVAR.

6. **What are the precise effects of the unique biological and physical characteristics of the Mascarene Plateau on the surrounding parts of the Agulhas and Somali LMEs?** The Mascarene Plateau arches across the Western Indian Ocean from the Seychelles down to Mauritius, with water depths up to 100 m. The area supports a wide diversity of ecosystems with potential for exploitable resources. The Plateau extends as a fault-composite arc for 2,300 km from the Equator southwards, with water depths ranging from 0 to 100 m[67]. It is a strong topographic feature, and probably acts as a barrier to latitudinal water flows in the Western Indian Ocean, and thus is of distinct, regional importance. Management of marine resources over large ocean areas provides a great challenge. Despite extensive studies in many of these large ocean areas, the interaction of physical and biological processes in large shallow mid-oceanic areas, such as the Mascarene Plateau is not well understood.

- The climate regime of the Indian Ocean (monsoons and trade winds) is influenced by its geography and its proximity to two large continental masses. However, the impact of the

[61] Bakun, A., S. Lluch-Cota and C. Roy. 1998. Coastal upwelling and other processes regulating ecosystem productivity and fish production in the western Indian Ocean. p. 103-141. In: K. Sherman, E. Okemwa and M. Ntiba, (eds.) Large Marine Ecosystems of the Indian Ocean: Assessment, Sustainability, and Management. Blackwell Science Inc. Malden, MA. USA.
[62] Ibid
[63] Ibid
[64] Bakun, A. and S.J. Weeks. 2004. Greenhouse gas buildup, sardines, submarine eruptions, and the possibility of abrupt degradation of intense marine upwelling ecosystems. *Ecology Letters* 7: 1015-1023.
[65] CLIVAR Project website: http://www.clivar.org/index.htm
[66] Ibid
[67] It is also described as a distinct shelf of continental origin (Mart, 1988).

Mascarene Plateau on these phenomena remain poorly understood and understanding of the climate regime is undermined by the lack of a specific climatic description for the area[68].

- An intense Indian Equatorial Jet (EJ) signals the transition from the northeast to southwest monsoons. The behaviour of this jet is, however, still not well known. Research shows that in any particular year the jet appears within the three-month window April–June as a feature of shorter (one-month) durations with higher peak velocities. Although it is on average a weak feature it may nonetheless result in a distinct physical forcing. As this could have an influence on productivity (and thus fisheries), improved understanding of this phenomenon is seen as important.

7. Does the circulation off western Africa, Madagascar and islands of the South West Indian Ocean play a critical role in global thermohaline circulation and thus in climate variability and global climate change? Considerable effort has been expended over the past decade in studying the manner in which the greater Agulhas Current contributes to the global thermohaline circulation. It has been demonstrated, through many international studies that it plays a crucial role in inter-ocean exchanges of water and that variations to these fluxes contribute to changes in climate variability. These results naturally have an enormous, but indirect, socio-economic impact. A number of key problems that require further investigation have been identified. Many of these do not require any observations at sea but can be researched through modelling, remote sensing and theoretical studies:

- What is the frequency of shedding of Mozambique eddies? It has recently been demonstrated that the main currents of the Mozambique Channel consist of anti-cyclonic eddies formed at the narrows of the Mozambique Channel from where they move in a polar direction. These eddies carry heat and momentum that are a component of the global thermohaline circulation. An increase or decrease in the shedding frequency of these eddies therefore may have global implications. Furthermore, these eddies have been implicated in triggering Natal Pulses and thus in the inter-ocean exchanges of water between the Indian and Atlantic Oceans. With regard to their impact on climate change, they are therefore of substantial importance. A sophisticated array of current meter moorings placed in the Mozambique Channel narrows by a research team from the Netherlands are currently monitoring the shedding of eddies. This work could be supported by the placement of hydrographic stations through eddies on research cruises as well as by altimetry.
- The triggering of Mozambique eddies Mozambique eddies move past the shelves of the coast of Mozambique where it has been observed that they draw water from the shelves into the deep sea. It is probable that they also affect the circulation of water on the shelves. In addition, they carry Indo-Pacific organisms from the tropics across political boundaries. It is not known what effect the Mozambique eddies have on the shelves of Madagascar, since there are no adequate hydrographic data for that region. It is therefore important to establish what factors or driving forces trigger the shedding of a Mozambique eddy. This could probably be most effectively done by analysis of remote sensing products and by the judicious use of modelling. Hydrographic observations in eddies will be of enormous value in establishing their nature and dynamics.
- Penetration of Red Sea Water in the South West Indian Ocean: The general, averaged motion of Red Sea Water into the ASCLMEs region has been established. However, it is not clear how Red Sea Water reaches various parts of this ocean region: does it come in a seasonal manner, in irregular occurring filaments or is it a continuous process? Understanding this cross-boundary process is important from a climatology point of view since this process has an impact on the global thermohaline circulation as well as on inter-ocean exchanges of water masses. The analysis for this project will have to be based on existing hydrographic data, but new additions of data in places in the ASCLMEs where no data are currently available will be of immense value. These data could be collected during cruises in designated regions where knowledge gaps need to be filled.
- Movement of South Equatorial Current eddies and their impact: It has been shown unequivocally that eddies embedded in the South Equatorial Current, on reaching the east and

[68] A few studies were undertaken in the 1990s by the INDOEX research project (Ramanathan *et al.*, 1995)

south coast of Madagascar as well as the region of the Comoros and the Mozambican coast, have a decided impact on the local circulations. Furthermore, it has been suggested that they play a triggering role in what may be considered the greater Agulhas Current system. This triggering role may have substantial climatological effects and thus influence global climate change. Comprehensive international studies are underway to study these effects, but they are limited to modelling and analyses of satellite remote sensing. Hydrographic observations at sea in any of the ASCLMEs regions where these eddies are to be found would be of value in establishing their hydrographic and dynamic natures and thus their role in affecting climate patterns and variability.

WHAT COMPONENTS OF THE OFFSHORE CIRCULATION AFFECT THE CIRCULATION OF SHELF REGIONS IN THE ASCLMES AND THUS THE DISTRIBUTION OF MARINE ORGANISMS?

8. **What is the influence of the South Equatorial Current on the shelf circulations of the WIO islands?** The Seychelles, Mauritius, Reunion and other islands have in many respects similar oceanic environments. They are open to deep-sea circulatory effects due to a very narrow shelf and are all influenced by the South Equatorial Current coming from the east (see Figure 1). This Current may be affected by lateral Rossby waves and by perturbations in the form of eddies. The effect of these on the marine environments of the islands is very poorly understood. This needs to be rectified. In most cases the economies of these islands depend increasingly on nature-based tourism. Coastal pollution, and climate change induced habitat destruction (such as bleaching of coral reefs) are aspects influenced by offshore currents and their variability. All in turn have direct economic implications.

9. **What are the determinants of forcing of the South Madagascar upwelling cell?** A number of previous investigations have pointed to the existence of an upwelling cell off the southeast coast of Madagascar. This shelf upwelling cell does not seem to be wind-driven, but rather driven by the passing southern branch of the East Madagascar Current. To date, only one research cruise vessel has tangentially) investigated the feature. This upwelling cell may have substantial socio-economic implications. There is some anecdotal evidence that fishing in the region is enhanced, but this has not been investigated rigorously. There are also indications that the organisms and larvae from this region may supply recruits for parts of the Mozambique Channel and for the shelves adjacent to the Agulhas Current proper, thus making this region of cross-boundary importance for the management of living resources. Habitat classifications, resource identification and taxonomic work need to be carried out. The driving forces of the cell and their variability need to be understood in order to manage potential fisheries.

10. **How is the Angoche upwelling cell shaped?** Information on primary productivity and its relation to fisheries is generally limited for the whole ASCLMEs region. Nevertheless, a number of prime locations for urgent investigation stand out. One is the coastal upwelling cell off southern Madagascar (see preceding bullet). Very little is known on the primary productivity here. On the western side of the Mozambique Channel there is slightly more information and it has been demonstrated that the highest primary productivity, by far, is to be found in an upwelling cell off Angoche (see Figures 3 and 4). The relationship of this feature to local fisheries and fisheries further downstream is imperfectly understood. The role of this cell in generating recruits for fisheries downstream makes this an important cross-boundary issue. The sustainability of this upwelling cell, its variability, its contribution to biodiversity and its driving forces are currently not well understood.

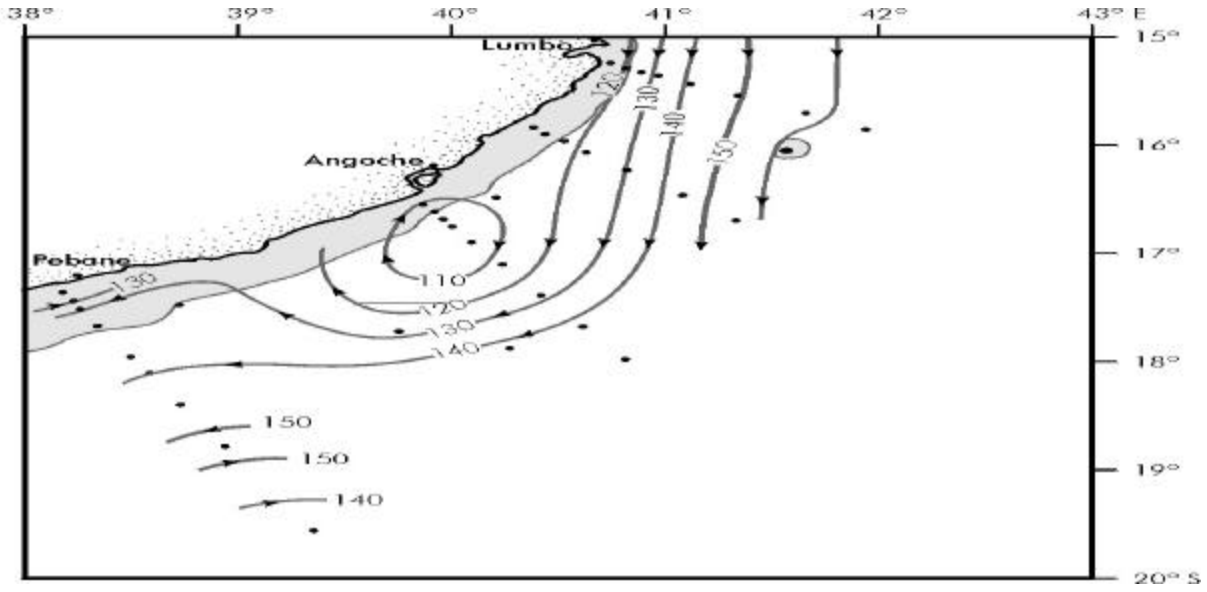


Figure 4. The flow pattern around the Angoche upwelling cell along the coast of Mozambique (see Figure 2 for general location) according to a cruise undertaken in 1980. After Lutjeharms (2004). Black dots denote the location of hydrographic stations. The most intense upwelling and highest values of chlorophyll-a on this occasion occurred within the 110 isoline. These isolines give the dynamic topography of the sea surface relative to 600 dbar in dynamic centimetre.

11. **What is the influence of Mozambique eddies on the adjacent shelf waters?** While past investigations have shown that a Mozambique current does not exist as such, large, anti-cyclonic ocean eddies are formed in the narrows of the Mozambique Channel and these eddies move along the western shelf creating the illusion of a western boundary current (see Figures 1 and 3). Confirmation of this scenario is very recent. This has crucial importance for an understanding of the circulation on the shelves off the Mozambican coast, their ecology, their role in sustaining local and downstream biodiversity and their consequent role in sustaining local and downstream fisheries. It has been demonstrated that passing Mozambique eddies draw off water and phytoplankton from the shelves in this region. This is only one aspect that requires investigation in order to secure a better understanding of underlying ocean variability—in turn needed to ensure living marine resources are effectively managed.

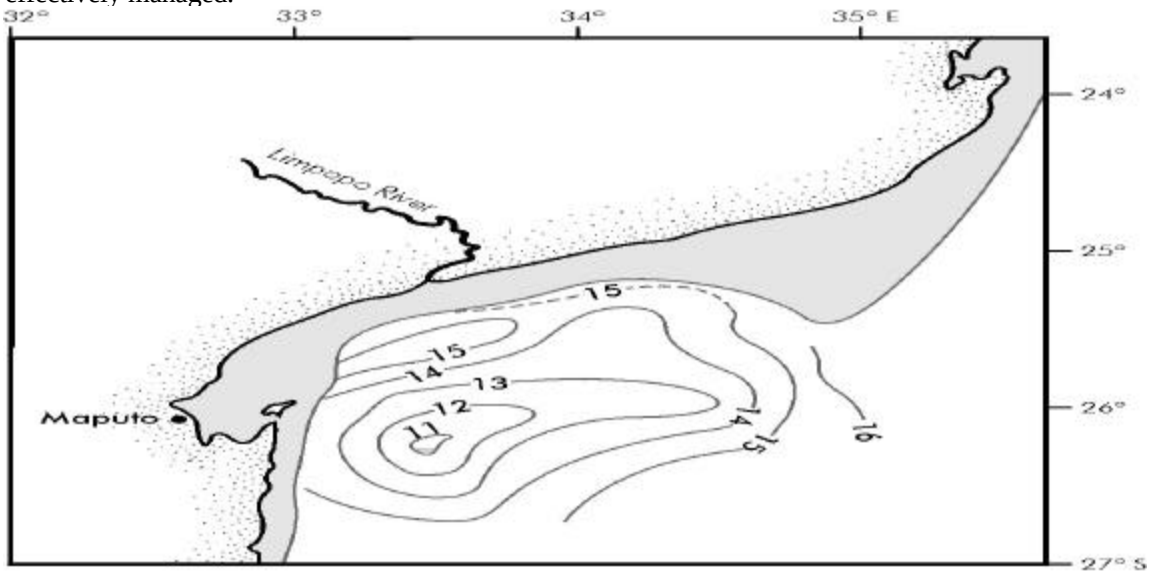


Figure 5. The eddy in the Delagoa Bight of the Mozambican coast (see Figure 3 for general location in the Mozambique Channel). The shaded area is the continental shelf shallower than 1000 m. Isolines are the isotherms at a depth of 200m showing the upwelling of cold (< 10º C) water in the centre of the cyclonic eddy.

12. **What are the factors underpinning the driving of the Delagoa eddy?** In the Delagoa Bight, off Maputo, the capital of Mozambique, a recurrent and persistent cyclonic eddy is found (see Figures 3 and 5, above). This resident shelf edge circulation is believed to be driven by passing Mozambique eddies, but no firm confirmation for this hypothesis is as yet available. Only one research cruise has been undertaken in the area to study the feature. This eddy is known to influence the shelf circulation, the disposition of river outflows, the dispersion of pollutants and thus the habitat of organisms and potentially the important prawn fisheries. Since this feature is close to the South African border, it may well play an important role in cross-boundary living resources. In order to establish the driving forces for this eddy and its role, satellite remote sensing and a research cruise are required. Mapping of biotopes in this feature and in the adjacent shelf region should be carried out.

13. **Where does the Agulhas Current start to influence the shelf circulation off Mozambique/South Africa?** It is a remarkable fact that the location at which the Agulhas Current proper starts to affect the motion of shelf waters on the Mozambican/South African shelf is not known. To date this location has only been surmised from patterns of the shelf sediments northeast of Durban (see Figure 6). Knowing this location is crucial not only for an understanding of shelf circulation between Durban and Maputo, but also for a better knowledge of the ecology of cross-boundary living resources and the dispersion of pollutants from Mozambique and Maputoland South. The placement of current meter moorings would be sufficient to fill this important knowledge gap.

14. **What factors contribute to the driving of the St Lucia upwelling cell and what is its effect on the Natal Bight?** The Natal Bight is a semi-enclosed part of the shelf of southern Africa lying between Cape St Lucia and Durban (see Figures 7 and 8). It is the widest part of this shelf region and is bordered on the seaward side by the Agulhas Current. It creates a somewhat specialized habitat with a number of endemic species. Other living resources migrate equatorward to the bight from further downstream. There are some indications that the living resources of the bight are not independent from those across the Mozambican border slightly to the north, making this a relevant case for cross-boundary management. A coastline that is partly highly industrialized and partly used for intensive tourism and eco-tourism borders the Natal Bight. The waters of the bight are therefore the recipient of considerably urban and industrial runoff and pollution. A number of rivers discharge their waters into the region. The marine ecology of the bight is highly unusual. It seems that an upwelling cell at Cape St Lucia, driven by the passing Agulhas Current, supplies all the nutrients to maintain the primary productivity in the bight (see Figure 7). This makes an understanding of this upwelling cell crucial to an understanding of the whole oceanography and ecology of the Natal Bight. Without this understanding, effective management of the living resources is not possible. Currently, there is no information on the variability of the Cape St Lucia upwelling cell, its lasting influence on the waters and ecosystem of the bight as a whole or on the forces that drive the upwelling. Information could be obtained by placing a set of current meter moorings at this upwelling cell.

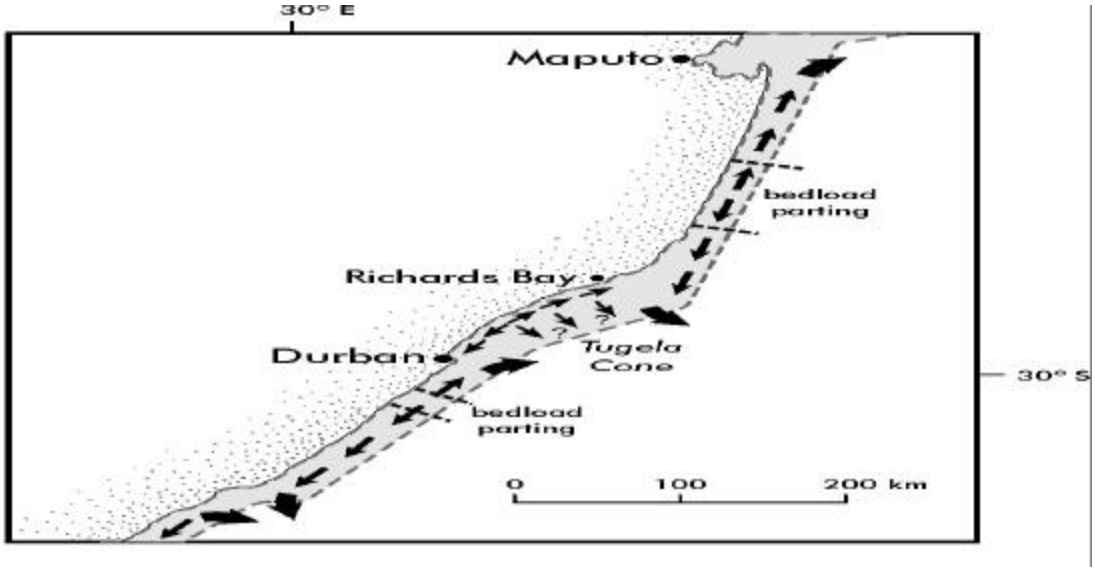


Figure 6. The inferred bedload motion along the coastline between South Africa and Mozambique, after Lutjeharms (2004). The bedload parting equatorward of Richards Bay may give an indication of where the Agulhas Current starts having an influence on shelf waters.

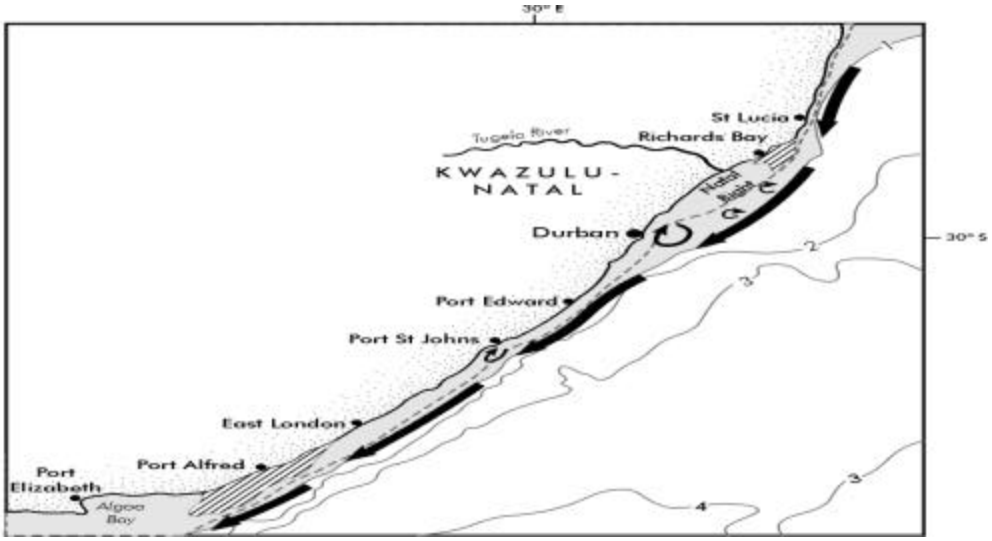


Figure 7. A portrayal of the general circulation off the east coast of South Africa. Lined regions denote where upwelling is known to occur; shaded regions are shallower than 1000m. Note the narrowness of the shelf and the way in which the Agulhas Current follows the shelf edge if there is no Natal Pulse present.

13. **What is the effect on shelf water of the Natal Pulse?** The Natal Pulse is an unusual perturbation on the trajectory of the Agulhas Current (see Figure 1 and 7). Its behaviour is crucial to an understanding of the Agulhas Current, the Agulhas retroflection and the role of this current in the global thermohaline circulation. It has also been demonstrated on a few individual occasions that the passing of the Natal Pulse has a dominating effect on the water movement on the adjacent continental shelf by reversing the currents dramatically and instantaneously. This process may play a key role in the movement of organisms along this coastline from the Agulhas Bank to the Natal Bight, in the annual sardine run, in the migration of whales and in the distribution of immotile organisms and larvae. It probably also has a decisive influence on the dispersion of pollutants on the shelf of this region. A proper understanding, based on appropriate data of the effect on shelf waters of the passing of Natal Pulses is essential if the fish resources of the eastern seaboard are to be properly managed.

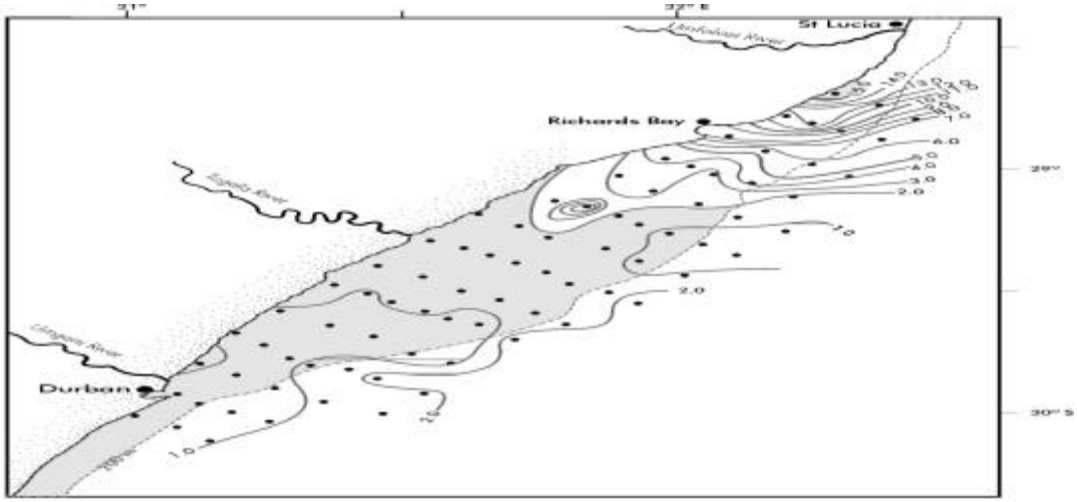


Figure 8. A portrayal of the Cape St Lucia upwelling cell and its influence on the Natal Bight waters. Dots represent station positions. The shaded region is shallower than 200 m.

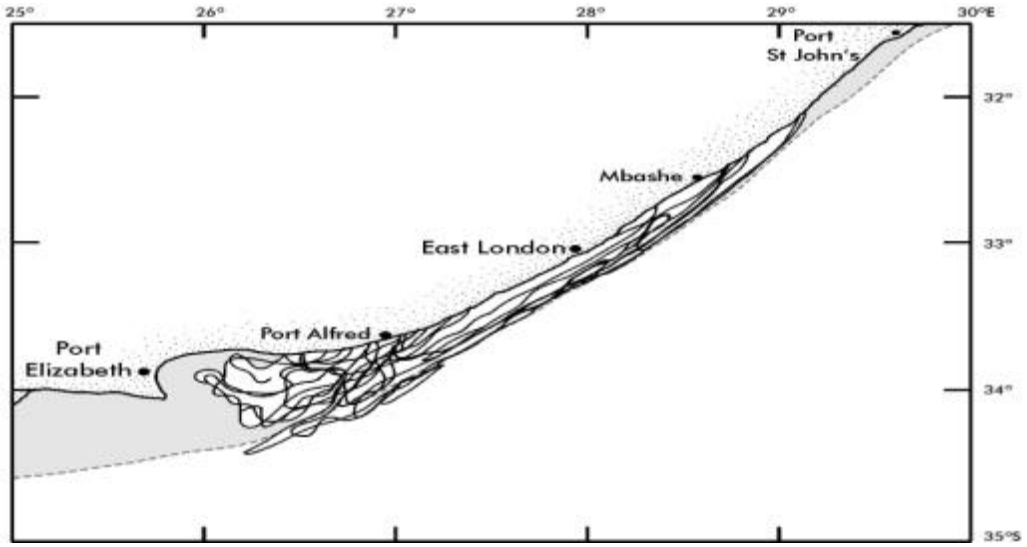


Figure 9. A composite of outlines of cold water (< 17ºC) of the Port Alfred upwelling cell, after Lutjeharms, 2004. The shelf shallower than 200m has been shaded.

What forces drive the Port Alfred upwelling cell and what is its effect on the Agulhas Bank?

14. The Agulhas Bank is a wide part of the shelf at the southern tip of South Africa (see Figure 1). It plays a crucial role in the west coast ecosystem of southern Africa and is thus a prime region for cross-boundary ecosystem management. It is here that the major economically important species such as anchovy and sardine spawn. It has been demonstrated that the environmental conditions on the bank during critical stages of the spawning period are crucial to the success, or failure, of that year class. A full understanding of the hydrodynamic working of the Agulhas Bank is therefore essential to the proper management of these cross-boundary living resources. It has enormous socio-economic consequences, but major knowledge and data gaps exist in this regard. It has been shown that there is a high likelihood that the upwelling cell found at Port Alfred carries cold water onto the shelf and here forms the bottom waters of the whole Agulhas Bank, thus enhancing the seasonal thermocline and creating a favourable habitat for the spawning of fish. The process through which this occurs is not understood. In order to evaluate and understand the role of this

upwelling cell, the driving forces need to be evaluated, the variability of the upwelling cell needs to be monitored and the effect of the cold water thus upwelled on the rest of the shelf determined. To answer these questions adequately placement of current meter moorings at the upwelling cell as well as a proper, multi-disciplinary cruise encompassing the whole of the Agulhas Bank quasi-synoptically should be carried out.

WHAT ARE THE WATER CHARACTERISTICS, WATER QUALITY INDEXES AND WATER CIRCULATION PATTERNS ON THE SHELF REGIONS OF THE ASCLMES THAT HAVE THE MOST MARKED EFFECTS ON TRANS-BOUNDARY ECOSYSTEMS, AND THUS LIVING MARINE RESOURCES?

15. Water quality of shelf waters have a decided influence on pollution, habitat destruction and thus fisheries and tourism. In many areas of the ASCLMEs there is no information of any kind on the water movement, water characteristics, water quality or the cross-boundary exchanges of water masses and biota. This precludes any management of cross-boundary living resources or biodiversity. Assessments are needed to establish baselines in the shelf areas of WIO Islands, East and West Coast of Madagascar[69], and coastlines of East Africa[70].

WHAT ARE THE MOST IMPORTANT COMPONENTS OF TERRESTRIAL RUN-OFF THAT INFLUENCE COASTAL ECOSYSTEMS AND THEIR HEALTH?

- **Saline and fresh water runoff on the Sofala Bank:** The Sofala Bank is one of the widest and shallowest shelf regions in the proposed ASCLMEs (see Figure 10). It is the recipient of substantial amounts of fresh water from the Zambezi and other rivers as well as saline inputs from the salt marshes in the vicinity of Beira. These inflows are by no means continuous. Occasional summer floods from the Zambezi River could conceivably overwhelm the saline surface waters of a large part of the adjacent shelf, whereas during dry periods the saline fluxes from salt marshes could be dominant. Neither of these hypotheses has been tested by appropriate observations, which is problematic for management purposes as the region supports an important fishery. Little is known about the distribution of biotopes and the habitats have not been adequately classified.
- **Limpopo runoff on the ecosystem of the Delagoa Bight:** One of the largest rivers in the ASCLMEs region is the Limpopo River that drains into the Delagoa Bight (see Figure 5). It has been conjectured that the economically important prawn fisheries of this region benefits from the organic material contributed by the runoff from this river. Biotopes in the region have not been adequately mapped nor have complete taxonomic determinations been carried out. Investigations using satellite remote sensing and well-focused hydrographic observations in the Delagoa Bight would go a long way to filling some of the knowledge gaps currently hindering management.
- **River runoffs from Madagascar:** All the criteria for including land runoff onto adjacent shelves in a list of priority actions hold equally for the river runoffs from Madagascar. These include filling knowledge gaps needed better to manage living resources, biodiversity and possible cross-boundary fish stocks. Biotopes need to be mapped and potential living resources identified. However, there seems to be no information whatsoever on the influence of river runoff on the Madagascar shelves. Two ways of approaching this information gap are foreseen. One is to include such an investigation in an exploratory cruise on the shelves of Madagascar and its adjacent current systems. The other, perhaps complementary, study would involve

[69] The shelf of Madagascar are in most respects *mare incognitum*. Hardly any measurements of an oceanographic nature have been carried out. The shelf west of Madagascar is wider than the East coast shelf, and is not bordered by a strong western boundary current. The characteristics of its waters and biota may therefore be entirely different.

[70] The shelf waters of the Somali system are of substantial importance for the artisanal fisheries of the East African coast. A question that needs to be addressed is how dependent is the shelf circulation on the reversing monsoonal winds and how much on the seasonality of the offshore Somali Current? How much does this vary from year to year and what impact does this variation have on the fish stocks, it at all?

smaller vessels that could carry out monitoring work on a more regular basis at predetermined locations.

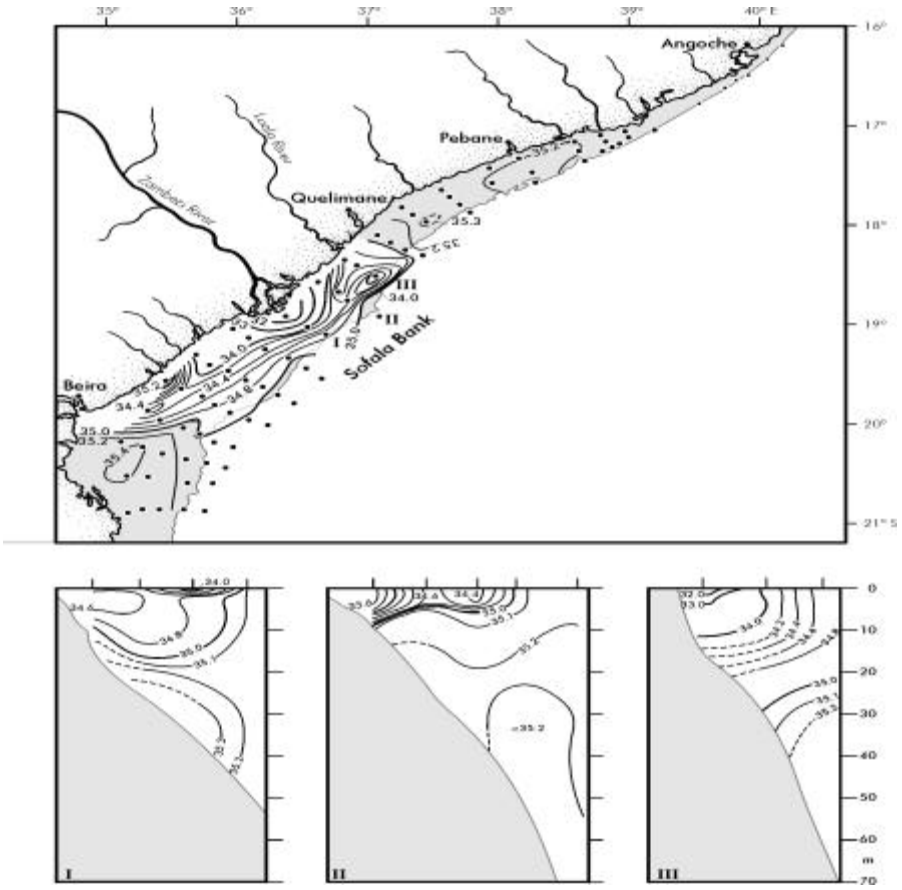


Figure 10. One-time observations of the effect of freshwater runoff from the Zambezi River on the waters of the Sofala Bank in the Mozambique Channel. The upper panel shows the salinities at the sea surface with low salinity region not shaded. The lower panel shows three vertical sections – marked in the upper panel – of salinity. Dots denote station position in the upper panel, vertical marks the same in the lower panels.

ANNEX 8: PROGRAMME AREAS, LME MODULE, AND FUNDING SOURCE

Programme Area	**Interventions/LME Module**	**Funding Source**
ASCLMEs Project Objective: *To fill prioritised knowledge gaps in understanding of transboundary living resources of the two LMEs and to build capacity of the participating countries to utilize this improved understanding for more effective management through use of a modular approach to ecosystem management.*	Four specific Outcomes: • Filling of key identified knowledge and information gaps (Productivity Module/ fisheries and pollution module) • Building project, Programme and Long-term monitoring and evaluation system Governance and Socio-economic Module); • Mainstreaming (Governance and Socio-economic Module); and • Public Participation Programme (Socio-economic Module).	ASCLMEs Project, with additional financial contributions from SWIOFP for joint cruises, and WIO-LaB for public participation activities.
Outcome: Key environmental knowledge gaps are filled as necessary to install an ecosystem approach to LME management;	Fill gaps in identified priority areas in oceanographic processes and environmental variability ((Productivity, fisheries and Pollution and Ecosystem Health Modules): Specifically, among others, system productivity in near-shore and off-shore area; larval transport; anthropogenically induced environmental variability; role of gyres and eddies in productivity	ASCLMEs Project, with support from SWIOFP on joint cruises, and WIO-LaB on near-shore areas of productivity in relation to pollution hotspots.
Outcome: Decision-making tools are in place, to facilitate the synthesis and application of data for LME management;	Defraying country and regionally based transaction costs to jointly establish monitoring and evaluation approaches based on IW indicators. (Socio-economic, Governance, and Fish and Fisheries Modules)	ASCLMEs Project, working with WIO-LaB for M&E related to coastal land based sources pollution, and SWIOFP for issues related to demersal, pelagic and crustacean fisheries.
Outcome: Foundational capacities are in place to assure the sustainability of assessment and data management activities to be undertaken in the sap implementation phase;	1) Defraying the transaction costs of national and regional discussions aimed at legislative and regulatory changes consistent Programme and project objectives, donor recruitment, and the establishment of other mechanisms aimed at Programme and project financial sustainability (Governance Module). 2) Capacity building during project implementation and leveraging of resources to assist countries retain trained personnel (Socio-economic Module).	1) ASCLMEs Project working with WB and UNEP partners in the areas of donor recruitment and other measures aimed at leveraging necessary human and financial investments to achieve sustainability of management and Programme and project outcomes. 2) ASCLMEs Projects working with WIO-LaB on capacity building for the pollution and ecosystem health module of the MA, and with SWIOFP on the fish and fisheries module.
Outcome: A Comprehensive Public Participation Initiative Enables Stakeholders to Engage in Programme activities.	1) De-mystifying science to benefit of Stakeholders (Socio-economic Module); 2) Stakeholder forums (Socio-economic Module); 3) Environmental Education Initiatives (Socio-economic Module); 4) Establishment of Project and Programme Web Site (Socio-economic Module).	ASCLMEs Project with additional support from WIO-LaB for stakeholder for a, and from SWIOFP and WIO-LaB for establishment and maintenance of Programme component of the dedicated web site.
SWIOFP Project Objective: *(i) To identify and study exploitable offshore fish stocks within the SWIO, and differentiate between environmental and*	Seven specific Outcomes: (Fish and Fisheries, Socio-economic, Pollution and Ecosystem Health and Governance Modules)	SWIOFP, in collaboration with ASCLMEs Project and WIO-LaB in relation to capacity building and fisheries interactions with non-

anthropogenic impacts; (ii) To develop institutional and human capacity through training and career building. (iii) To develop a regional fisheries management structure and associated harmonized legislation in collaboration with the SWIOFC.	• Identify exploitable offshore fish stocks; develop inst. Capacity; develop regional fisheries management. (Fish and Fisheries Module)); • Do baseline assessment and assess crustacean fisheries by-catch (Fish and Fisheries Module); • Do baseline assessment of demersal stocks in targeted areas; • Develop and test fisheries monitoring techniques; • Baseline assessment of fisheries interactions with non-consumptive marine; and Strengthen national fisheries management.	consumptive resources.
Outcome: Regional database piloted and ranked effective by majority of SWIOFP countries (Fish and Fisheries and Socio-economic Modules); Production of a gap-analysis which identifies gaps in knowledge of SWIO fisheries resources and presents research agenda to be implemented by SWIOFP (Fish and Fisheries Module); historic data identified for inclusion in database/data atlas sourced or entered into database *Regional fisheries database fully operational and inclusive (Fish and Fisheries and Socio-economic Modules); National fisheries related IT and communications infrastructure procured or upgraded (Fish and Fisheries and Socio-econom ic Module); and Training in data handling and reporting provided (Fisheries and Socio-economic Modules).*	Regional database piloted and ranked effective by majority of SWIOFP countries (Fish and Fisheries and Socio-economic Modules); Production of a gap-analysis which identifies gaps in knowledge of SWIO fisheries resources and presents research agenda to be implemented by SWIOFP (Fish and Fisheries Module); historic data identified for inclusion in database/data atlas sourced or entered into database Regional fisheries database fully operational and inclusive (Fish and Fisheries and Socio-economic Modules); National fisheries related IT and communications infrastructure procured or upgraded for each of nine SWIOFP countries (Fish and Fisheries and Socio-economic Module); and Training in data handling and reporting provided for each of nine SWIOFP countries (Fish and Fisheries and Socio-economic Modules).	SWIOFP, with assistance from ASCLMEs Project on data base creation and gaps in knowledge on fisheries information.
Outcome: (I) Baseline assessment of shallow and deep water crustacean stocks and fisheries in the EEZs of Mozambique, Kenya, South Africa, Tanzania, Seychelles, Madagascar and Comoros. *(ii) Assessment of crustacean fisheries by-catch, evaluation of discard impacts, testing of exclusion devices, and measurements of ecosystems impacts in selected areas of the SWIO.*	Survey methodology defined and found scientifically sound (Fish and Fisheries Module); Seven ship-based surveys and data collection exercises to assess the potential of new and existing fisheries (Fish and Fisheries Module); Production of preliminary country reports and consolidated sub-regional reports on status of crustacean fisheries (Fish and Fisheries and Socio-economics Modules); pilot studies on optimising artisanal shallow-water lobster fisheries completed	SWIOFP, and in cooperation with ASCLMEs Project on ecosystem measurements.
Outcome: (i) Baseline assessment of demersal stocks and fisheries in the EEZs of Kenya, Tanzania, Mozambique, South Africa, Seychelles, Comoros and Madagascar.	Survey methodology defined and found scientifically sound (Fish and Fisheries Module); ship-based surveys and data collection exercises to assess the potential of new and existing fisheries (Fish and Fisheries Module); Production of preliminary country reports (Fish and Fisheries and Socio-economic Modules);	SWIOFP

	and consolidated sub-regional reports on status of demersal fisheries (Fish and Fisheries and Socio-economics Modules).	
Outcome: Monitoring of fishing effort and catch. Development and testing of fisheries monitoring techniques and linkage of communication infrastructure and development of coordination mechanisms and verification systems.	Scientific sea observers trained (Fish and Fisheries Module); Improvement in frequency and coverage of national monitoring activities in each country (Fish and Fisheries and Socio-economic Modules); Initiation of land based monitoring and data verification systems in at least half of participating countries (Fish and Fisheries, Socio-economics, and Governance Modules); Initiation of discharge monitoring Programme in at least half of participating countries (Pollution and Ecosystem health and Governance Modules); Two aerial surveys and data collection to monitor fishing effort in select areas of the SWIO (Fish and Fisheries and Socio-economics Modules); and Initiation of a regional Vessel Monitoring System (Fish and Fisheries and Governance Modules)	SWIOFP, in cooperation with ASCLMEs Project and WIO-LaB on development of monitoring systems.
Outcome: Baseline assessment of fisheries interactions with non-consumptive marine resources and assessment of marine biodiversity as alternative sources of income	Development of guidelines for research grant proposals completed (Fish and Fisheries and Socio-economics Modules); Research studies on interaction between commercial and non commercial marine resources or potential alternative livelihoods completed Fish and Fisheries and Socio-economics Modules); Key marine species GIS mapped SWIOFP countries (all except Réunion) Pollution and Ecosystem health Module); and bio-indicator species identified and relationships between target species and ecosystem health established (Fisheries and Socio-economics Modules).	SWIOFP, in cooperation with ASCLMEs Project on GIS work and key marine species.
Outcome: Strengthening of Regional and National Fisheries Management. Development of regional fisheries management framework and support to regional and national fisheries management bodies.	Evaluation of national fisheries regulations and identification of areas where harmonization is needed completed (Fish and Fisheries and Governance Modules); Establishment of working relationship and technical support between SWIOFP and Southwest Indian Ocean Fisheries (Fish and Fisheries and Governance Modules); Regional PMU and national project offices in place; and national level workshops to disseminate project outputs and develop follow on activities (Socio-economics Module).	SWIOFP, with collaboration of ASCLMEs Project and WIO-LaB on harmonization and workshop activities.
WIO-LaB Project Objective: *To fill prioritised knowledge gaps in understanding of transboundary living resources of the two LMEs and to build capacity of the participating countries to utilize this improved understanding for more effective management through use of a modular approach to ecosystem management.*	Three specific Outcomes: (Governance, Socio-economics and Pollution and Environmental health Modules) • Strengthen regional legal basis for preventing land-based sources of pollution; • Reduce ecosystem stress through sediment and water quality	WIO-LaB

	improvements; • Develop regional capacity and strengthen institutions for sustainable, less polluting environment.	
Strengthen regional legal basis for preventing land-based sources of pollution	Gaps identified in legal/regulatory regimes (Governance Module), ratification of international agreements (Governance Module); Regional EIA process (Governance and Socio-economic Modules); and National Plans of Action (Pollution and Ecosystem Health Modules).	WIO-LaB
Outcome: Reduce stress to the ecosystem by improving water and sediment quality	Common regional monitoring methods agreed and pilot monitoring carried out (Governance Module); Improved knowledge of priority pollutants and carrying capacity; Regionally agreed EQOs and water-based EQSs (Pollution and Ecosystem health Module); and Six demonstration projects successfully implemented (Pollution and Ecosystem Health Module).	WIO-LaB
Outcome: Develop regional capacity and strengthen institutions for sustainable, less polluting development	Sustainable framework for managing land-based sources, including updated TDAs/SAPs (Governance and Socio-economic Module); Enhanced capacity developed for sustainable environmental management in region (Governance Module); and Fully involved stakeholders and improved civil society (Socio-economics Module).	WIO-LaB, with strong support from SWIOFP and ASCLMEs Project for finalization of the TDAs and SAPs

ANNEX 9: PLANNING AND STRATEGY FOR THE OCEANOGRAPHIC SURVEYS ASSOCIATED WITH THE ASCLMEs PROJECT

PROCEDURAL:

The Project will develop an Oceanographic Survey Workplan and Strategy during its first months (and prior to the oceanographic field –work), which will include the following components:

a) A final review of current knowledge to re-confirm 'gaps' in the oceanographic record to guide the planned cruises.

b) Identification of a detailed oceanographic survey plan for the ASCLMEs project lifecycle (locations, vessels, timing, data collection and analyses, databases to be developed, etc). This will include a contingency plan to extend/ expand survey sites or methodology as necessary to address newly identified gaps.

c) Elaboration of a training and capacity building Programme through a selected counterparting process using both regional specialists and those experts associated with the survey vessels and their home institutions.

d) Identification of local/regional institutes and personnel most appropriate for the shipboard training and capacity building Programme. This may also include appropriate training periods (especially for data analyses) at the vessel 'home' institutes.

e) Elaboration of a data handling (including quality assurance and control) and storage Programme to include clear definition of the management uses and operational values of the data, and how the data would be targeted at management agencies and institutions.

f) Adoption of an effective coordination mechanism for the various oceanographic and fisheries cruises and use of vessel-time between the three projects under the overall Programme for the ASCLMEs. This mechanism will also seek to develop cooperative partnerships with other field-work initiatives which may be identified within the region and which could help to build the information database or provide further training opportunities.

N.B. Items c) and d) will feed into the Project's overall Capacity Building and Training Programme.

This Workplan and Strategy will be discussed by the Cruise Coordinating Group (which will include representation from the other GEF projects within the ASCLMEs Programme), in the invited presence of other pertinent stakeholder observers, at a cruise design workshop to ensure all parties are clear of the aims and deliverables as well as the cruise locations and timing. Furthermore, there will be mid-term and 'end-of-surveys' coordination workshops to 'progress-chase' and steer the cruise Programme and ensure capture of the necessary data to fill the priority gaps. These 3 workshops (Cruise Design, Mid Term Coordination and 'End-of-Surveys' coordination) will also address any need for additional cruises or extensions to existing cruise-plans in order to cover unforeseen data needs by way of a 'contingency' approach

METHODOLOGY:

Oceanographic survey cruises will collect information on the parameters listed below:

PHYSICAL PARAMETERS	CHEMICAL PARAMETERS	BIOLOGICAL PARAMETERS
Air and Sea Temperature	pH	Plankton Identification
Salinity	Dissolved Oxygen	Zooplankton Population Assessment
Conductivity	Chlorophyll Concentration	Phytoplankton Growth and Distribution

PHYSICAL PARAMETERS	CHEMICAL PARAMETERS	BIOLOGICAL PARAMETERS
Density (derived variable)	Sediment Characteristics	Benthic sampling
Sea Surface Height	Nutrient Levels	
Current Velocity/Direction	Heavy Metals	
Solar Radiation/Available Light	Persistent Organic Pollutants	
Bathymetry		
Sediment Characteristics		
Sea Floor Mapping/Acoustics		
Wind Velocity/Direction		

Remote sensing and GIS data coordination methodologies will be used to integrate this data and to provide overall data mapping for the LMEs. In addition moored instrument arrays will be used in selected areas to collect information on temporal shifts in parameters at fixed points. This will help to rationalise the spatial data collected across the survey areas.

The survey vessel(s) will deploy a state of the art undulating array that can "shuttle" up and down the water column, and represents the latest in monitoring technology and, more specifically, includes within a single device the following capabilities:

- Fast Repetition Rate Fluorometer (FRRF), which measures the growth rate of phytoplankton electronically, in real time, without the time-consuming laboratory procedures required by traditional methods. The FRRF serves as an effective and cost efficient alternative to the traditional use of 14C incubation, which is time consuming, labour intensive, and brings with it the expense and logistical complications of dealing with a radioisotope;
- Optical Plankton Counter (OPC), which measures the number and size of zooplankton by putting a curtain of light across a tunnel through which the water flows. When a zooplankter interrupts that curtain, it is recorded. The animal's size is estimated from the size of the interruption;
- Photosynthetic Active Radiation (PAR), which will measure how much light is available for photosynthesis at different depths;
- Conductivity, Temperature, and Depth (CTD) Fluorometers, which measure salinity, temperature, depth, and chlorophyll concentrations;
- Dissolved Oxygen Electrode, which measures concentrations of dissolved oxygen; and a
- Continuous Plankton Recorder (CPR), which captures zooplankton between two layers of silk mesh, making a "sandwich" that secures the creatures for later counting under a microscope.

The survey vessel(s) will also deploy a series of sondes, which create time series datasets that allow managers to identify long-term patterns as well as track short-term influences such as weather. A sonde is approximately the size of a roll of paper towels and contains electronic sensors that measure temperature, salinity, dissolved oxygen, pH, sea surface height and current velocity/direction. The data from these sondes will be combined with data from the undulating towed array thus forming complementary data sets. The sondes will provide excellent temporal resolutions but have limited spatial resolution capability since each stays at a fixed point, while the towed array datasets will give excellent spatial resolution, both horizontally and vertically, but limited temporal resolution. Together the two databases will provide a new and panoramic view of ecosystem structure and dynamics.

During the cruises, samples will be collected for analyses of heavy metal concentrations of mercury, selenium, cadmium, copper, zinc, and analyses of POPs that are listed under the Stockholm Convention and heavy metal concentrations of mercury, selenium, cadmium, copper, zinc, and arsenic in the muscle, liver, and kidney tissue of seabirds and fish, and in the blood and feathers of seabirds.

At the desktop level, information will be integrated through overlays (e.g. satellite-based estimates of primary production, information from fisheries stock assessments, larval transport data, etc). As an example relating specifically to primary production mapping, satellite images will be generated at a spatial resolution of one kilometer/megapixel. These estimates will be computed using a high resolution (1 km) SeaWiFS and MODIS chlorophyll (Csat), AVHR sea surface temperature (SST), and Photosynthetically Active Radiation (PAR), also from SeaWiFS and MODIS in concert with the vertically generalized production model (VGPM) developed by Rehrenfeld and Falkowski (1997). The combination of these technologies will allow a three dimensional distribution of primary production to be computed.

Throughout the survey planning, fieldwork, data analysis and data integration/mapping process an emphasis will be focused on the involvement of regional specialists and the capacity building and training of national and regional scientists (field-workers and data analysts). Beyond this, the primary objectives for the data collection process will also be a priority consideration, those being A. the collection of sufficient and reliable data to inform the TDA/ SAP formulation process, B. the development of a baseline of information for long-term monitoring purposes, and C. the capture of information to inform operational management procedures and policies (i.e. related to the sustainable management of the LME resources).

ANNEX 10: LINKAGES TO RELATED GEF PROJECTS

GEF Project	Project Emphasis	Main Linkages
Strategic Partnership for Sub-Saharan Africa LMEs (WB/GEF)	The project is to encourage country-level investments aimed at building the capacity of SSA countries to manage their fishery resources. The project will assist countries to undertake the necessary policy, legal, and institutional reforms needed to improve governance of fisheries. This is expected in turn, to provide a framework for leveraging investments in fisheries development and management, including surveillance and enforcement functions.	The ASCLMEs Project will provide information on the physical and chemical oceanography of the ASCLMEs, essential to the management of the area's fisheries. Information generated through the project will be shared with this initiative, with a view to informing the development of policy and institutional frameworks.
Marine Highway Development and Coastal and Marine Contamination and Prevention Project (WB-GEF)	The project's main global environmental objective is to reduce the risk of ship-based environmental contamination (such as oil spills from groundings and illegal discharges of ballast and bilge waters) and the unsustainable exploitation of marine resources (such as illegal fishing and fishing practices). This will be achieved by testing the economic, technical, and institutional feasibility of introducing precision navigation systems, such as an electronically supported marine highway to guide ships through sensitive areas and to monitor the movements and activities of fishing and other vessels operating within territorial waters. The project will also strengthen port state control capabilities.	This project relates directly to the ASCLMEs Programme through its emphasis on contamination (the *Pollution and Ecosystem Health* module). Close cooperation will be ensured between the respective initiatives particularly in the arena of capacity building to optimise investments. The ASCLMEs will help to define the down stream impacts from pollution in 'hotspots' by generating a better understanding of ocean currents.
Atlantic and Indian Ocean SIDS Integrated Water Resource and Wastewater Management (UNEP/UNDP-GEF)	Envisions a partnership between UNEP and UNDP to address constraints to effective water resource management - an absence of effective strategy and policy; the absence of workable and inter-sectoral legislative and institutional mechanisms, limited financial sustainability; absence of a strategy to deal with extreme or chronic events that threaten the resources (e.g. flooding, drought, saltwater intrusion); lack of access to or awareness of appropriate and cost-effective technologies and methodologies; inadequate management capacity at the institutional and individual level; an imbalance between long-term planning for development and that for resource and environmental sustainability; short-term strategies for the prioritisation of water needs (tourism and agriculture); and inadequate information to support sustainable policy-making and management strategies.	Three SIDS (Mauritius, Comoros, and Seychelles) are participating in both projects. ASCLMEs will generate information on environmental variability crucial to water resource management strategies. The monitoring system will allow this information to be codified and the knowledge management system will ensure it is widely disseminated to water sector planners.
Coral Reef Targeted Research and Capacity Building Project (WB/GEF)	The main objective of this World Bank/GEF project CRTRCBP is filling critical science gaps related to coral reef management. The CRTRCBP will support scientific research to be conducted by an international network of scientists.	This Project will offer excellent opportunities for collaboration with the suite of Projects contemplated for the Agulhas and Somali LMEs, providing science support in relation to coral reefs. The ASCLMEs will share data and information related to natural and anthropogenically induced environmental variability that are threatening coral reef systems.
Benguela Current LME (UNDP-GEF)	The Benguela Current runs parallel to the coastline of South West Africa, from the Cape of Good Hope in the South to Northern Angola, and	A key focus of the LME project is on understanding the determinants and effects of environmental variability in

GEF Project	Project Emphasis	Main Linkages
Namibia, South Africa, Angola	comprises one of four major coastal upwelling systems globally. GEF is providing funding for the implementation of the LME SAP.	the LME. As the Benguela and Agulhas currents are interconnected, with the latter transferring heat into the former through the formation of Agulhas rings, an understanding of the oceanography of the ASCLMEs is critical to securing a better understanding of the BCLME. Accordingly, close-working relationships will be maintained between the projects – to share information and inform the Assessment Methodology activities.
Implementation of the Strategic Action Programme for the Orange-Senqu River Basin (UNDP-GEF)	The Project will develop mechanisms to ensure the cooperative and sustainable use of the land and water resources of the Orange River Basin; develop regionally based and agreed upon short, medium, and long term management objectives for the Orange River Basin; build capacity for adaptive management approaches to River Basin management; create a comprehensive stakeholder involvement and public information Programme; and strengthen regionally based institutions, particularly ORASECOM, to ensure the long term sustainability of joint basin management endeavours. The Project will create synergies with and build upon a range of initiatives being undertaken in the Bain by the countries themselves and those of bi-lateral and multi-lateral donors.	A major emphasis in the Orange-Senqu River Basin will be on assessing climatic variability, with a view to informing adaptation strategies. As this variability is closely related to environmental variability in the ASCLMEs, the work planned under ASCLMEs will have tremendous utility for this initiative.
IW LEARN	The project aims at building the capacity among transboundary water resource projects worldwide, through Internet-based applications, networking within a community of practice, and knowledge management.	The information systems and networking initiatives planned through the project will be closely tied to IW Learn information systems. Provision is made for south-south knowledge transfer, which would benefit from the IW Learn network, and the participation of project stakeholders in IW Learn sponsored conventions, including the biennial GEF IW Conference.
Marine and Coastal Biodiversity Projects Madagascar, Mauritius, Mozambique, Seychelles, South Africa, Tanzania	The GEF is supporting a number of projects under the biodiversity focal area, aimed 1] strengthening national systems of PAs (Mauritius, Madagascar, South Africa); or 2] strengthening the framework for Integrated Coastal Zone Management. Amongst other things, these initiatives are designing MPAs in order to optimise the benefits to fisheries, through increasing spawning biomass and through optimising recruitment into target populations.	The suite of projects in the region is addressing direct threats to coastal and marine biodiversity at particular sites. However, these efforts are somewhat hampered by limited access to oceanographic information, needed to map larval transport systems and identify critical areas for conservation; and identify key refugia from climate change (i.e. coral reefs affected by upwelling cells). These initiatives will be key recipient of knowledge dissemination efforts on these subjects under the ASCLMEs Project through DLIST.

ANNEX 11: RESPONSE TO STAP REVIEWS

N.B. In view of the complexity of dealing with two LMEs in an area where baseline information is frequently missing, the Project requested two STAP reviews, one from A. A reviewer with a marine chemical and oceanography background and one from B. a Living Marine Resources Specialist with experience of the Indian Ocean. The STAP Reviews are appended immediately following the RESPONSE.

STAP COMMENT	RESPONSE TO COMMENT	REFERENCE TO PRODOC
Strategy and logistics for conduct of hydrographic work is inadequately explained. More detail is required on the proposed oceanographic cruise Programme The project is deficient in omitting, probably as an annex, a summary of the circulation and structure of the waters in the region in the context of known oceanic circulation. The description of planned oceanographic surveys is neither adequately detailed nor placed in the context of prevailing patterns of circulation in the Indian Ocean and the two subject systems.	1. A summary of the circulation and structure of the waters in the region has been added . 2.The Project activities under Outcome 1 have been modified to include a planning and strategy process for the oceanographic cruises, with linkage to an additional Annex that explains how this planning will take place and how a strategy will be developed.	1. See **Annex 2 - A Summary of Oceanographic Knowledge in the Agulhas & Somali Current LMEs**. 2. See main ProDoc text under **Outcome 1** for new activities plus **Annex 9 - Planning and Strategy for the Oceanographic Surveys Associated with the ASCLMEs project**.
It is very important that the perception of the project in the participating countries and the international community is not one of it being a data-collecting exercise for overseas academics. Any plans and strategies developed for the field-work must included a training and counterparting component to ensure that data collection and analysis techniques are captured within institutes through the capacity building of regional scientists.	The Planning and Strategy for the Oceanographic Surveys Associated with the ASCLMEs project (as noted above) will also address training needs and counterparting arrangements, and a clear emphasis will be made on building capacity within the appropriate national and regional institutes so as to capture and enhance skills within the region	See **Annex 9 - Planning and Strategy for the Oceanographic Surveys Associated with the ASCLMEs project**. See also **Outcome 3 - Output 3.2**. Additional explanation provided regarding a Capacity Building and Training Programmewithin the Project
Inadequate specification of the mechanisms and procedures for the coordination of the oceanographic surveys among the three companion GEF WIO projects and existing work being undertaken with the Norwegian Research vessel	Preliminary coordination of needs has been undertaken during the PDF B to define the expected number of cruises and ship's time, along with agreements on sharing of cruises. This would need to be refined once all three projects are under implementation and timing can be better coordinated (along with the availability of the relevant vessels). Such a coordination mechanism and planning arrangements will be covered in the earliest stages of the Project under Outcome 1 which will include development of the strategy and logistics for the oceanographic cruises	See **Annex 9 - Planning and Strategy for the Oceanographic Surveys Associated with the ASCLMEs project**. Also discussion on **Cruise Coordinating Group** under **Executing Arrangements**
Document needs clearer justification for the proposed oceanographic work and whether the information to be gained from this work is the only information required. A clear and forceful statement is needed to defuse any potential criticism of too much 'science and research'.	The information from the oceanographic work is not the only information required or sought but needs to be seen in context with the other project Outputs and the other Programme initiatives by UNEP (Land-based sources)and the World Bank (fisheries). The real purpose of this project is to recognise and fill information gaps across the LMEs through an environmental baseline assessment, and then to use this information to drive a TDA process and arrive at SAP(s). Again, lessons have been learned from previous LME projects that indicate the absolute necessity to capture accurate and adequate baseline data and information to support the long-term management process. A SAP can only be as effective as the TDA that advises it and provides it with priorities and recommendations. A TDA can only be efficient and accurate if it has this baseline data to inform it and from which to draw its LME-wide conclusions.	Discussion on project Outputs under **Outcome 1** expanded to include coastal data capture on larval transport, mapping of nursery areas and artisanal fisheries. A table has also been added showing the expected management applications of the new data and knowledge as relates to the LME modular approach which should clearly defuse any suggestions that the project is undertaking 'too much science and research' or 'doing science for science's sake'
The baseline knowledge used for the design of the capacity-building component is not adequately explained	The project will undertake an early assessment of baseline knowledge, available expertise and potential human resources for training within the region. This will flow into the development of a CB&T workplan and strategy that will identify CB&T needs at the national and regional level. Sustainability mechanisms will be identified for CB&T to ensure that the capacity and the trained personnel remain available within the appropriate institutes.	**Outcome 3** - Text expanded to include explanation and elaboration of the CB&T Programmewithin the project

STAP COMMENT	RESPONSE TO COMMENT	REFERENCE TO PRODOC
Justification for including so called 'pollution' (actually 'contamination') studies in proposal is weak	The need to capture baseline information for long-term monitoring purposes should be considered to be sufficient justification. There is also justification for these studies on the basis of being able to compare any new data on heavy metals and POPS within tissues etc., with other data from the Indian Ocean and globally. This could tell scientists in the region a lot about the chronic and cumulative concerns regarding these pollutants. This has important implications for human health in an area that is very dependent on marine resources as a source of nutrition. However, the information also has a valuable role to play in the TDA process (where are the impacts of such pollutants being felt and what are their origins). If the TDA is properly conducted in collaboration with the UNEP WIO-LaB Project then it should be possible to start to develop linkages between sources/causes and impacts/effects.	See expanded text in **Outcome 1 - Output 1.2**
Neither does the inclusion of this contaminant component immediately appear to align with the conclusions of the GIWA Assessment of this region	The only completed GIWA assessment for this region addresses the Indian Ocean Islands. In this context GIWA clearly identifies pollution as the most important transboundary concern. GIWA has yet to finalise its assessments of the Agulhas Current and Somali Current regions.	See expanded text in **Outcome 1 - Output 1.2**
Without an explanation of the meaning of the **'ecosystem approach'** in scientific terms and how it influences strategic aspects of the project design, reference to the phrase is meaningless	The Ecosystem Approach and the concept of Large Marine Ecosystems are a central tenet of the GEF International Waters Operational Strategy and overall business policy, including where it relates to its function as the funding instrument for the Convention on Biological Diversity. Explanation of the ecosystem approach in relation to LMEs and the need for affect transboundary assessment and analysis is now included in the text along with an explanation of how it influences strategic aspects of the project design. The WSSD Plan of Implementation also addresses the need for the Ecosystem Approach, especially in relation to fisheries. This is covered in the ProDoc under the section on the **Ecosystem Approach** as well as under **Country Eligibility**.	See **Ecosystem Approach** section under **Part Two - Project Strategy**. See also **Country Eligibility** for further reference to the WSSD. See also **Expected Global, National and Local Benefits** for a more detailed reference to the WSSD PoI and how it relates to this Project
There is . an underlying conviction that capacity building and stakeholder involvement can be prosecuted prior to the commencement of the TDA process. There is a danger that (this) may not be undertaken in a manner that most appropriately matches the requirements identified through the conduct of a systematic TDA	Capacity building at the basic, foundation level will be necessary from the very beginning of the project. This is a clear lesson that has arisen from other GEF projects and is now seen to be an essential imperative in order for all stakeholders to understand and address many of the technical challenges within an LME project of this nature. Although not intended to be seen in isolation or uncoupled from the TDA process, there are a number of basic CB&T requirements that can be addressed during the assessment stage and prior to the TDA. Indeed, some of this would be introductory to the TDA process and that process itself will constitute a training exercise for many stakeholders. Such training can only improve the chances for sustainability (e.g. long-term monitoring and assessment beyond the baseline to drive management processes)	See **Outcome 3 - Outputs and Activities 3.2 and 3.5**
The Project does not adequately describe the precise mechanisms of TDA-SAP preparation among the 3 interrelated GEF WIO projects. More clarity is required on how this project integrates with the UNEP and WB components	Document has been amended in order to clarify these mechanisms	See **Outcome 3 - Output and Activity 3.5**

STAP COMMENT	RESPONSE TO COMMENT	REFERENCE TO PRODOC
There could be valid criticism for including 2 LMEs, which are for the most part independent (by definition) under the same roof. A more specific and focused proposal, primarily addressing the Agulhas system, with a reduced or eliminated contaminant component would have lower risks than those associated with (this) wide ranging proposal. There is no explanation or justification of why the two LMEs are grouped together in one project. Such a justification would seem necessary if the current system boundary for the project (which is not really clear in any case) is to be maintained. The Project needs more biogeographic justification to be credible. A comment to the effect that the TDA/SAP process will resolve system boundary issues would be acceptable, but some definition of why the areas were selected would benefit the document. The Project Document should make it clear that one of the primary functions of the TDA and SAP process will be to define boundaries between ecosystems for further development of regional management strategies including long term monitoring strategies	An explanation for the multiple LME approach and the need to look at the wider regional picture has now been added to the Project Document	See new text under introductory section to **Project Objectives, Outcomes and Outputs/Activities**
Project is . Inappropriately arranged in places with occasional, unnecessary repetition and some omissions. More work should be done on its presentation, arrangement and detail	Following the STAP Review, the original Project Document has now benefited from a more careful and cautious review and revision. The presentation and the structure is now believed to be much improved	Various changes to the text to improve the flow and logic
Work on the Somali LME may prove difficult due to the political situation in the north of the region. This biogeographic issue needs to be clarified and justified.	The Project document had been amended to clarify the intention to address the entire Western Indian Ocean region in assessing the ecosystem parameters of the various LMEs (Agulhas Current, Somali Current and possible Mascarene Plateau LME). The political difficulties within the northern area of the SCLME have been noted. The Project will aim to complete a preliminary TDA for the southern section of the Somali Current (i.e. the Zanzibar Current area) which will provide a benchmark for eventual completion of a TDA and SAP for this LME once the political situation stabilises	See relevant Paras under **Project Objectives, Outcomes and Outputs/Activities**
Some of the proposals for institutional strengthening, data processing, training and public participation are lacking in detail and require some work to develop fully	A workplan and strategy will be developed as part of a CB&T Programme, which will address the need for more detail on institutional strengthening and training. A Public Participation plan is included in the Project Document. DLIST also represents a major platform for public participation within the Project. Outcome 2 identifies the fact that 'a coordinated regional framework will be developed to facilitate acquisition, distillation and dissemination of data'. The project will also facilitate regional discussions to decide upon the mechanisms for synthesising country and regional data, and for repatriating and incorporating extra-regional information. These strategies will include a regional information clearing house linked to national information focal centres.	**Outcome 3.2** addresses the intention to develop a CB&T Programmein the early stages of Project Implementation. **Outcome 2** identifies the intent to develop a coordinated regional framework ands clearing house for data handling

STAP COMMENT	RESPONSE TO COMMENT	REFERENCE TO PRODOC
It is difficult to distinguish the coverage of these investigations (UNDP Project) from those intended to be carried out under the sister GEF/World Bank implemented SWIOFP project because Annex 5 provides insufficient clarification, is confusing, and provides inadequate explanation of the way these projects dovetail	Annex 5 and accompanying text has been amended to clarify the distinction between the three ASCLMEs Programmatic projects and to explain how they will dovetail	Both the sections on the **ProgrammaticApproach** and on **Inter-linkages between Programme Interventions** have been expanded and summary annex added (Annex 5) detailing the objectives and outputs of the two sister projects (WIO-LaB and SWIOFP) in relation to the GEF UNDP ASCLMEs project. Also the text under **Interlinkages Between Programme Interventions** has been expanded to explain the relationship between the three projects in the context of the TDA and SAP process. Also new text added to **Implementing Agency Consultations, Linkages and Cooperation**
(The project) makes no direct reference to the most deterministic (i.e. inevitable) effect of increased atmospheric CO2, namely ocean acidification	The Project Document has been amended to include suitable reference to climate change in relation to ocean acidification	New para added under Threats description
Has any consideration been given to connections/collaboration with other investigations and organisations (such as IOC and SCOR) that have interests in ocean circulation studies and marine environmental protection issues?	Yes, in preparing the assessments needs due discussion was held with IOC, SCOR and other interested parties/stakeholders. However, it should be noted that the Project will further involve such interested parties and stakeholders in the evolution and design of the strategy and logistics for the oceanographic cruises through the work of the Cruise Coordinating Group and the Cruise Coordinator	No amendment required
The document could do more to capitalise on the good points or innovative approaches of the intended project strategy (e.g. more emphasis on economic studies as a tool for high-level government awareness, the need to define clearly the ecosystem boundaries within the region, etc). The Project Document would benefit from a clear map of the project area. (N.B. Annex 2, Map of bathymetry is confusing and needs to be clarified).	The Project document has been amended to make stronger reference to the need and delivery of the economic studies for awareness purposes, and the need for clearer ecosystem boundaries to be defined/agreed within the ASCLMEs region Document Amended	New text relating to economic studies added to **Output 3.1** See also new text under introductory section to **Project Objectives, Outcomes and Outputs/Activities** New Map (**Figure 1**) at front of ProDoc before **Section 1: Project Rationale**
There is very little reference to coastal linkages and issues and similarly there is little reference to the association between globally significant biodiversity (e.g. related to coral reefs and sea-mounts) and the LMEs. Also, the clarification (of the justification for the emphasis on the oceanographic cruises) should extend to why the coastal waters are being effectively ignored by the UNDP project. One of the big concerns within this region should be the upstream -downstream relationship between coral reefs and associated species. There is much evidence that coral reef systems are supported by upstream (up-current) spawning by other reef systems over quite a considerable distance and this is also true for important commercial stocks such as lobster (and some commercially important reef fish species also).	The project has been amended and expanded to include more emphasis on assessment of coastal issues, especially larval transport and the mapping of nursery areas. Also further reference has been added to habitats supporting globally significant biodiversity in the project system boundary (such as coral reefs and seamounts) and their relationship to the LMEs. In this respect the coastal waters are no longer being ignored by the UNDP Project following amendments. The UNEP sister project will be dealing with land-based sources of pollution. The Project will also be working closely with the IOC Project on a 'Regional Programme for the Sustainable Management of the Coastal Zones of the Countries in the Indian Ocean', which will provide significant additional information on coastal issues to inform the TDA process. Other information exists within past and on-going coastal projects which will be captured during the assessment process	Additional text added to section on **Marine and Coastal Biodiversity** in relation to coral reefs and seamounts. See also **Outcome 1** with additional text on mapping of nursery areas and on larval transport (including commercial species and major ecosystem-function species such as coral reefs)

STAP COMMENT	RESPONSE TO COMMENT	REFERENCE TO PRODOC
It is not immediately clear from the project document on ..whether it is envisioned that there may be other gaps in knowledge that may become apparent as the project proceeds. It might be wise to include a contingency element in the project to account for this, both in allocation of ship time and personnel and an element of the budget.	Additional budget has been identified as a contingency to cover unexpected 'gaps' that need to be addressed. A contingency element will also be included in the Planning and Strategy for the Oceanographic Surveys	See **Annex 9 - Planning and Strategy for the Oceanographic Surveys**
There is almost certainly considerable relevant data that resides outside of the region as a result of earlier scientific work by international groups and bodies. This needs to be identified and made available and accessible to the region through whatever mechanisms the project adopts as an information 'clearing house'.	Repatriation of appropriate data is a high priority within the project and is reflected under the outputs and activities of Outcome 2. Such data would be stored within a clearing house for access by the countries and the project	No amendment required
The issue of what will be done to process, report and archive the vast quantities of data once it has been collected needs to be addressed. It is imperative that this data remains accessible to the countries and scientists of the region and the project should define some sort of mechanisms for developing an information 'clearing house', possibly attached to an existing regional agency with the skills or capacity to handle said mechanism.	The project document now makes direct reference to a clearing house mechanism and the need to define (within the early stages of the project) where such a clearing house should be institutionalised.	See **Outcome 2 - Output 2.1**
Outcome 2 is that "Decision making tools are in place to facilitate the synthesis and application of data for LME management". This is to be achieved through the creation of a data management facility, the definition of a set of indicators and by the development of a GIS capability for spatial mapping. The document is vague on the methodology for achieving these outcomes. (Furthermore) the document would benefit from an explanation of how data and monitoring results would flow into management/operationalisation, and into Governance/policy.	The document has been amended to provide better explanation of how data would be synthesised and applied to management processes in such a way that there would be an appropriate flow of results into the operationalisation process and up to the policy level. Furthermore, Project linkages to IW:LEARN will provide access to fora for global linkages, while NEPAD will provide a forum for linkages within Africa, through its Coordinating Unit for Coastal and Marine Programmes, based in Nairobi. The Coordinator of this Unit will sit on the PSC.	See Revised **Outcome 2**.
The linkages with other GEF supported LME projects (particularly at a global level) may prove to be an expensive and time consuming business. More use of a web-based "virtual" forum should be considered, and the Project Document should identify a regional agency that would have responsibility for coordination of African LME initiatives, lessons and best practices.	A web-based forum would indeed be a central part of the 'linkage' and 'coordination' process. Identification of a regional agency (e.g. NEPAD) for coordinating African LME initiatives is already underway and it is hoped that this will have been agreed by the time that this project enters its inception stage, if not before.	See **Outcome 3 - Output 3.4** for additional text clarifying this development
The text identifies that DLIST would provide a mechanism of community outreach and to build community support. However, it is not clear how such a Tool (which, on the surface at least, seems to be fairly advanced) would make this outreach or build this support at the grass-roots level.	A clearer explanation of the purpose and function of DLIST and how it achieves community outreach has now been added to the document	See additional text and website link now added to **Outcome 4 - Output 4.2**
There is very little mention anywhere in the Project Document about private sector participation, which will be vital for long-term sustainability. A Partnership Conference might be a valuable tool for promoting cooperation and trust and to develop ideas for mutual work and co-funding (always with a view to the Implementation Phase later).	An initial Partnership Conference has now been scheduled for the later stages of this project once the assessment has been completed and TDA processes are underway. This would be appropriate timing as there would be a clearer understanding then of what GEF can achieve in the ASCLMEs region in relation to LMEs and what sort of timescale might be appropriate. True private sector involvement and partnership evolution will come into its own during the following (SAP Implementation) phases of the GEF initiative and assistance	See additional text in **Outcome 4 - Output 4.2**
Table 8 (Para. 52 - linkages to related GEF projects), would be better as an Annex, with primary links mentioned in the text and referring the reader to the Annex. This is an example of the unnecessarily heavy use of tables within the text, which attempt to abbreviate and clarify, but actually compress and repeat too much information within one place, and end up detracting from the flow of the document.	Table 8 has been moved to the annexes and expanded somewhat to include other non-GEF activities in the region. Where appropriate, other tables have been annexed with reference to them from the main text	Text amended (see **Linkages with GEF Financed Projects**) and relevant information annexed as appropriate

ANNEX 12: REFERENCES

Agrawal, A. 2001. "Common Property Institutions and Sustainable Governance of Resources." *World Development*, 29 :1649-72

Ahamada, S., Bijoux, J., Bigot, L., Cauvin, B., Kooonjul, M., Maharavo, J., Meunier, S., Moine-Picard, M., Quod, J.P. and R. Pierre-Louis. Status of the Coral Reefs of the South West Indian Ocean Island States. In Clive Wilkinson, ed. Status of the Coral Reefs of the World: 2004. P189-211.

Andrew, J., Cooper, G., Harrison, TD and Ramm, AEL, 1998. The role of estuaries in Large Marine Ecosystems: examples from the Natal Coast, South Africa. In K. Sherman, E.N. Okemwa, and M.J. Ntiba, eds. Large Marine Ecosystems of the Indian Ocean: Assessment, Sustainability, and Management. Blackwell Science, Inc. Malden MA. 237-246.

Beckley, Lynnath E. 1998. The Agulhas Current ecosystem with particular reference to dispersal of fish larvae. In K. Sherman, E.N. Okemwa, and M.J. Ntiba, eds. Large Marine Ecosystems of the Indian Ocean: Assessment, Sustainability, and Management. Blackwell Science, Inc. Malden MA. 255-276.

Bablan Ingole and J. Anthony Koslow, Indian Journal of Marine Sciences, Vol. 34 (1), March 2005.

Bakun, Andrew; Roy, Claude; and Lluch-Cota, Salvador. 1998. "Coastal Upwelling and Other Processes Regulating Ecosystem Productivity and Fish Production in the Western Indian Ocean," In K. Sherman, E.N. Okemwa, and M.J. Ntiba, eds. Large Marine Ecosystems of the Indian Ocean: Assessment, Sustainability, and Management. (Oxford: Blackwell Science).

Bakun, A. and S.J. Weeks. 2004. Greenhouse gas buildup, sardines, submarine eruptions, and the possibility of abrupt degradation of intense marine upwelling ecosystems. *Ecology Letters* 7: 1015-1023.

Balmford, A., and A. Whitten. 2003. "Who Should Pay for Tropical Conservation, and How Should the Costs be Met?" *Oryz*, 37 :238-50

Bene, C. 2003. "When Fishery Rhymes with Poverty: A First Step beyond the Old Paradigm on Poverty in Small-Scale Fisheries." *World Development*, 31 :949-75

Blueprint 2050, Sustaining the Marine Environment in Mainland Tanzania and Zanzibar. Ruitenbeek, Hewawasam, Ngoile (eds). The International Bank for Reconstruction and Development/The World Bank, Washington, DC.

Bryceson, I., T.F. de Souza, I. Jehangeer, M.A.K. Ngoile and P. Wynter, 1990. State of the marine environment in the Eastern African Region. UNEP Regional Seas Reports and Studies No. 113. Nairobi, Kenya.

Connell, J.H. 1997. In C.M. Roberts and J.P. Hawkins, 2000, "Disturbance and Recovery of Coral Assemblages." Proceedings of the 8th International Coral Reef Symposium, *Panama*, 1 :9-22

De Ruijter, W. P. M., P. J. van Leeuwen and J. R. E. Lutjeharms (1999). Generation and evolution of Natal Pulses: solitary meanders in the Agulhas Current. *Journal of Physical Oceanography*, **29**(12): 3043-3055.

Donohue, K. A., E. Firing and L. Beal (2000). Comparison of three velocity sections of the Agulhas Current and Agulhas Undercurrent. *Journal of Geophysical Research*, **105**(C12): 28,585-28,594.

Döös, K. (1995). Interocean exchange of water masses. *Journal of Geophysical Research*, 100(C7): 13,499-13,514.

Dwivedi, S.N. and A.K. Choubey, 1998. Indian Ocean Large Marine Ecosystems: need for national and regional framework for conservation and sustainable development. In: K Sherman, E.N. Okemwa, and M.J. Ntiba, eds. Large Marine Ecosystems of the Indian Ocean: Assessment, Sustainability, and Management. (Oxford: Blackwell Science).

Fisheries Country Profiles, FAO. Primary and secondary sector employment for Kenya and Tanzania's SWIO coast is estimated from total national fishery employment using the proportion of the marine coastal catch to the total national catch.

FAO, 2003. Trends in oceanic captures and clustering of large marine ecosystems—2 studies based on the FAO capture database. FAO fisheries technical paper 435.

Gallienne, C.P. and D. Smythe-Wright, 2005. Epipelagic mezoplankton dynamics around the Mascarene Plateau and Basin, Southwestern Indian Ocean. Philosophical Transactions of the Royal Society: Mathematical, Physical and Engineering Sciences. Vol. 363, No. 1826. P.191-202.

Glaesel, H., and M. Simonitsch. 2001. "The Discourse of Participatory Democracy in Marine Fisheries Management, Environment and Development in Coastal Regions and in Small Islands Programme (CSI)." UNESCO

Landell Mills Ltd. 2004. Regional Programme for the Sustainable Management of the Coastal Zones of the Countries in the Indian Ocean - Draft Appraisal Report. Prepared for the Indian Ocean Commission. Pp. 135.

Lutjeharms, J. R. E., and E. Machu (2000). An upwelling cell inshore of the East Madagascar Current. *Deep-Sea Research*, in press.

Lutjeharms, J. R. E., J. Cooper and M. Roberts (2000). Dynamic upwelling at the inshore edge of the Agulhas Current. *Continental Shelf Research*, **20**(7): 737-761.

Lutjeharms, J. R. E., H. R. Valentine and R. C. van Ballegooyen (2000). The hydrography and water masses of the Natal Bight, South Africa. *Continental Shelf Research*, **20**(14): 1907-1939.

Lutjeharms, J. R. E., P. M. Wedepohl and J. M. Meeuwis (2000). On the surface drift of the East Madagascar and the Mozambique Currents. *South African Journal of Science*, **96**(3): 141-147

Macfayden, G., and E. Corcoran. 2002. "Literature Review of Studies on Poverty in Fishing Communities and of Lessons Learned in using Sustainable Livelihoods Approach in Poverty Alleviation Strategies and Projects." FAO Fisheries Circular no. 979. Rome: Food and Agriculture Organization

New, A.L., K. Stansfield, D. Smythe-Wright, D.A. Smeed, A. J. Evans, and S.G. Alderson. Physical and biochemical aspects of the flow across the Mascarene Plateau in the Indian Ocean. Philosophical Transactions of the Royal Society: Mathematical, Physical and Engineering Sciences. Vol. 363, No. 1826. P.151-168.

Nguta, C. Mweu. 1998. An overview of the status of marine pollution in the East African region. In K. Sherman, E.N. Okemwa, and M.J. Ntiba, eds. Large Marine Ecosystems of the Indian Ocean: Assessment, Sustainability, and Management. Blackwell Science, Inc. Malden MA. 61-71.

Obura, D. J. Church, C. Daniels, H. Kalomb, M. Schleyer and M. Suleiman. Status of the Coral Reeds in East Africa 2004: Kenya, Tanzania, Mozambique and South Africa. In Clive Wilkinson, ed. Status of the Coral Reefs of the World: 2004. P171-188

Payet, R.A., Soogun, N., Ranaivoson, E., Payet, R.J. and F. Ali AbdallahGlobal International Waters Assessment. Indian Ocean Islands, GIWA Regional assessment. University of Kalmar on behalf of United Nations Environment Programme , University of Kalmar on behalf of United Nations Environment Programme, June, 2004.

"Plan of Implementation of the World Summit on Sustainable Development." 2002. World Summit on Sustainable Development, Johannesburg, South Africa

Ragoonaden, S., 1998. Mean monthly sea level variation and its relation to large-scale ocean circulation in the Southwest Indian Ocean. In K. Sherman, E.N. Okemwa, and M.J. Ntiba, eds. Large Marine Ecosystems of the Indian Ocean: Assessment, Sustainability, and Management. Blackwell Science, Inc. Malden MA. 193-214.

Spencer, T., A.S. Laughton and N.C. Fleming. 2005. Variability, Interaction and Change in the Atmosphere-Ocean-Ecology System of the Western Indian Ocean. Philosophical Transactions of the Royal Society: Mathematical, Physical and Engineering Sciences. Vol. 363, No. 1826. P.3-13.

Tomks Forbes, A., and DP Cyrus, 1998. Status and future of the St. Lucia lake system, a large estuary of the Southwestern Indian Ocean. In K. Sherman, E.N. Okemwa, and M.J. Ntiba, eds. Large Marine Ecosystems of the Indian Ocean: Assessment, Sustainability, and Management. Blackwell Science, Inc. Malden MA. 283-296.

Turner, J. and R. Klaus. 2005. Coral Reefs of the Mascarenes, Western Indian Ocean. Philosophical Transactions of the Royal Society: Mathematical, Physical and Engineering Sciences. Vol. 363, No. 1826. P.229-250.

Ntiba, (eds.) Large Marine Ecosystems of the Indian Ocean: Assessment, Sustainability, and Management. Blackwell Science Inc. Malden, MA. USA.

Payne, A.I.L. and Crawford, R.J.M. (eds) 1995 Oceans of Life off Southern Africa.

Quartly G.D. & M.A. Srokosz, 1993. Seasonal Variations in the Region of the Agulhas Retroflection: Studies with Geosat and FRAM J. Phys. Ocean. 23, 2107-2124.

R. Roman and J.R.E. Lutjeharms, An inventory of environmental data for the West Indian Ocean. University of Cape Town, 2004.

The Royal Society. 2005. Ocean Acidification due to Increasing Atmospheric Carbon Dioxide. ISBN 0 85403 617 2. Policy Document 12/05 - Pp. 68. This report can be found at www.royalsoc.ac.uk

Wells, S. 2005. Assessment, Synthesis, and Gap Analysis of Existing and Planned Activities in the Coastal Zone of countries of the Agulhas & Somali Current Large Marine Ecosystems. Report to Wildlife Conservation Society as part of the PDF-B project preparation activities for the Agulhas Somali Current Large Marine Ecosystems (ASCLMEs) assessment project. Pp.60.

Western Indian Ocean Environment Outlook. 2000. UNEP. In 'Global Environmental Outlook 2000 (GEO 2000)'. ISBN 1 83583 588 9. Pp.89

Wilkinson, C. (Ed.). 2002. "Status of Coral Reefs of the World: 2002 Global Coral Reef Monitoring Network." Published by the Australian Institute of Marine Science. Townsville, QD, Australia.

Williams, M. 1996. In Matthews and A. Hammond, (eds.), "The Transition in the Contribution of Living Aquatic Resources to Food Security," 1999. Food, Agriculture and the Environment Discussion Paper No. 13. Washington, D.C.: International Food Policy Institute.

WSSD (World Summit on Sustainable Development). 2002. "Plan of Implementation of the World Summit on Sustainable Development." Johannesburg, South Africa.