

## Appendix

### Template for Submission of Scientific Information to Describe Ecologically or Biologically Significant Marine Areas

*Note: Please **DO NOT** embed tables, graphs, figures, photos, or other artwork within the text manuscript, but please send these as separate files. Captions for figures should be included at the end of the text file, however.*

#### Title/Name of the area:

**Kenya Wildlife Service, Coast Conservation Area**

**Presented by** (names, affiliations, title, contact details)

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#### **Abstract** (in less than 150 words)

The marine ecosystems within Kenya's protected areas are monitored twice annually. The monitoring period coincides with the monsoon seasons. The monitoring focuses on; benthic cover, fish diversity and abundance and Macro-invertebrate densities. Kenyan reefs are dominated by algae turf and followed by hard corals. However, among the MPAs monitored Kisite is distinct by having higher coral cover (~ 39% cover) than algae turf cover. Siganids are the most abundant fish species. The least abundant species were, expectedly, sharks and barracudas these are pelagic fish. There is significant difference in invertebrates densities in the monitored areas. The crown of thorn (COTS) are in high densities in Kisite and Mombasa MPAs. Sea cucumbers densities are higher in Mombasa MPA. Sea urchins show high densities in all monitored MPAs.

#### **Introduction**

The Kenyan coast runs for approximately 600 km in a NNE to SSE direction, between 1° and 4° south (UNEP 1998). The distribution of ecosystems along the Kenyan coastline is influenced by coastal geology, hydrology, oceanography, and the characteristics of the continental shelf. The hills from south of the Shimba Hills to Malindi block the flow of major rivers to the South Coast, enabling the development of a continuous fringing coral reef, rocky cliffs, white sandy beaches and small mangrove creeks and estuaries. The coast north of Malindi is a wide, flat sandy plain carrying Kenya's two largest rivers to the coast. The sediment plumes from these rivers provide predominantly soft-substrate habitats, open sandy beaches and river deltas.

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The northern section of the coast is dominated by sandy-substrate habitats influenced by Kenya's two largest rivers, the Tana and Sabaki Rivers. Reef growth in the northern coastline is inhibited by cold nutrient-rich waters of the Somali Current upwelling system, which isolate the East African coast from the Red Sea, Gulf of Aden and Arabian Gulf to the north.

### **Ocean Currents and the Monsoon**

There are four oceanic currents influencing Kenya's coastal waters, namely the East African Coastal Current (EACC), the Somali Current (SC), the Southern Equatorial Current (SEC) and the Equatorial Counter Current (ECC) (UNEP, 1998). When it reaches the African coast at Cape Delgado, the SEC diverges into two currents—the Mozambique Current, which flows southwards, and EACC, which flows northward (UNEP, 1998; Obura, 2001).

The Kenyan coast experiences two distinct monsoon seasons. The Northeast monsoon (NEM) locally referred to as *kaskazi* and the Southeast monsoon (SEM) locally referred to as *kusi*. SEM runs from May to September and NEM from November to March. In between the NEM and SEM there is one to two months of transition period characterized by variable and lower winds locally referred to as *matlai* (Church & Obura, 2004a)

### **Sea Surface Temperature**

Sea surface temperatures are highest during the Northeast Monsoon (September–February), averaging 28.4°C (maximum 29°C) and lowest during the Southeast Monsoon (March–May), averaging 26°C (minimum 24°C) (UNEP, 1998; Obura, 2001). Seasonal temperature variations decrease with increasing water depth, with temperatures stabilizing at 6–7 °C and 2.5 °C at 1,000 and 2,000 m depth respectively (Duineveld et al., 1997).

Salinity variation of the EACC waters is low, ranging between 34.5 and 35.4 ppt (UNEP, 1998). This variation is primarily due to heavy rainfall between March and May and the associated terrestrial freshwater runoff, as well as input from rivers. In estuaries and tidal creek systems such as Gazi Bay, Mtwapa, Mwache/Port Reitz and Tudor, it has been shown that there are significant seasonal salinity variations, particularly in the inshore waters; in the dry season, salinity can rise to 38 ppt while in the rainy season, it can be as low as 19 ppt (Kitheka, 1996).

### **Tides**

The Kenya coast experiences mixed semi-diurnal tides, with approximately two tidal cycles every 24 hours. The reference port for tidal observations in Kenya is Kilindini (Port of Mombasa) where the maximum tidal range generally does not exceed 3.8 m.

### **Coral reef distribution**

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Kenya's coral reefs are part of the northern end of the East African Fringing Reef System, decreasing in extent, size and diversity northwards towards and into Somalia. Warm water conditions along the South Coast reflect the predominant influence of the South Equatorial Current and East African Coastal Current, with cooler, more nutrient-rich conditions in the north influenced by the Somali Current upwelling system. In addition, inflows from Kenya's two largest rivers, the Athi/Galana/Sabaki and Tana Rivers depress the growth of coral reefs between Malindi and Lamu, due to their high sediment loads. On the southern coast from Malindi southwards, the fringing reef system is broken at creeks and river mouths, where outflowing fresh water suppresses reef growth.

Coral reef communities in Kenya extend from the sea surface to about 20–25 m depth, limited by low water clarity (visibility of 15–25 m) and a change from rocky to sandy substrates on the continental slope. Where present, however, deeper rocky knolls and relict reefs support corals down to 35 m. Kenyan reefs have around 220 species of scleractinian corals, compared to over 250 species farther south in Tanzania and Mozambique.

Dominant coral species include the massive reef-building coral *Porites lutea* and other *Porites spp.*, regionally dominant species such as *Galaxea astreata*, and a broad diversity of species in the genera *Acropora*, *Pocillopora*, *Favia*, *Favites* and others (Hamilton and Brakel, 1984). Primary reef fish families include the herbivorous parrotfish (Scaridae) and surgeonfish (Acanthuridae), as well as predators such as snappers (Lutjanidae), sweetlips (Haemulidae) and groupers (Serranidae). North of Lamu, a mixing of species from the Red Sea/Gulf of Aden is evidenced by the changing patterns of coral abundance, and the presence of some fish species not seen farther south, such as the coral species *Porites nodifera*, *P. columnaris*, an undescribed *Coscinaraea* species and the angelfish *Apolemichthys xanhotus* (Hamilton and Brakel, 1984).

Kenya's coral reefs conform to those of other parts of the western and central Indian Ocean (Rosen 1971, Sheppard and Sheppard 1981), typically consisting of hard substrate/coral dominated patches interspersed with extensive seagrass beds in shallow water changing to algal- dominated platforms and sand in deeper water.

Physiographically the Kenyan coral reef can be divided into three groups based on tidal current, wave exposure and depth (Church & Obura, 2004b; Obura & Church, 2004). These are; high-energy fore-reef slopes; moderate-energy slopes and back-reef patches; and sheltered back-reef and island-channel patches. Coral and fish species diversity is now thought to be as high as in the main areas of reef development in the Indo-Pacific region.

### **Seagrass Beds**

Seagrasses occur in extensive beds that cover the largest proportion of shallow reef slopes, and form an important habitat for many species living in them and adjacent systems. Twelve seagrass species are found in Kenya, with *Thalassondendron ciliatum*, which forms monospecific stands. Other common seagrass species found in Kenya are *Halophila ovalis*, *Halophila minor*, *Halophila stipulacea*, *Halodule uninervis*, *Halodule wrightii*, *Syringodium isoetifolium*, *Cymodocea rotundata*, *C. serrulata*, *Thalassia hemprichii*, *Zostera capensis* and *Enhalus acoroides*.

*(To include: feature type(s) presented, geographic description, depth range, oceanography, general information data reported, availability of models)*

## Location



*(Indicate the geographic location of the area/feature. This should include a location map. It should state if the area is within or outside national jurisdiction, or straddling both. It should also state if the area is wholly or partly in an area that is subject to a submission to the Commission on the Limits of the Continental Shelf)*

Fisheries data collection - fish landings, fishing effort and fish prices data is collected in some MPAs which are designed as reserves.

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Mangroves and climate change studies are also conducted within a select MPAs (Watamu and Malindi)

Sea turtle nesting, mortality, hatching and incidental catch monitoring , data collection is done in key sites along the Kenyan coast (formerly protected and unprotected areas).

Biodiversity monitoring and use of camera traps to document shy and nocturnal mammals is conducted in the coastal forests within the coast conservation area.

Socio-economic studies at Watamu -Malindi MPAs on ecosystem valuation and willingness to pay (a Master's thesis).

MPA ecological status at Kiunga MPA focusing on the ecological relationship between coral benthos and fish fauna (a Masters thesis)

*(This should include information about the characteristics of the feature to be proposed, e.g. in terms of physical description (water column feature, benthic feature, or both), biological communities, role in ecosystem function, and then refer to the data/information that is available to support the proposal and whether models are available in the absence of data. This needs to be supported where possible with maps, models, reference to analysis, or the level of research in the area)*

#### **Feature condition and future outlook of the proposed area**

Coral reefs and seagrass beds are diverse marine ecosystems, critical for the livelihoods of millions of people. The coral reefs and seagrass ecosystems have varied socio-economic, ecological, aesthetic, and cultural values and importance. Despite this, the health and ecological integrity of these critical marine ecosystems shows a decline mainly due to local stresses occasioned by human activities, climate change and poor resource management and governance structures.

*(Description of the current condition of the area – is this static, declining, improving, what are the particular vulnerabilities? Any planned research/programmes/investigations?)*

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### Assessment of the area against CBD EBSA Criteria

(Discuss the area in relation to each of the CBD criteria and relate the best available science. Note that a candidate EBSA may qualify on the basis of one or more of the criteria, and that the boundaries of the EBSA need not be defined with exact precision. And modeling may be used to estimate the presence of EBSA attributes. Please note where there are significant information gaps)

CBD EBSA Criteria (Annex I to decision IX/20)	Description (Annex I to decision IX/20)	Ranking of criterion relevance (please mark one column with an X)			
		Don't Know	Low	Some	High
<b>Uniqueness or rarity</b>	Dugong ( <i>Dugong dugon</i> )				X
	East Coast Akalat ( <i>Sheppardia gunningi sokokensis</i> )				X
	Amani Sunbird ( <i>Anthreptes pallidigaster</i> )				X
	Clarke's Weaver ( <i>Ploceus galandi</i> )				X
	Spotted Ground-thrush ( <i>Turdus fischeri fischeri</i> )				X
	Green Turtle ( <i>Chelonia mydas</i> )				X
	Hawksbill Turtle ( <i>Eretmochelys imbricata</i> )				X
	Triton's Trumpet ( <i>Charonia tritonis</i> )				X
<p><i>Explanation for ranking</i></p> <p>Dugong is Vulnerable, East Coast Akalat is rare, Amani Sunbird is rare, Clarke's Weaver is rare, Green and Hawksbill turtles are endangered and Triton's Trumpet is rare.</p>					
<b>Special importance for life-history stages of species</b>	Turtle nesting Turtle foraging grounds			X	
<p><i>Explanation for ranking</i></p> <p>5 of the 7 turtle species in the world forage and nest in Kenyan waters</p>					
<b>Importance for threatened, endangered or declining species and/or habitats</b>	Coastal forests Sea grass beds Coral reef benthos				X

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<p><i>Explanation for ranking</i></p> <p><i>Coastal forest are utilized by birds, the seagrass beds and the coral reef are essential for sea turtles and giant clams</i></p>					
<p><b>Vulnerability, fragility, sensitivity, or slow recovery</b></p>	<p>Coral reef</p> <p>Seagrass</p>				<p><b>X</b></p>
<p><i>Explanation for ranking</i></p> <p><i>Coral reefs and seagrass are vulnerable to both natural and anthropogenic impacts and their recovery is very slow</i></p>					
<p><b>Biological productivity</b></p>	<p>Upwellings off Kiunga MPA</p>		<p><b>X</b></p>		
<p><i>Explanation for ranking</i></p> <p><i>Has high fish density but low diversity - act as replenishing grounds for the heavily fished nearshore reefs</i></p>					
<p><b>Biological diversity</b></p>	<p>North - South dichotomy</p>	<p><b>X</b></p>			
<p><i>Explanation for ranking</i></p> <p><i>There is a north - dichotomy of marine species along the Kenyan coast. Areas located in the south have higher species</i></p>					
<p><b>Naturalness</b></p>	<p>Kiunga MPA has a relatively low anthropogenic foot print due to its remoteness</p> <p>Some areas are Pristine</p>			<p><b>X</b></p>	
<p><i>Explanation for ranking</i></p> <p><i>Supports the rare and endangered dugong and sea turtles</i></p> <p><i>Its already designated as Man and Biosphere Reserve</i></p>					

**Sharing experiences and information applying other criteria (Optional)**

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Other Criteria	Description	Ranking of criterion relevance (please mark one column with an X)			
		Don't Know	Low	Some	High
Add relevant criteria	Database or synthesized data		X		
Explanation for ranking Low feedback after data submission					

## References

(e.g. relevant documents and publications, including URL where available; relevant data sets, including where these are located; information pertaining to relevant audio/visual material, video, models, etc.)

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## Maps and Figures

**Table 1: Marine Protected Areas along the Kenyan coast**

Name of MPA	Size of MPA (km <sup>2</sup> )	Year legally established
Mombasa Marine Park & Reserve	Reserve: 200 Park: 10	1986
Watamu Marine Park & Reserve	Reserve: 10 Park: 10	1968
Malindi Marine Park & Reserve	Reserve: 165 Park: 6.3	Reserve: March 1968 Park: June 1968
Kiunga Marine Reserve	Reserve: 250	1979
Kisite-Mpunguti Marine Park & Reserve	Reserve: 11 Park: 28	1973 and regazetted in 1978
Diani Marine National Reserve	Reserve: 75	1995

**Table 2: List of key endangered or rare species along the kenyan coastal strip.**

	Common Name	Scientific Name	Status
<b>Mammals</b>	Dugong	<i>Dugong dugon</i>	Vulnerable

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<b>Birds</b>	Sokoke Pipit	<i>Anthus sokokensis</i>	Status unknown
	Amani Sunbird	<i>Anthreptes pallidigaster</i>	Rare
	East Coast Akalat	<i>Sheppardia gunningi sokokensis</i>	Rare
	Clarke's Weaver	<i>Ploceus galandi</i>	Status unknown
	Spotted Ground-thrush	<i>Turdus fischeri fischeri</i>	Rare
<b>Reptiles</b>	Green Turtle	<i>Chelonia mydas</i>	Endangered
	Hawksbill Turtle	<i>Eretmochelys imbricata</i>	Endangered
	Loggerhead Turtle	<i>Caretta caretta</i>	Vulnerable
<b>Molluscs</b>	Triton's Trumpet	<i>Charonia tritonis</i>	Rare
	Green Snail	<i>Turbo marmoratus</i>	Commercially threatened
	Fluted Giant Clam	<i>Tridacna squamosa</i>	Indeterminate
	Small Giant Clam	<i>Tridacna maxima</i>	Insufficiently known
	Pearl Oyster	<i>Pinctada spp.</i>	Commercially threatened
<b>Crustaceans</b>	Spiny Lobster	<i>Panulirus spp.</i>	Commercially threatened

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