

Review and assessment of biodiversity values and conservation priorities along the Tana Delta - Pate Island coast of northern Kenya

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Abstract

The purpose of this study was to review and assess the biodiversity values and identify priority areas for conservation intervention along the Tana-Pate coast of northern Kenya. The study was done through a review of literature and a 10 day field survey in January-February 2011 to qualitatively validate the literature review. We also consulted key informants from organisations with a history of working in the area and community members on their perceptions of biodiversity values and their socio-economic importance and what they felt were conservation priorities and concerns. This area of Kenya has a rich cultural history of the Swahili /Omani sultanates, as seen in the numerous ruins dating back to the 10th Century.

Biodiversity values on this northern coastline of Kenya can be summarised into three unique areas of marine and coastal habitats: i) the vast Tana Delta with diverse and contiguous habitats from fresh to marine waters, including mangroves, beaches which extend for almost 100 km, and dunes supporting a wide range of fauna and flora and several endangered or threatened species including sharks. The Delta extends into the productive (nutrient rich) Ungwana Bay and the offshore North Kenya Bank which probably support the most valuable offshore fisheries in Kenya, though data are scant; ii) the Ziwayu-Pate-Kiunga coral reef system which occurs at the convergence of the East Africa Coastal Current (EACC)

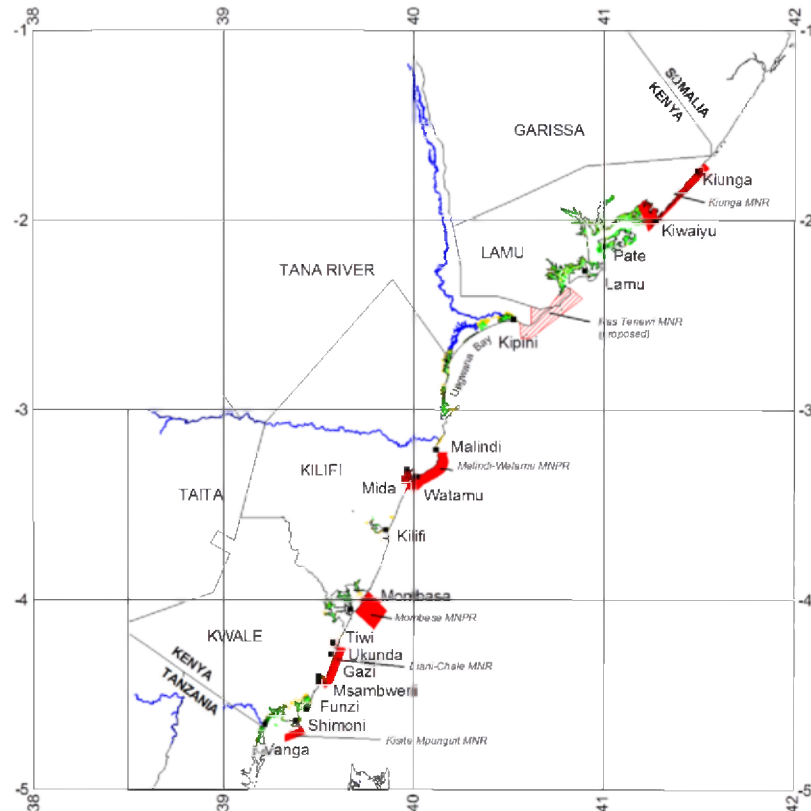
and the Somali current, which is a cold upwelling, bringing its own unique mix of coral and fish species which combine Arabian Gulf with East African species, including rare and endemic corals not seen elsewhere in East Africa; iii) one of the largest stands of mangrove forests in East Africa representing 60% of Kenya's mangroves and hosting *Heritiera littoralis* which is only found in the Tana Delta and the Rufiji Delta in Tanzania. This region contains one of the last remaining populations of dugong (*Dugong dugon*) in East Africa; and extensive turtle nesting beaches for four endangered turtles: Hawksbill, Green, Loggerhead and Leatherback. The Tana Delta, the associated mangroves and the nutrient rich colder Somali current combine to create rich and productive waters supporting valuable fisheries in Ungwana Bay and the offshore North Kenya Banks.

There are many threats to the conservation and management of the area which can be summed up as: poor governance, a sectoral approach to resource management, a lack of community access and participation in decision making, lack of access to environmental information for local communities, lack of legal remedy and land tenure insecurity. Consequently the management of the coastal and marine environment in this area is piecemeal and inadequate. The proposed Lamu Port in the channel between Manda and Pate islands will have severe environmental consequences.

We provide recommendations for area based and community driven conservation approaches which address habitat protection and rehabilitation as well as species-specific conservation action for endangered species. We maintain that the connectivity of the marine environment requires wide coordination and synergy between different groups, agencies and approaches. This requires significant planning and consultation and should build on existing initiatives and organisations already active in the area. However, current initiatives need to be scaled up to adequately address the conservation issues of the area today. Conservation planning also requires a field survey of the area to map habitats and the status of key species to prioritise areas for community-based no-take zones and community forest associations. Community members should be assisted immediately so that they can be part of enforcement patrols, are engaged in legislation review and development, and are active players in any conservation and resource management scheme. Empowerment in terms of knowledge of the natural resources and how best to manage them, knowledge of the legislation and knowledge of community rights is needed. There are now several legal opportunities with a commitment at the highest level in the new Constitution (2010) for due diligence when it comes to the environment and in recognising citizens' rights to environmental resources and a healthy environment.

Introduction

The coast of Kenya extends for around 600 km bordering the Western Indian Ocean (Map 1), from Somalia's border at Ishakani in the north (Longitude



Map 1. Kenya's coastline with major towns and nationally gazetted Marine Parks and Reserves (red shaded areas). Kipini and Pate mark focal areas for this study. (Map prepared by R. Lamprey, FFI).

1° 41' S), to Tanzanian's border at Vanga in the south (Longitude 4° 40' S) (GoK 2009a). The coastline is characterised by a fringing coral reef running parallel to the coastline from Vanga to Malindi Bay enclosing a lagoon with extensive seagrass beds. To the north is the Lamu Archipelago with its extensive mangrove forests. The continental shelf is narrow, generally 5 to 10 km wide, with depths dropping below 200 m in under 4 km of the shoreline (GoK 2009a). The Tana and Sabaki rivers, both draining into Ungwana Bay north of Malindi are the largest rivers draining to the coast. The Tana is the largest river in Kenya (Map 2) with a catchment area of 127,000 km² and discharges an average of 4,000 million cubic meters of freshwater and 6.8 million tonnes of sediment, annually (Kitheka et al. 2005).

The coastal population of Kenya, at 3.3 million people, represents around 8.6% of the country's total population (GoK 2009b). The population of Tana

Delta and Lamu Counties, 341,614 people, represents 10% of the coastal population (GoK 2011). Of these 82% live in rural areas and are still largely dependent on natural resources for their livelihoods. The northern coastline is still the least developed part of the coast. The coastal people of Kenya have an ancient and complex history due to various traders and merchants using or colonising the coastal strip over the last 2,000 years resulting in a diverse community with African, Arab, Greek, Portugese, Italian and English cultural influences. The Swahili People evolved from widespread intermarriage between Arab traders and the African inhabitants of the original coastal settlements. They have considerable influence having formed powerful dynasties, such as the Omani Dynasty which spread from Lamu to Zanzibar. The current coastal population is highly mixed, with continuing immigration from inland adding to this mix.

The purpose of this study was to review and assess the biodiversity values, identify the threats to biodiversity, and prioritise conservation areas and actions along the Tana-Pate coast, with the objective of providing recommendations for a coordinated community-based marine conservation initiative in this area.

Materials and Methods

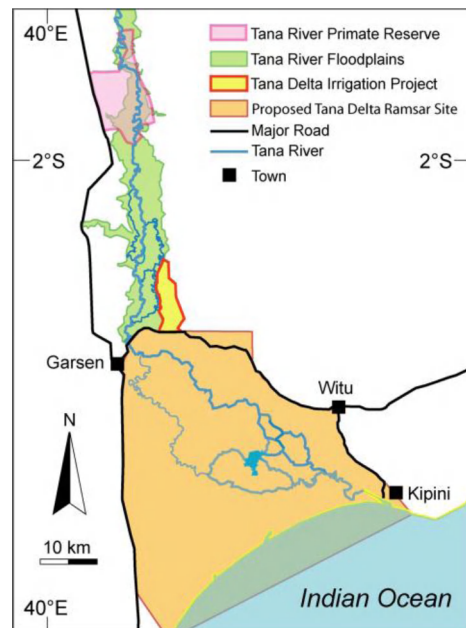
The assessment of biodiversity and conservation needs in the Tana Delta - Pate Island area was done largely through a review of literature supplemented by a 10 day field survey in January-February 2011 to qualitatively validate and update the literature review. We also consulted with key community members on their perceptions of biodiversity values and conservation priorities and concerns during the field survey, together with other key informants from organisations with a history of working in the area. We selected two key locations within this 150 km stretch of coastline, the Tana Delta and Pate Island, including the mainland creeks of Wange and Dodor (Map 1) from prior knowledge of likely high biodiversity and need for conservation action due to increasing threats. Findings are presented by ecosystem within these two areas, to give a description of the ecosystem, biodiversity value,

conservation value, socio-economic importance and threats.

Tana Delta

Tana Delta and Ungwana Bay ecosystem

Tana Delta is the only major ocean delta in Kenya extending 1,300 km² in area, which is subject to frequent flooding and changes in the channels formed (UNEP, 1998). This section of the coast consists of several distinct coastal and marine habitats including riverine forests, grasslands, woodlands, bush land, freshwater lakes, mangrove forests, sand dunes, coastal dunes, beaches and offshore coral reef and seagrass beds. Tana Delta is one of the three largest and most important freshwater wetland systems in Kenya (Nunow, 2011). Its importance is illustrated by the government nominating it for designation as an internationally recognised wetland site under the Ramsar Convention on Wetlands to which Kenya is a Contracting Party (Fishpool & Evans 2001; Ramsar 2008; KWS-Ramsar sheet 2010; KENWEB 2011). The process for final approval is apparently at the final stages. This will be the first marine Ramsar site in Kenya, the others all being freshwater lakes.



Map 2. Tana River drainage and Ramsar site nomination area (Source: Hamerlynck et al. 2010).

Tana Delta is a large complex river delta which flows through infertile dry country, creates wetlands with highly fertile soils, and ends through several distributaries in Ungwana Bay through an extensive dune system, tens of km of beaches, and rich mangrove forests (Plates 1 and 2). The complexity of the Tana Delta and its associated ecosystems make it highly diverse and unique. There is no other large scale coastal ecosystem involving so many different contiguous habitats on the Kenyan coast. It is, together with the Rufiji Delta in Tanzania, one of the largest and most significant coastal delta ecosystems in Eastern Africa. The Tana River drainage basin contributes 32% of the total river runoff in Kenya, and the total length of the river, from its headwaters in Central Kenya highlands to the Indian Ocean, is about 1,100 km (KMFRI 2002).



Plate 1. Tana Delta. a) Kipini and Tana river mouth with sand flat; b) meandering Tana river; c) Tana River bend; d) dry country & mangrove creek; g) Vegetated dunes and Elephant Island; h) Ungwana Bay beach & dunes

The delta is formed by the Tana and Ozi rivers and their numerous tributaries which range across vast swamp plains with complex river distributaries. The Tana River is deep and wide bordering fertile flood plains, and drains to the sea through narrow mangrove lined channels. As with all deltas the

ecosystem is constantly shifting with changes in water flow causing shifting beaches and sand dunes, forming and disappearing mangrove forests, changes in the Tana that have been partially documented through old historic accounts since the 1800s. The creation of the Belasoni channel in 1896 which connected the Tana and Ozi rivers changed the course of the Tana River dramatically. The canal was dug for trade and transport to Lamu during the Sultanate of Witu's reign. The present mouth of the Tana River near Kipini town used to be the estuary of a smaller river, the Ozi, and is referred to as such in historic records. Prior to 1896, the Ozi River mouth at Kipini formed a large and natural harbour, and the original mouth of the Tana River was located about 30 km southward, at Shekiko, in the middle of the Ungwana Bay beach. In this mid to southern end of Ungwana Bay the beach borders Elephant Island, a large dune that becomes isolated at high tide followed by a series of old vegetated dunes stretching inland (Plate 1).



Plate 2. Tana Delta. a) lower Tana river near Ozi flanked by mangroves; b) mangrove forests; c) *Heriteria littoralis* mangrove, *Hyphaenae* palm & Mulikani Lodge board walk; f) *Heriteria* canopy; g) Re-planted *Seriops* sp.

The hard compacted beach of Ungwana Bay stretches for around 32 km and flanks a shallow (<20m) sandy-muddy bay which extends out for around 8km (KMFRI 2002). Offshore the bay gives rise to the North Kenya Bank, a wide extension of the continental shelf, at depths of 100 to 200m, off Ungwana Bay and Ras Tenewi (see Map 3). The

shallow Ungwana Bay receives a huge volume of nutrient-laden freshwater from the Sabaki (to the south of the bay) and Tana Rivers, and this combined with the associated mangrove systems of the Tana Delta combine to make it one of the richest and most productive fishery grounds along the Kenyan Coast (KMFRI 2002).

Conservation value and socio-economic importance

The Tana Delta seagrass beds support one of the few remaining dugong (*Dugong dugon*) populations in Kenya, and possibly East Africa. Other remnant populations are in Mozambique and the Rufiji Delta, Tanzania. Dugongs are listed as Vulnerable (VU-A2bcd) on IUCN's Red List (IUCN 2010). *Dugong dugon* range throughout the Indo-Pacific. In Eastern Africa dugong once ranged from Somalia to Mozambique and across to western Madagascar (Kemp, 2000; WWF 2004), but now are so rare they are in danger of going locally extinct. In Kenya, there is no reliable historical data on dugong populations (Wamukoya *et al.*, 1997). It is believed that dugongs may now only remain in very small numbers in the Lamu-Kiunga region (Wamukoya *et al.* 1996; Dutton 1998) and in Funzi Bay in the south of the country. Recent reports (2008-2009) of 1 individual sighted per year in Funzi Bay (Magileviciute (GVI) pers. comm.) provide a startling indication of how rare these animals are lending support to the view that dugong are one of the most endangered mammals on the African continent.

Forty-eight freshwater fish species are recorded from the lower Tana, including three eels *Anguilla* spp., a distinct subspecies of *Petrocephalus catostoma* (BirdLife International, 2011), three Critically Endangered sawfish (*Pristis pectinata*, *Pristis zijsron*, *Anoxypristis cuspidata*) and two endemics (W. Nyingi pers. comm.; KWS-Ramsar sheet 2010). The Delta also harbours key breeding sites for birds including globally threatened and data deficient species, both resident and migratory. Communities in the Lower Tana Delta told us they attribute value to the following: fisheries, mangroves, beaches, coastal dunes, forests, turtles, wild animals, birds, the ancient ruins and cultural heritage, the Tana River, the associated farms and the ocean.

The Tana Delta and the associated mangroves support valuable fisheries including prawns, notably the valuable "jumbo" prawns, *Penaeus monodon*, in Ungwana Bay. In the survey conducted by KMFRI (2002), the prawn species by composition consisted of the white prawn *Penaeus indicus* (47%) and *Penaeus monodon* (19.7%). Other recorded species were *Penaeus monocerous*, *Penaeus semisulcatus* and *Penaeus japonicum*. In 2004, the prawn landings in Kenya was valued at 112 million Kenya shillings (FiD 2005), worth around 1.2 million USD at today's exchange rate, most of which came from Malindi and Ungwana bay. The site is estimated to have a prawn fishery maximum sustainable yield (MSY) of 433 tons per year with a corresponding effort (Fmsy) of 5.5 trawlers (KMFRI 2002). The Delta represents Kenya's only commercial prawn trawl fishery, as well as an important artisanal prawn fishery taken by hand nets that are highly valued by the communities living around Tana Delta (Plate 2). Contiguous to Ungwana Bay but offshore is the North Kenya Bank, Kenya's widest area of continental shelf. The North Kenya Bank is likely to be Kenya's most productive offshore fishery area due to the combination of the large and productive (nutrient rich) delta and a wide continental shelf that supports seasonal migration of pelagic fish (WWF, 2002). The potential for commercial fisheries of deep water demersal (bottom) fishing as well as pelagic (surface water) fishing is therefore high. Kenya is yet to exploit this Bank with its own fishing vessels.

Ungwana Bay is likely to be an important nursery area for coastal sharks based on their preferred habitat of coastal sand-mud bays and since it is rich in nutrients. It is also a feeding area for sailfish, marlin and swordfish (WWF 2002). KMFRI (2002) report high quantities of small sized sharks, rays, fish (Leiognathidae, Clupidae, Scieanidae) and turtles supporting the notion that the Bay is an important nursery and feeding ground.

Threats

The Tana Delta has been the focus of a number of agricultural development projects over the last three decades which have been controversial and largely disliked by local communities. These include sugarcane farming, irrigation, aquaculture projects such as prawn farming, and biofuel farming. A range

of other threats are also occurring in the Tana Delta area including: i) deforestation; ii) immigration and squatters bringing slash and burn practices; iii) wildlife poaching; iv) illegal commercial prawn trawling bringing by-catch problems and impacts on local fisheries; v) unsustainable and illegal fishing particularly the use of beach seines (KMFRI 2002, FiD 2008); vi) hydrological changes such as damming and water offtake for irrigation from developments upstream (Pankhurst & Pigué, 2004). Local communities are also hampered by unclear land ownership and security. Overall, environmental threats can have been attributed to poor environmental governance and compartmentalised decision-making with little regard for ecosystem health and function (Becha pers. comm.).

Dunes and sandy beaches

Kenya has an estimated 27,000ha of beach and dunes most of which are concentrated in the north (UNEP, 1998) and these are a feature of Ungwana Bay south of the main mouth of the Tana River at Kipini and also to the north to Ras Tenewi (Map 3, Map 4). The beach of Ungwana Bay stretches for 32 km (Plate 1), and is the longest continuous beach on the East African coast. This hard compacted beach flanks a sand-mud bay which extends out to the North Kenya Banks. Behind the beach is an extensive dune system ranging inland, and at Shekiko (Map 4) lines of dunes are clearly visible and form the dune “Elephant island” which becomes isolated at high tide (Plate 1). A narrower strip of dunes fringes the beaches to the north of Kipini, from Ras Mkomani to Ras Tenewi. These beaches are softer and are important turtle nesting sites (Plate 3).

Conservation value and socio-economic importance

The dunes and associated beaches of Ungwana Bay are unique and dynamic - no other dunes system exists on this scale in Kenya. Sand dunes play a critical role in the retention of freshwater tables protecting against saltwater intrusion. Habitat threats were not evident, there is very little development within the dunes, only one low impact tourist camp near Shekiko, occasional fisher camps over a distance of around 25 km and the Tana Friends of the Marine Environment (TAFMEN) turtle banda at Mkomani

beach used for turtle guarding and monitoring (Map 4).

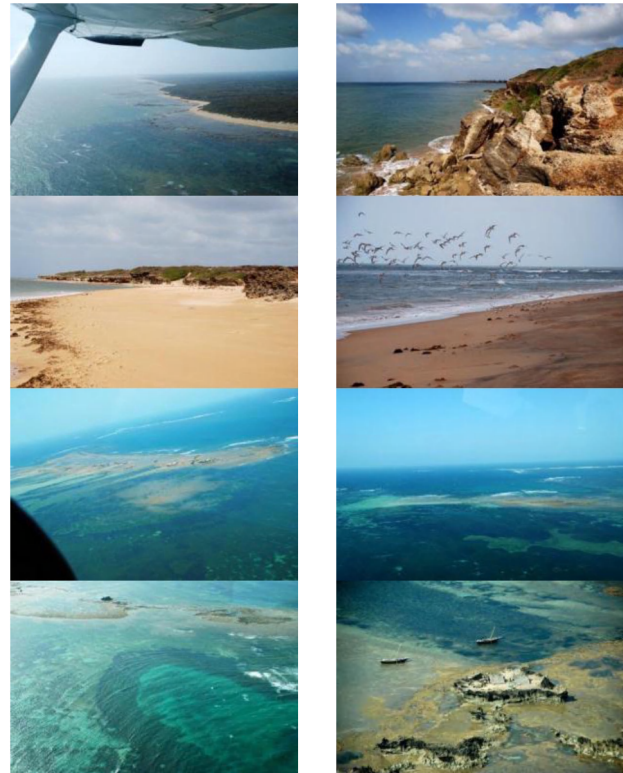
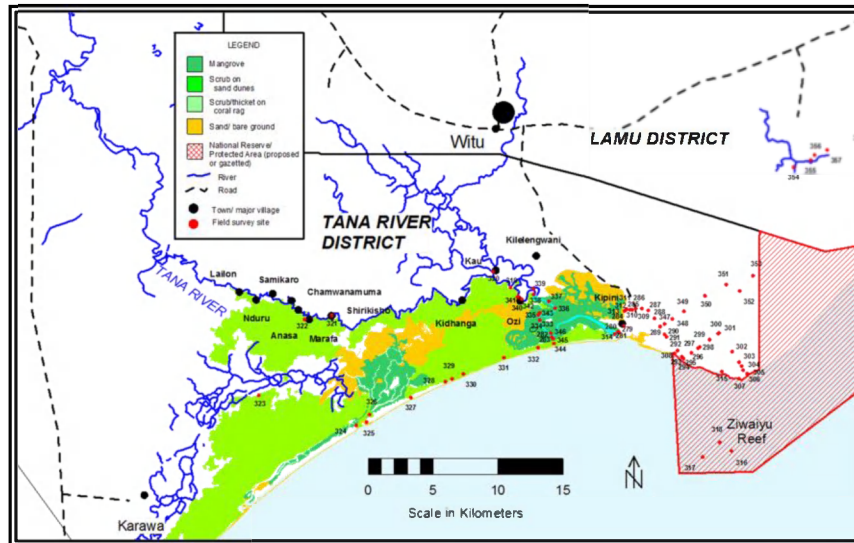


Plate 3. Tana Delta – northern beaches, rocky headlands, and Ziwaiyu coral reefs. a) Ras Shaka to Ras Tenewi with turtle nesting beaches and fringing reef flats; b) Ras Shaka; c) Ras Mkomani fossil reef and beach; d) Mkomani beach & terns; e) Ziwaiyu reef complex with fossil coral islets; f) Ziwaiyu with fringing and barrier reefs; g) Ziwaiyu reef flat, lagoon & seagrass beds; h) Ziwaiyu fossil coral islets with fisher camps and boats.

The beaches are important nesting grounds for *Chelonia mydas* (EN), *Eretmochelys imbricata* (CR) and *Lepidochelys olivacea* (EN) turtles. TAFMEN have been monitoring and guarding turtle nests from 2005 to 2010 along Ras Mkomani beach to roughly half way along to Ras Tenewi (Map 4). Their data shows there are on average 30 nests along a stretch of 9.4km of beach. Villagers and TAFMEN perceive these protection efforts have boosted turtle population numbers. However, they cite local prawn trawlers as thwarting their efforts since turtles are frequently taken as by-catch in trawl nets if turtle excluding devices (TEDS) are not installed on the nets. Major nesting beaches are marked on Map 4 and correspond



Map 3. Tana Delta showing Ungwana Bay, the offshore North Kenya Bank and the Ziwayiu reef complex off Kipini marked as Mwamba wa Ziwayiu and Mwamba wa Punju (Source: Admiralty Chart)



Map 4. Tana Delta with notable sites and locations of field survey (Map prepared by R. Lamprey, FFI).

The primary threats are to turtles from poaching, for eggs and meat, and from by-catch of trawlers. Artisanal fishing along the beach and reef flat may be at unsustainable levels but there are no data to verify this. The use of illegal and destructive gears such as the beach seine has been a recent problem, though local community groups appear to have stopped this. Conservation efforts to halt the capture of dugong are a high priority before the population is driven to local extinction.

Rocky headlands and reef flats

To the north of Kipini from Ras Mkomani to Ras Tenewi (Map 3) the coastline consists of rocky headlands (Ras Tosi and Ras Shaka), a narrow strip of young dunes, old fossil coral cliffs and soft sandy beaches that are important turtle nesting beaches (Plate 3). This area lies within the proposed Ras Tenewi Marine Reserve ($2^{\circ}30' 0''$ S, $40^{\circ}45' 0''$ E), an area of 350km^2 (Map 4) which was proposed by the government in the

to Ras Tosi to Ras Tenewi. This information was provided by TAFMEN.

Threats

1980s but has never been gazetted.

Just off these beaches are coral reef flats and small submerged reefs such as Mwamba Tawandani (also

called Ras Mazarui). The fringing reef off Ras Tenewi was described in 1987 as approximately 500m offshore, with only a narrow strip (10m wide) of hard (hermatypic) corals and these dominated by very large *Porites* sp. bommies (bommies are large massive coral heads), dropping to a sandy bottom, seagrass beds and algae at 6m with high silt content (Samoily, 1988). The large *Porites* bommies are characteristic of high silt conditions and this is not surprising considering the proximity of the mouth of the Tana

River. There are large areas of seagrass beds off these beaches which extend seaward to the offshore Ziwayyu coral reef system (TAFMEN pers. comm.; UNEP 1998) and these are important for the local dugong population. Conditions were too rough and murky to do any snorkelling to verify the state of the seagrasses, but no apparent threats were evident so they are likely to be healthy. However dugong sightings in this area are now very rare. We were told that two dugong are generally sighted each year in February-March in the seagrass beds around Ras Mkomani. Around 1986-87 this annual sighting apparently involved many individuals. The reason for their disappearance was given as fishers targeting them for their meat.

Conservation value and threats

There were no apparent threats associated with the rocky headlands and reef flats, though no data are available on the state of reef fish populations. Land ownership is private and therefore there is potential for unplanned coastal development.

Ziwayyu coral reef system

The Ziwayyu coral reef system offshore from Ras Shaka – Ras Mkomani comprises small coralline islets with extensive reef flats, small lagoons, fringing reefs and a seaward barrier reef (Plates 3). The islets of fossil reef are large enough for fishers to have built sturdy camps. Seagrass beds surround the reef flats and extend shoreward to around Ras Tosi and Mkomani beach (Map 3) and were likely to be important feeding areas for dugong. Winds were in excess of 25-30 knots and therefore no in situ surveys were possible. Surveys in 1987 (Samoily 1988) report extensive seagrass beds of *Thalassodendron ciliatum* on the leeward side and on the southern side

very large massive *Porites* sp. bommies and other occasional coral heads on a shallow bed of sand and seagrass, with varied reef fish species in fairly silty conditions. Seaward is a well formed reef slope with spur and groove structure typical of outer slopes with soft and hard corals and good visibility, but no quantitative surveys were done at that time due to strong winds (Samoily 1988). The barrier reef visible from the air (Plate 3) is an unusual reef structure for Kenya where coral reefs are predominantly fringing close to the coast encompassing a shallow lagoon.

Conservation value and socio-economic importance

The diversity of hard (hermatypic) corals and extent of hard coral cover in the far north of Kenya are low as they are at their far northern limit on the mainland coast due to the influence of the cold Somali current upwellings. Average percentage cover in the Kiunga Marine National Reserve north of Pate (where extensive coral reef monitoring has been done since 1998) has never exceeded 21% and is frequently lower, and the coral species total count is at 154 (Lamu) to 157 (Kiunga) compared with 241 in Mombasa and over 250 further south in Tanzania and Mozambique (Obura 2008). However, reefs of the far north of Kenya, have a unique mix of species from the Red Sea/Arabian Gulf which are not found further south. These include the presence of the coral species *Porites nodifera*, *P. columnaris*, and an undescribed *Coscinaraea* species (Hamilton & Brakel, 1984; Obura 2008). In addition, Kenya's far northern reefs contain the rare and endemic coral *Horastrea indica* and also *Siderastrea savignyana* which is currently undergoing revision and likely to be a coral species restricted to the northern WIO (Obura pers. comm.). The Red Sea/Arabian Gulf angelfish *Apothemichthys xanthotis* (Fraser-Brunner 1950) is also found here presumably at its southern limit as it is not found further south (Church and Obura 2006). Ziwayyu reefs remain unsurveyed but are likely to yield some interesting species. Ziwayyu is also an important nesting grounds for the Arctic tern, and feeding areas for whale sharks (*Rhinocodon typus*) (NEMA, 2004).

Threats

Ziwayyu is widely used by artisanal fishers including migrant fishers from further south (as far as Tanzania) (Wanyonyi et al. 2011), evidenced by semi-

permanent camps on the rocky islets, and reportedly so by community groups (Manufaa and TAFMEN). Fishing pressure is therefore likely to be high but no data are available.

Mangrove forests

Substantial areas of mangrove forest (Plate 2) exist in the lower Tana in the Hajawa and Bauleli areas and these have been surveyed and described in detail by the Lower Tana Delta Conservation Trust (Dhidha et al. 2005). Another area of mangroves is found near the Tana distributary mouth at Shekiko, though only recently developed in the last 10 years due to changes in river flow. Here *Avicenia marina* dominates. All of the nine mangrove species found in the Western Indian Ocean (WIO) are found in the Tana Delta, these are: *Avicennia marina*, *Ceriops tagal*, *Bruguiera gymnorrhiza*, *Rhizophora mucronata*, *Lumnitzera racemosa*, *Sonneratia alba*, *Xylocarpus granatum*, *Xylocarpus molucensis* and *Heriteria littoralis*. These all have a wide range from the Indian Ocean to the Pacific.

Avicenia marina is the main species fringing the Tana River growing nearest the river bank and it dominates in the lower section near the river mouth (Plate 2). A distinct species not found elsewhere in Kenya is *Heriteria littoralis*, which grows in large stands in the lower section of the Tana giving the highest canopy trees in the mangrove forest (Plate 2). Growing at the base of these *H. littoralis* trees is a small shrub (not identified) which we were told are eaten by elephant. The elephant also feed on the dwarf palm, *Hyphaene coriacea*, which grows abundantly within and neighbouring the mangroves forests. This is to our knowledge the only coastal area where elephants can be found within mangroves forests (pers. obs.).

Conservation value and socio-economic importance

The mangrove *Heriteria littoralis* only occurs in the Tana Delta, and provides the highest canopy trees in the mangrove forest in this region. To our knowledge its status has not been assessed by IUCN. The association of elephants with mangroves in this area is unusual and gives the Delta another unique conservation value. Two other mangrove species that are considered threatened, *Xylocarpus granatum* and

Bruguiera gymnorrhiza, are also common. At least 280 plant taxa have been recorded in the delta, of these, 18 are considered rare in Kenya or globally (BirdLife International, 2011).

Mangrove forests are important nursery areas for a wide range of species including some coral reef fishes, crabs, prawns and molluscs, and are therefore an integral part of the ecosystem (Thayer et al., 1987; Laegdsgaard & Johnson 1995; Nagelkerken et al.2000; Nagelkerken & van der Velde, 2002; Weis & Weis 2005 Fondo et al. 2010). Mangroves poles are also cut for house building, boats and fire wood.

Threats

We were told by community groups that in areas near Kipini and Ozi mangroves are cut excessively by cutters licensed by the Forestry Department. Community groups said the issuing of licenses was unlimited and there is a poor harvesting plan (Mulakani and TAFMEN). Others (village headman) said there were plenty of regulation governing mangroves and that they are well managed. Good management was seen in Chara BMU which has strict control over mangrove cutting where licenses are issued on a very limited basis, and this is strongly enforced by the community through the BMU. There is some small scale re-planting of mangroves by some community groups (e.g. Mulakani in Tana Delta), but probably on a scale that is inadequate to deal with the level of over-harvesting. The Tsunami in 2006 caused widespread flooding of the Tana Delta and may have contributed to loss of mangroves (Semesi, 1998) but this has not been quantified.

Summary and recommendations

The Tana Delta is huge, with diverse and contiguous habitats including mangroves, beaches and dunes supporting a wide range of fauna and flora, with particularly high diversity of birds, and extends into the productive Ungwana Bay and the offshore North Kenya Bank. It has one of the largest stands of mangrove forests in East Africa representing 60% of Kenya's mangroves which include the rare and tall *Heriteria littoralis*. Found within the mangroves are elephants providing a perfect illustration of the diversity, value and contiguous nature of very different habitats and fauna. This unique, complex

and diverse ecosystem needs to be considered as a whole and managed as a whole with due respect and understanding of the ecological linkages across the habitats and the dependence of local communities on the entire system.

Community representatives should be actively included in turtle conservation and management and continued monitoring, patrolling and protection of turtle nesting sites should be supported. A key role for community representatives would be as official observers on commercial prawn trawlers. This would involve community support in monitoring of zone limits and use of TEDS (turtle excluding devices) which would contribute to enforcement of the Prawn Fishery Management Plan (2011) and would empower local fishers in the management of their local resources. One difficult issue to be addressed through fishery observer programmes is the risk of corruption, as an observer fee is likely to be lower than a bribe to “turn a blind eye”.

Targeted conservation action for dugong is urgently needed. It is likely that one of three remnant populations in Kenya occur in the Delta – Ziwayu area.

Controlled and selective harvesting of mangroves is needed. Different species can be harvested at different rates, or not at all. Research on this is now well known (largely from work at KMFRI, Kairo et al. 2001; Kairo, et al. 2002). It is recommended that support be provided to facilitate the development of a national level mangrove harvesting plan through the Forestry Service in partnership with KMFRI. This could involve a focus on the Tana - Pate area with some site specific harvesting and protection plans. Immediate action should be directed at supporting those BMUs trying to manage mangroves through restricted licenses.

Pate Island

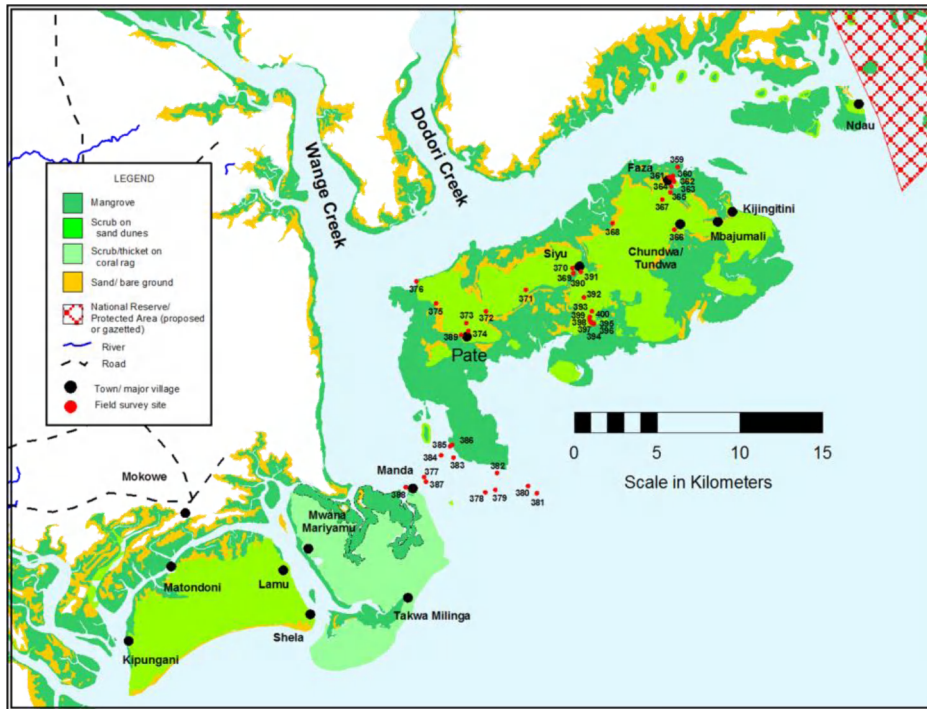
Pate is the largest island within the large and complex mangrove archipelago that extends from Lamu to Kiwaiyu Island covering an area of approximately 165 km² (Map 5, Plate 4). This system includes the large sand islands of Lamu and Manda which have extensive dunes and sandy beaches, and the fossil

coral islands of Pate, Ndau and Kiwaiyu, collectively often called the Lamu archipelago. The sand dunes assist in the retention of freshwater tables protecting against saltwater intrusion and are the sole source of fresh drinking water to Lamu (Wiggin, 2010). Lamu and Manda have long beaches to seaward (e.g. Shela) with little development and these are important turtle nesting beaches. Further north in the Kiunga Marine Reserve the continental shelf narrows with a series of small bays, beaches, pockets of mangrove forests, islets and an offshore submerged rocky – algal reef which runs into Somalia (Samoilys 1988). The Lamu archipelago mangrove forests represent 60% of all Kenya’s mangroves (Kairo 1995, GoK 2008) and are in relatively good health though have been harvested for centuries.

Coral reefs and seagrass beds

Rapid snorkel surveys of selected sites around the Pazarli reef complex on the southeast of Pate Island (Map 5, Plate 5) were done to get a sense of the health of the reefs. Four sites were surveyed: i) Pazarli - shallow reef flat and reef edge bordering extensive sea-grass beds (0.5-2.0m depth); ii) Pazarli - southwestern shallow reef slope (0.5-10.0 m depth); iii) Canalino - channel further west towards Pate, strong tidal currents, reef top at around 0.5 m dropping to around 6m; iv) Tausi reef, fringing the mangroves of Pate.

Corals were largely dead, in places at around 90% mortality, covered in sediment or overgrown with brown macro-algae (*Sargassum sp.*, *Turbinaria sp.* and *Hormophysa cuneiformis*). Coral mortality is undoubtedly due to the widespread coral bleaching and mortality event in the 1997/8 El Niño across the Indo-Pacific (Wilkinson 2000, Obura 2005). In northern Kenya recovery from this bleaching event has been slow. Live corals were found in some areas - large massive *Porites* spp. and a large bank (approx. 10 x 20m) of *Goniopora sp.* among the seagrass beds dominated by *Thalassodendron ciliatum*. Other seagrass species seen were *Syringodium isoetifolium* and *Cymodocea serrulata*. Despite the extensively damaged corals the reef fishes were surprisingly diverse, quite abundant and large, especially the parrotfishes (Scarinae). The much larger reef area of Mwamba Hasani was also mentioned as significant by local people with good corals and fishes but we were



Map 5. Pate Island and the mainland creeks of Wange Creek (site of proposed Lamu Port) and Dodori creek. locations of scoping survey are marked in red (Map prepared by R. Lamprey, FFI).

Pate Island lies within Kenya's largest mangrove forest archipelago and the island is surrounded by mangroves (Map 5). This system confers high productivity to the surrounding fisheries and also provides valuable mangrove products for local communities. Harvesting of mangroves appears to be only partially managed in a sustainable and planned approach. There is also some small scale mangrove re-planting occurring. The susceptibility of the mangroves to unplanned overharvesting is high.

not able to get there. This reef was described in 1987 as having an extensive reef flat but the slope was rocky with algae sand and silt, with low diversity and cover of hard corals but high cover of soft corals (Samoily 1988).

Conservation value and socio-economic importance

The most important dugong habitats in Kenya are in the area of Kiunga Marine National Reserve (KMNR), Dodori and Mongoni (also called Wanga on some maps) creeks and the Siyu Channel between Pate and the mainland; as well as around Gazi on the south coast (WWF 2004). Dugong (*Dugong dugon*) are extremely rare: aerial surveys in the Lamu Archipelago counted 10 in 1994 and 6 in 1996 (Wamukoya et al. 1997). The sighting in 1996 was of four animals in Siyu channel and two individuals sighted near Manda Toto Island. During the same period several clear feeding trails were also observed in areas off Faza, Uvondo and Ndau Islands (Wamukoya et al. 1997). In 2002, there were anecdotal reports of between five and eight animals including two calves at Siyu Channel and Kiunga Muini in the far north.

One of the most significant observations of our snorkelling surveys (1 day only) was finding three sub-adult or young female Napoleon Wrasse, *Cheilinus undulatus*, on the deeper slope at Pazarli reef. The Napoleon wrasse is listed as Endangered in the Red List and on Appendix 2 of CITES. This is the largest wrasse, reaching 1.4m in length (males) and is naturally uncommon. Seeing one is unusual, seeing three on the same reef in one dive is exceptional. A group of Napoleon wrasse can signify a spawning aggregation; therefore it is possible that Pazarli reef may represent an important reef for the Napoleon wrasse population in this region, and therefore an important area for this species in the WIO.

As for the Ziwayu coral reefs off Tana Delta, the diversity of corals around Pate is low but they comprise a mix of species from the Red Sea/Arabian Gulf which is not found further south on East Africa's reefs. Whales and dolphins are said to be abundant in the Lamu-Pate area according to local resorts and local communities. This needs further verification. In 1996 a total of 540 dolphins were counted in

Ungwana Bay and Lamu archipelago (Wamukoya et al.1997). Of these, 40 were observed in Ungwana Bay and 500 in areas outlying Manda and Pate Islands. Of relevance here is the hump back dolphin, *Sousa chinensis*, which though wide ranging across the Pacific and Indian Oceans, is now Near Threatened (IUCN 2010).

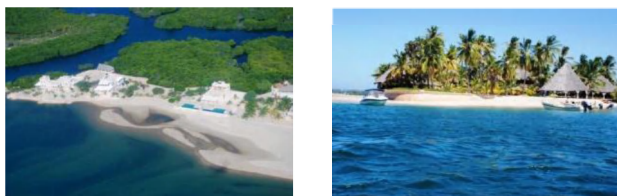


Plate 4. Lamu archipelago - Manda to Kiwaiyu. a) Mangrove archipelago; b) Mangroves, sand flats and pans; c) Manda Island with fringing reef; d) Shela beach and dunes; e) hotels and development on Manda; f) Manda Bay Hotel.



Plate 5. Pate Island. a) Faza village; b) Mangroves at Shaba-Rubu; c) Fossil coral islet, Jiwe Mpupo, with corals in foreground; e) *Rhizophora* mangroves; g) stalks and herons on Jiwe Mpupo; h) Swahili ruins - tomb at Shanga-Rubu.

Fishing is a major livelihood activity for the Lamu-Pate communities. Tourism activities are also of importance. Protection of reefs around Pazarli, southern end of seaward reefs off Pate appear to have improved fish population diversity and sizes of fishes taken in local fisheries – parrot fish were noticeably large, as were the ring tail surgeon fish. The fish

community resembled that seen in the Parks further south (e.g. Malindi). The community conservation area has also boosted tourism activities in the area. Some of the best offshore bill-fish (marlin, sailfin etc) fishing in the world is said to occur in the Lamu area according to local hoteliers (Manda Bay Resort, Peponi Hotel, Shela). These stocks are further protected by the Somali piracy threat which is deterring commercial foreign fishing vessels from fishing in Kenya's EEZ.

Threats

The Pate islanders rely heavily on marine resources. The interlinked ecosystem of mangrove forest, coral reef and seagrass beds provides a productive and diverse range of fish species which are taken in the local artisanal fisheries. These include rabbitfish, mullet, milkfish, emperors, parrotfish, snappers, kingfish, eel, sharks (as listed by Rasini Fishermen Cooperative and Pate BMU). This diversity of species is threatened by overfishing due to an increasing population size and destructive fishing by Kizingitini fishers known to use the illegal beach seine (*juya*). The health and productivity of the ecosystem is therefore threatened. Sharks are likely to be heavily overfished and certain species threatened (see below).

Fossil coral mining for building block is associated with the creation of open pits desiccating and reducing the value of the landscape. Clay mining for pottery has been associated with degradation of mangrove habitats in addition to creating open pits. Threats to beaches and dunes emanate mainly from the extraction of sand which is used for construction.

The proposed Lamu Port in the Manda-Pate channel in Wange creek (Map 5) would have a profoundly negative ecological impact on this region. We were unable to access an environmental impact assessment, though were able to access plans which covered large areas of the mainland and Manda Island. Absolute confirmation that the Port will proceed is not available. The economic and logistic merits of this proposed port, reputedly to secure oil transport from South Sudan (on the brink of war over oil with Sudan) and positioned on the border with Somalia, a failed state with high insecurity, is questionable (see Maina et al 2011).

Summary and recommendations

The Pate area has several threatened or vulnerable species that currently are unmanaged (dugong, fish, corals, turtles) except by some local CBOs. Conservation action needs to be increased with national, regional and international level support. There is potential to establish and support community based conservation management areas that would address some of the concerns. Addressing overfishing and destructive fishing is harder and requires introducing alternative options for fishers. There is potential to develop offshore fishing to reduce fishing pressure inshore, and to increase income from fishing – especially if combined with fish storage facilities on boats and on shore (Harrison and Samoily 2009). Pate Island has extremely significant Swahili ruins which are a valuable resource for local communities, should be properly protected and managed, and could be used in tourism in the future to generate revenue.

Biodiversity threats

Here we highlight species threats as they appear to be the most critical in the Tana Delta – Pate Island region. Habitat threats are also of concern but we believe approaches to address species concerns would also address habitat concerns. There are several flagship species of high conservation value in this region which should help raise awareness and support for local conservation action. Fishing is also discussed here as it is causing some of the most direct detrimental impacts on the marine environment. Despite the many biodiversity threats there are also opportunities for mitigating some of these. There has been much ground work, much awareness raising particularly in the Tana Delta area and there are several committed CBOs and individuals already taking steps to conserve and protect these unique and diverse natural systems (see Maina et al. 2011).

Dugong

Among the greatest threats to dugong survival in Kenya is fishing, habitat loss and degradation (Pertet & Thorsell, 1980). Dugongs are caught in nets set deliberately to catch them, or as incidental by-catch in gillnets targeting sharks and rays (Wamukoya, et al., 1997). Since these impacts have continued unabated for the last 30-40 years the population of dugongs in

Kenya is now depleted to such low levels it is not clear that remaining numbers are viable. Local extinction is highly likely if there continues to be no management intervention.

Turtles

Five of the sea turtles that range in the WIO are found in the Tana-Pate area. Four of the most endangered sea turtles (based on IUCN's Red List) nest in the Lamu archipelago:

- Hawksbill *Eretmochelys imbricate*, Critically Endangered (A2bd, IUCN 2010)
- Leatherback *Dermochelys choriacea* Critically Endangered (A1abd, IUCN 2010)
- Green *Chelonia mydas*, Endangered (A2bd, IUCN 2010)
- Loggerhead *Caretta caretta* Endangered (A1abd, IUCN 2010)
- Olive Ridley *Lepidochelys olivacea* Vulnerable A2bd (IUCN 2010)

There are several long turtle nesting beaches north of Kipini to Ras Tenewi, and on Lamu and Manda Islands. These are being monitored and protected in pockets by active and determined CBOs (eg TAFMEN and Lamu Marine Conservation Trust) with some funding support from WWF. But the distances involved are vast, government resources to patrol these beaches non-existent, and therefore poaching of eggs and adult turtles for meat is inevitable.

Corals

Corals are threatened by sea surface temperature rise (Linden and Sporrang 1999; Wilkinson 2000). The coral bleaching from the extreme temperature event during the 1998 El Niño and their subsequent recovery has been quantified and reefs in the far north of Kenya were some of the most heavily impacted with mortality levels of >80% (Obura 2005, Obura et al. 2006, McClanahan et al. 2007). Recovery in this region has been monitored from 1998 to 2008 and has progressed slowly in shallow inner and outer reefs to levels varying from 20-80% of pre-bleaching levels. Species of special interest that are either rare, endemic or have limited ranges include: *Horastrea indica*, *Siderastrea savignyana*, *Porites nodifera*, *P. columnaris*, and an undescribed *Coscinaraea* (Obura pers. comm.)

Teleost Fishes

The Napoleon wrasse, *Cheilinus undulatus*, is listed as Endangered on IUCN's Red List (A2bd+3bd, IUCN 2010), and is also listed on Appendix 2 of CITES due to serious concerns of the trade in this species to the Asian live reef fish market and crashing populations. Important sites for this species such as Pazali reef off Pate, should be given special protection status. This reef lies in the channel of the proposed Lamu Port and would therefore be destroyed if this port goes ahead. The Red Sea/Arabian Gulf angelfish *Apolemichthys xanthurus* occurs in this area, at its southern limit. The Vulnerable giant grouper *Epinephelus lanceolatus* (IUCN Red List: A2d) and other threatened groupers are likely to occur in this region. There is little information on their status in this northern part of Kenya's coast.

Rays and Sharks

The Critically Endangered sawfish *Anoxypristis cuspidata* (knifetooth sawfish) and *Pristis zijsron* (longcomb sawfish) occur in Ungwana Bay and the lower reaches of the Tana River (Wanja Nyingi, NMK pers. comm.) as the shallow muddy habitat is ideally suited to these species. All sawfish are listed on Appendix 1 of CITES. Sawfish are the sole living family Pristidae within the order Pristiformes.

Based on our understanding of the nursery grounds of many tropical shark species, the large mud-sand bay of Ungwana is likely to be an important nursery ground for sharks in Kenya (WWF 2002). There is currently very little information available on sharks in Kenya, but there is global concern for the status of sharks due to heavy offshore fishing, little management and regulation, the pressure brought by the valuable trade in shark fin and the destruction of near shore nursery grounds (see IUCN Sharks and Rays Specialist Group). Since there is no other bay on this scale the relative contribution of Ungwana Bay to the shark populations of Kenya is probably high. Small (< 2m) coastal sharks that generally have small home ranges (but not milk shark), and high site fidelity make them highly vulnerable and these are likely to be being fished to extirpation.

Species include *Carcharhinus wheeleri*, *C. sealei*, *C. dussumieri*, *C. sorrah*, and *Rhizoprionodon acutus*. On the coral reefs the Black tip *Carcharhinus melanopterus*) and White tip (*Triaenodon obesus*) reef sharks are now extremely rare and have not appeared in any recent survey counts in the WIO (Samoilys unpubl.) suggesting their populations have dropped dramatically.

Mangroves

The species listed in Table 1 occur in the Tana-Pate area and are considered threatened locally (KMFRI 2002) due to over-harvesting, but are listed as Least Concern on IUCN's Red List. KMFRI have expressed concern over the worrying levels of exploitation in this area of the two rare mangrove species *Xylocarpus granatum* and *Heritiera littoralis* (Abuodha & Kairo 2001). Community reports on the sustainability of cutting vary considerably. KMFRI have done some studies in the Lamu region and report a removal rate of 19 poles ha⁻¹ yr⁻¹, the loss of 100 ha of mangrove forest during the construction of Mokowe sea jetty and the problem of no management plan (Kairo and Kivyatu, 2000; Abuodha & Kairo 2001; Kairo et al. 2002). Despite KMFRI's significant outputs in mangrove research there is still no national management plan for the country. This appears to reflect the legislative framework (KMFRI provides

Table 1. Mangrove species occurring in Kenya.

Family	Species	Local name	Geographical range
Avicenniaceae	<i>Avicennia marina</i> (Forskål) Vierh.	MCHU	WIO, Red Sea, A Gulf to W Pacific Ocean
Rhizophoraceae	<i>Bruguiera gymnorrhiza</i> (L) Lamarck	MUIA	Indo-Pacific
Rhizophoraceae	<i>Ceriops tagal</i> (Perr) C. B. Robinson	MKANDAA	WIO to W Pacific
Rhizophoraceae	<i>Rhizophora mucronata</i> Lamarck	MKOKO	WIO to W Pacific
Combretaceae	<i>Lumnitzera racemosa</i> Willd	KIKANDAA	WIO to W Pacific
Sonneratiaceae	<i>Sonneratia alba</i> J.E. Smith	MLILANA	WIO to W Pacific
Meliaceae	<i>Xylocarpus granatum</i> Koenig	MKOMAFI	WIO to Central Pacific Ocean
Meliaceae	<i>Xylocarpus molucensis</i> (Lamarck) Roem.	MKOMAFI DUME	WIO to W Pacific
Sterculiaceae	<i>Heritiera littoralis</i> (L.) Dryander	MSIKUNDAZI	WIO to Central Pacific Ocean

technical advice, not legislation) where the regulatory authority over mangrove forests comes under the Forestry Department (Samoilys et al. 2011, this volume), which has little expertise in mangroves, only in terrestrial forests.

The loss in mangroves is said to have reduced fisheries yield in the area (Tiensongrusee, 1991). Clay mining for pottery has also been associated with the degradation of mangrove habitats (NEMA 2011). Small scale re-planting by some community groups is helping but is probably on an inadequate scale to deal with the level of over-harvesting.

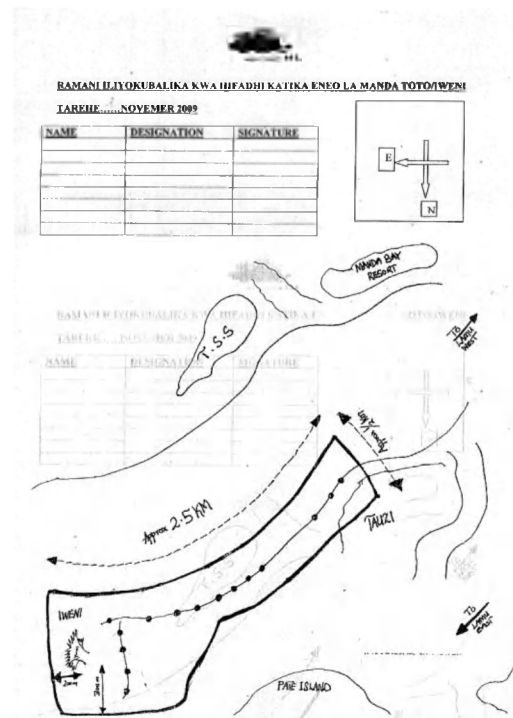
Fishing

Overfishing and the use of illegal and destructive fishing gears in unsuitable habitat, such as beach seines and ring nets (small purse seines) is widespread, both within Ungwana Bay and in the Lamu archipelago. Increasing pressure from migrant fishers from as far as Tanzania is also widespread, as far as the Somali border (pers. obs. Wanyonyi et al. 2011). Well established fisher camps on Ziwayu coral islets suggest fishing pressure is likely to be high. Overfishing is a function of an increasing population size (Kenya's population has doubled in 30 years), combined with immigration to the coast. Destructive fishing gears such as beach seines are widely used by fishers from Kizingitini village on the north coast of Pate and were used by migrant fishers around Kipini (pers. obs.) and are threatening the health and productivity of the ecosystem around Pate Island.

The prawn trawlers that operate in Ungwana Bay are a Kenyan fishing fleet of six vessels that has operated for decades, though was shut down in 2006 due to concerns about habitat destruction and impacts to inshore artisanal fisheries. It has apparently not been re-opened, however a trawler was seen in the bay for the 5 days we were there (in January 2011). These trawlers certainly take turtles as incidental by-catch if turtle excluding devices (TEDS) are not installed. However there are encouraging developments as the fishery is being closely evaluated and a strict management plan is now close to completion and implementation by the Fisheries Department of the Ministry of Fisheries Development.

Existing marine conservation projects of relevance

Two conservation initiatives are mentioned here though there are several other small active CBOs (see Maina et al. 2011), because they provide a strong base for future conservation in this area. The Lower Tana Delta Conservation Trust (LTDC) was initiated in the early 2000s to establish community based conservation to enhance wildlife protection, and to promote tourism and the wise use and management of available natural resources. It is however largely focussed on the land rather than the marine environment (pers. obs.) However, it provides a strong and committed conservation orientated community based organisation with which to engage in future marine conservation action.



Map 6. Kiweni Community Conservation Area declared through village by-law.

Kiweni (also called Iweni) is a 3km² community managed marine conservation area (CCA) off Pate village (Map 6), largely comprising shallow coral reefs around Pazali and Tausi reef that have been snorkeling areas for tourists from Manda Bay since

the 1980s. Kiweni was established with help of Lamu Marine Conservation Trust (LamCot). The conservation area is also called Manda Toto Conservancy by tourism operators. LamCot are an active small NGO based in Shela initially focused on turtle conservation but now expanding to area based conservation approaches such as Kiweni.

Summary of findings and recommendations for conservation action

The following summary of findings and suggestions for conservation action build on the findings in this report as well as the survey of existing community projects (Maina et al. 2011) and the review of legislation (Samoilys et al. 2011, this volume), as well as our understanding of coastal and marine conservation and management systems and infrastructure in Kenya. Key findings are:

1. Three unique areas of marine and coastal habitats occur in the Tana-Pate area:
 - the Tana Delta which is huge, with diverse and contiguous habitats including mangroves, beaches and dunes supporting a wide range of fauna and flora, with a notably high diversity of birds and several endangered or threatened species including sharks. This Delta extends into the productive (nutrient rich) Ungwana Bay and the offshore North Kenya Bank which probably support the most valuable offshore fisheries in Kenya;
 - the Ziwaiyu-Pate-Kiunga coral reef system which occurs at the convergence of the East Africa Coastal Current (EACC) and the Somali current, which is a cold upwelling, bringing its own unique mix of coral and fish species which combine Arabian Gulf with East African species, including rare and endemic corals not seen elsewhere in East Africa.
 - One of the largest stands of mangrove forests in East Africa representing 60% of Kenya's mangroves; lies in the archipelago north of Lamu in which Pate island is situated. The rare and very tall *Heritiera littoralis* is only found in the Tana Delta and the Rufiji Delta in Tanzania.
2. One of the last remaining populations of dugong (*Dugong dugon*) in East Africa occur in the area, though numbers are so low it is uncertain whether the population is viable;
3. There are extensive turtle nesting beaches around Ras Tenewi and on Manda and Lamu Islands for four endangered turtles (Hawksbill, Green, Loggerhead and Leatherback).
4. The Tana Delta and the associated mangroves combine to create nutrient rich and productive waters supporting valuable fisheries including prawns, notably the valuable *Penaeus monodon*, in Ungwana Bay. On the offshore North Kenya Bank deep water demersal and pelagic fishes are likely to be abundant but as yet remain un-surveyed.
5. The mangroves of the Lamu archipelago combined with the nutrient rich colder Somali current confer high productivity supporting some of the highest densities of fin-fish and crustaceans inshore in Kenya. They are also likely to support highly productive offshore fisheries but this is not yet quantified. These mangrove trees also provide valuable wood products for local communities.
6. Communities repeatedly cited their major and valuable resources as being: the fisheries, mangroves, beaches, coastal dunes, forests, turtles, wild animals, birds, the ancient ruins and cultural heritage, the River Tana and the Delta, farms and the ocean.
7. The numerous historical and archaeological Swahili sites of mosques, tombs, mounds and walls of ancient city houses in Pate, Siyu, Shanga ya Rubu and Kipini are outstanding and represent a rich cultural heritage.
8. There are several threats to the conservation and management of the area which can be encapsulated as (see Samoilys et al. 2011, this volume; Becha pers. comm.): a) Poor environmental governance; b) Lack of access to decision-making and opportunity to participate for local communities; c) Lack of access to environmental information for communities who find it increasingly difficult to contribute to the protection and conservation of their local environment; d) Lack of access to redress and legal remedy - communities have often challenged decisions on development they consider unfair or flawed, however, they have not able to get public access to judicial and administrative remedies; e) Land tenure insecurity and legal constraints; f) a sectoral

approach to resource management - this approach is not suitable because the natural resources in the area are highly interdependent.

Recommended conservation interventions

We recommend that conservation in this Tana Delta - Pate Island area should be area-based through community conservation areas (CCAs, also called locally managed marine areas (LMMAs), sanctuaries or conservancies) that are or include fully protected no-take zones (NTZs). These need to be community driven but co-managed with relevant government agencies leaning on available and relevant legislation (e.g. Ministry of Fisheries Development, Ministry of Forestry and Wildlife, and Ministry of Environment and Mineral Resources, see Samoily et al. 2011, this volume). Setting up such CCAs can involve mechanisms whereby the relevant government institution is requested to provide input as per their mandate. Key community institutions available to lead on the co-management side are the BMUs, active CBOs with an environmental mandate and local NGOs. However, wider input is needed for technical advice and this can be provided by national, regional and international NGOs and government agencies. Key to this approach is coordination between different marine conservation areas and between different groups and agencies.

NTZs are recommended to conserve the unique coral reefs of the area. These reefs represent the northern most limit of the East African fauna and also contain species from the Red Sea/Arabian Gulf which are not found further south. NTZs are recommended to help fish populations recover from the heavy fishing pressure. Coral transplanting to help stimulate coral recovery is an option to help coral reefs recover from bleaching. This has been done successfully over several years in Kiunga Marine Reserve as a joint activity between CORDIO, KWS and WWF, in response to the coral mortality caused by the 1998 El Niño (Obura et al. 2006). It is recommended that this is considered for the reefs off Pate Island, particularly for small areas visited by tourists.

Area-based conservation efforts could consider building on existing or proposed protected areas, such as the Lower Tana Delta Conservancy (500 km²), Kipini Conservancy (200 km²) Ras Tenewi Marine

Reserve (350km²), and Kiweni CCA off Pate (3km²). Ras Tenewi Marine Reserve adjacent to the Tana Delta is a government proposed reserve that was put forward in the 1980s but was never gazetted (Tychsen 2006 (Coastal Resource Atlas), Kibiwot 2008). Obstacles to gazettement need to be properly understood. Participatory co-management was not the norm in the 1980s so it is likely there was local opposition at that time. KWS participatory approaches have changed dramatically in the intervening years, as has the awareness of communities and their rights to self management of natural resources. The potential for gazettement with strong community involvement and full understanding of the implications of a Reserve should be investigated. The Reserve should have multi-use status, including no-take zones for habitat and fish stock rehabilitation, but also cater to differing needs of local people while addressing biodiversity conservation. Kiweni CCA on Pate provides an excellent opportunity to promote community based NTZs. However, Kiweni lies right in the channel of the proposed Lamu Port so if the port goes ahead the CCA will be destroyed. It is advisable to encourage villages on the north of Pate Island, such as Faza and Kizingitini, to establish their own CCAs using Pate village as an example. Since Pate island is proposed as the new resort city for the Lamu port such community conservation areas may have tourism value in the future.

Support for the formal designation of the Tana Delta as a Ramsar site will give Kenya the second marine Ramsar site in East Africa, the first being the Rufiji-Kilwa-Mafia site in Tanzania designated in 2004. This additional status and international recognition should help control the development of the delta by large scale commercial agricultural and mining schemes. KWS are pursuing this nomination and have submitted the Ramsar Sheet.

An integrated planning approach is also recommended for habitat and population rehabilitation. A proper survey of the two areas is needed to map the inventory of habitats and status of key species. From this a proper plan for rehabilitation and future conservation can be done. A national mangrove management plan is urgently needed in Kenya; mangroves in the Lamu area represent 60% of

the nation's mangroves but the lack of a harvesting plan is threatening their existence. The reasons that no management plan exists in Kenya lie in the lack of coordination and harmony in existing mandates and legislation between different Ministries (Samoily et al. 2011, this volume). Tanzania has had an effective management plan since the 1990s (see Wells et al. 2007), and Kenya has experienced mangrove scientists at KMFRI, so there is plenty to build on. This would enable more strategic coordination of existing mangrove replanting in the area. Integrated conservation planning for Pate Island must include both coral reef areas and the mangrove forests. Villages with existing mangrove re-planting activities (Pate and Tchundwa) should be supported and given training. Community Forest Associations (CFAs), already enshrined in legislation (Forest Act 2005) could be established to protect and harvest mangroves in a sustainable manner. Pate islanders also need to be given the opportunity to be part of mitigation activities to minimise the impacts of port development and this should focus on maintaining the ecological integrity of the Pate Island - Siyu Channel mangrove archipelago with a focus on the northern end of Pate Island.

It is recommended as a matter of urgency that community members are assisted so that they can be part of enforcement patrols, are engaged in legislation review and development, and are active players in any conservation and resource management scheme. This will ensure community buy-in, and a sense of community ownership. Community leadership and engagement in co-management are essential for the sustainable management of small scale fisheries (Gutiérrez et al. 2011). One of the most significant areas of assistance needed is empowerment in terms of knowledge of the natural resources and how best to manage them, knowledge of the legislation and knowledge of community rights. A wide ranging educational and awareness programme targeted various community groups and BMUs would help fill this significant gap.

The proposed Lamu Port in the Manda-Pate channel will have severe environmental consequences. It would be advisable to request the Port Management Association of Eastern and Southern Africa (PMAESA) for a formal assessment of the relative merits of this

port. PMAESA, designed to boost regional economy through trade, aims to become the critical centre of excellence for ports and maritime and related industries through proper planning of ports development. If the Port proceeds the following are strongly recommended: a thorough and proper EIA; the latest technology in terms of maritime construction with regard to the environment; strong mitigation; compensation; and local communities enabled to become involved and understand their rights in terms of access to their natural environment.

There are several endangered species or those of special interest and concern that require immediate attention. The strong local acceptance of community-based turtle conservation as an important environmental activity among communities from Kiunga (Samoily and Kanyange 2008) to Tana Delta (e.g. TAFMEN - this study) provides an excellent case study on how to focus attention and find support for endangered species conservation. Dugongs (Vulnerable, IUCN 2010) are one of the most threatened mammals on the African continent. A focussed and concerted effort is needed to protect this iconic, extraordinary and benign sea mammal if any are to survive in Kenya. The conservation effort needs to be highly public, have a strong awareness component and involve guards, patrols and an educational team. Protection of turtle nests and hatchlings and adults (through fishery gear restrictions) is needed for four endangered turtles: Hawksbill, Green, Loggerhead and Leatherback. A number of reef corals and fish require protection: Arabian Gulf species of coral (*Porites nodifera*, *P. columnaris* and an undescribed *Coscinaraea* species), and the angel fish *Apolemichthys xanthis*; the rare and endemic coral *Horastrea indica* and also the restricted range species *Siderastrea savignyana*; the Endangered and CITES listed Napoleon wrasse, *Cheilinus undulatus*. Focused species research and conservation action planning is needed for the following sharks: the Critically Endangered sawfish *Anoxypristis cuspidata* (knifetooth sawfish) and *Pristis zijsron* (longcomb sawfish), listed on CITES Appendix 1. Research on these species has not been done and needs to occur as a matter of urgency to establish population, size, residency patterns, breeding locations etc. Small (< 2m) coastal sharks which are probably being fished to extirpation due to the shark fin trade. These include

Carcharhinus wheeleri, *C. sealei*, *C. dussumieri*, *C. sorrah*, *Rhizoprionodon acutu* and Black tip and White tip reef sharks.

Any marine conservation action requires consideration of sustainable financing and alleviating poverty for local communities (Samoilys and Obura 2011, this volume). Alternative livelihoods for local communities to alleviate pressure on near-shore marine resources need to be considered and this needs proper assessment, business plans and a value chain analysis. Enterprise based conservation approaches as seen in Madagascar (Harris 2007) or Payment for Ecosystem Services (PES) models may offer solutions (Samoilys 2011, this volume).

The amount of legislation governing the natural environment which is relevant to marine and coastal ecosystems in Kenya is enormous with 14 Ministries containing a further nine Authorities responsible for around 47 pieces of legislation (Samoilys et al. 2011, this volume). This heavily sectoral approach has led to a lack of synergy, a lack of harmony, duplication and a lack of awareness across different sectors and Ministries. One of the challenges in the marine environment is that it represents one of the most interconnected ecosystems and therefore the legislation governing it needs to be equally interconnected. Despite the lack of harmony and confusion over legislative instruments for the marine environment, the shift in government attitude in recent years is very positive and there are now several opportunities for taking this forward. At the highest level there is a commitment in the new Constitution (2010) for due diligence when it comes to the environment and in recognising citizens' rights to environmental resources and a healthy environment. Key avenues worth considering are: the *National Environmental Civil Society Alliance (NECSA)* –an implementation committee to oversee the quality of the government's rolling out of environmental legislation within the new Constitution; the *Constitutional Implementation Committee (CIC)* – an independent committee monitoring the Constitution. NECSA has an MoU with CIC, so there is immediate communication and collaboration there; National and County government levels can be used to make sure legislation is appropriate (National) and implemented (County). Specific action on this could be hosting a

public forum to discuss issues regarding the translation of new national legislation to county level. e.g. in Tana Delta County. This could provide a mechanism for enabling national level (e.g. NECSA) input to County dialogue. Such a forum would be educational and raise awareness and would discuss how the Constitution, for example on environmental rights, can be implemented at the County level. An effective mechanism for maintaining the education and awareness could be local network centres or "community knowledge cafes" (Hadley Becha pers. comm.) to share knowledge and to enable community input to national debates. Similar community knowledge centres for Climate Change Adaptation are being developed by CORDIO East Africa; the task force of the Ministry of Environment and Mineral Resources drafting legislation to implement land use, environment and natural resource provision of the new Constitution. Marine civil society representation on this task force is important since the marine environment is often neglected.

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References

- Abuodha, P.A.W. and J.G. Kairo. (2001). Human induced stresses on mangrove swamps along the Kenyan coast. *Hydrobiologia* 458: 255-265.
- Ahmed, A.G.M. (2001). Livelihood and resource competition, Sudan. In: Salih, M.A., Dietz, T. and G.M.A. Ahmed. (eds.) *African Pastoralism: Conflict, Institutions and Government*. London: Pluto Press, in association with OSSREA, 172-193 pp.
- Baxter, P.T.W. (2001). Immediate problems: A view from a distance; In: Salih, M.A., Dietz, T. and G.M.A. Ahmed. (eds.) *African Pastoralism: Conflict, Institutions and Government*. London: Pluto Press in association with OSSREA.

- BirdLife International (2011). Important Bird Areas factsheet: Tana River Delta. Downloaded from <http://www.birdlife.org> on 19/05/2011.
- Church J.C. and D.O. Obura. (2006). Sustaining coral reef ecosystems and their fisheries in the Kiunga Marine National Reserve, Lamu, Kenya. ICRS Conference.
- Dhidha, M.B., Mwendwa, K.A. and O.M. Dhadho. (2005). Lower Tana conservation pilot project; inventory of natural resources and baseline studies of ecological, social and economic parameters in the lower Tana Delta.
- Dutton, P. (1998). East African dugongs disappearing. Sirenews: Newsletter of the IUCN/SSC Sirenia Specialist Group, 29: 4.
- Fisheries Department (2005). Department of Fisheries Annual Statistics. Ministry of Fisheries Development, Kenya.
- Fisheries Department. (2008). Frame survey report. Ministry of Fisheries Development, Kenya. Provincial Headquarters, Mombasa, 143 pp.
- Fishpool, L.D.C. and M.I. Evans. (eds.) (2001). Important Bird Areas in Africa and associated islands: Priority sites for conservation. Newbury and Cambridge, UK: Pisces Publications and BirdLife International (BirdLife Conservation Series No. 11).
- Fondo, E.N., Kimani, E.N. and Odongo, D.O. (2010). The status of mangrove mud crab fishery in Kenya, East Africa. *Inter. J. Fish. Aquacult.* 2(3): 79-86.
- Government of Kenya (2009a). Kenya state of the coast report: towards the integrated management of Kenya's coastal and marine resources. UNEP and NEMA, Nairobi. 90 pp.
- Government of Kenya (2009b). Kenya population and housing census, 2009, Central Bureau Statistics, Government Printers.
- Government of Kenya (2011). Integrated coastal zone management action plan for Kenya, 2011-2015. Towards an integrated management of Kenya's coastal and marine resources. NEMA, Nairobi. 90 pp.
- Gutiérrez, N.L., Hilborn, R. and O. Defeo. (2011). Leadership, social capital and incentives promote successful fisheries. *Nature*. In press.
- Hamerlynck, O, J Nyunja, Q Luke et al (2010). The communal forest, wetland, rangeland and agricultural landscape mosaics of the Lower Tana, Kenya: A socio-ecological entity in peril. In: Sustainable use of biological diversity in socio-ecological production landscapes, pp.54-62. CBD Technical Series No. 52.
- Hamilton, H.G.H. and W.H. Brakel. (1984). Structure and coral fauna of East African reefs. *Bull. Mar. Sci.* 34: 248-266.
- Harris, A. (2007). To live with the Sea: development of the Velondriake Community - Managed Protected Area Network, southwest Madagascar. *Madagascar Conservation and Development* 2 (1): 43-49.
- Helland, J. (2001). Participation and governance in the development of Borana; Southern Ethiopia; In: Salih, M.A., Dietz, T. and G. M. A. Ahmed. (eds.) *African Pastoralism: Conflict, Institutions and Government*. London: Pluto Press, in association with OSSREA.
- IUCN (2010). IUCN Red List of Threatened Species. Version 2010.4. <www.iucnredlist.org>
- Kairo, J. G. (1995). Artificial regeneration and sustainable yield management of mangrove forests at Gazi bay, Kenya. University of Nairobi. Kenya. Msc. Thesis: 104 pp.
- Kairo, J.G. and B. Kiviyatu. (2000). Mangrove management survey within and adjacent to Kiunga Marine National Reserve, Final Technical Project, Nairobi, WWF-East Africa Regional Program Office (WWFEARPO), Contract No. WWF/KE: 0089/01, 113 pp.
- Kairo, J.G., Dahdouh-Guebas, F., Bosire, J. and N. Koedam. (2001). Restoration and management of mangrove systems with a special reference on East Africa. *S. Afr. J. Bot.* 67: 383-389.
- Kairo, J.G., Kiviyatu B. and N. Koedam. (2002). Application of remote sensing and GIS in the management of mangrove forests within and adjacent to Kiunga Marine Protected Area, Lamu, Kenya. *Environment, Development and Sustainability* 4: 153-166.
- Kemp, J. (2000). Eastern Africa Marine Ecoregion: Biological reconnaissance final report. WWF.
- KENWEB (2011). Integrating scientific and traditional knowledge for co-management of socioecological landscapes for the well-being of communities in the flood-dependent lower floodplain agroforestry, pastoral and fishery systems of the eastwards flowing rivers of Eastern Africa. An action research oriented proposal for eastern Africa wetlands. http://satovama-initiative.org/en/wp-content/uploads/1077/Proposal-Satovama-Initiative_KENWEB_EAST-AFRICA
- Kibiwot, R. (2008). Towards the formulation of Kenya's integrated ocean management policy including institutional framework. New York. Division for Ocean Affairs and the Law of the Sea (DOALOS). 109pp.
- Kitheka, J.U., Obiero, M. and P. Nthenge. (2005). River discharge, sediment transport and exchange in the Tana estuary, Kenya . *Estuar. Coast. Shelf Sci.* 63: 455-468.
- KMFRI (2002). Current status of trawl fishery of Malindi – Ungwana Bay. 97pp. http://www.oceandocs.org/bitstream/1834/927/1/Ungwana_2002.pdf (Accessed 21 January 2011)
- KWS-Ramsar sheet (2010). Information Sheet on Ramsar Wetlands (RIS) – 2006-2008 version. Available for download from http://www.ramsar.org/ris/kev_ris_index.htm
- Laegdsgaard, P. and C.R. Johnson. (1995). Mangrove habitats as nurseries: unique assemblages of juvenile fish in subtropical mangroves in eastern Australia. *Mar. Ecol. Pro. Ser.* 126: 67-81.
- LamCot (2010) LamCot annual report 2009-2010 <http://lamcot.org/> (accessed 26 February 2011).
- Linden, O. and N. Sporrang. (1999). Coral reef degradation in the Indian Ocean. Status reports and project presentations, 1999, Sida/SAREC Marine Science Programme, Sweden.
- Maina, GW, Samoilys MA, and K.Osuka (2011) Review of current and potential community-based marine conservation projects on the Tana Delta - Pate Island coast of Kenya. Report to Fauna and Flora International.
- McClanahan, T.R., Ateweberhan, M., Muhando, C.A., Maina, J. and M. Mohammed. (2007). Effects of climate and seawater temperature variation on coral bleaching and mortality. *Ecol. Monogr.* 77(4): 503-525.
- Nagelkerken, I. and G. Van der Velde (2002). Do non- estuarine Mangrove harbour higher densities of juvenile fish than adjacent shallow -water and coral reef habitats in Curacao (Netherlands Antilles)? *Mar. Ecol. Pro. Ser.* 245: 191-204.
- Nagelkerken, I., Van der Velde G., M.W. Gorissen, Meijer, G.J., Van'thof, T. and C. Den hartog. (2000). Importance of mangroves, seagrass beds and the shallow coral reef as a nursery for important coral reef fishes, using a visual census technique. *Estuar. Coast. Shelf Sci.* 51:31-44.
- NEMA (2004). Mission report on the preliminary assessment of conservation and economic development in the Tana Delta. 37pp.

- NEMA (2011). Towards integrated management of Kenya's coastal and marine resources. Ministry of Environment and Mineral resources. 94pp.
- Nunow, A.A. (2011). The dynamics of land deals in the Tana Delta, Kenya. Moi University, School of Environmental Studies, Eldoret, Kenya. 27pp.
- Obura D.O. (2005). Resilience and climate change: lessons from coral reefs and bleaching in the Western Indian Ocean. *Estuar. Coast. Shelf Sci.* 63: 353-372.
- Obura D.O. (2008). Scleractinian coral fauna of the Western Indian Ocean. In: Ten years after bleaching – facing the consequences of climate change in the Indian Ocean. *CORDIO Status Report 2008*. (eds). Obura, D.O., Tamelander, J., and O. Linden. *CORDIO (Coastal Oceans Research and Development in the Indian Ocean) / Sida-SAREC*. Mombasa. 139-147 pp.
- Obura, D.O., Causey, B. and J.C. Church. (2006). Management response to a bleaching event. *In: Corals and Climate Change*. (eds.) Phinney J., Hoegh-Guldberg, O., Kleypas, J., Skirving, W. and A. Strong. American Geophysical Union.
- Pankhurst, A. and F. Piguet. (2004). Contextualizing migration, resettlement and displacement in Ethiopia. *In* Pankhurst, A. and F. Piguet. (eds.) *People, Space and the State: Migration, Resettlement and Displacement in Ethiopia*. Addis Ababa: Department of Sociology and Social Anthropology.
- Pertet, F. and J. W. Thorsell. (1980). The dugong in Kenya, Kenya Wildlife Planning Unit, December.
- Ramsar. (2008). 10th Meeting of the conference of the parties to the convention on wetlands (Ramsar, Iran, 1971). Changwon, Republic of Korea.
- Samoilys MA, Osuka K and GW Maina (2011). Opportunities and challenges of current legislation for effective conservation in the Tana Delta – Pate Island region of the Kenyan coast. This volume.
- Samoilys, M.A. (1988). A survey of the coral reef fish communities on the Kenyan coast. Report for the World Wide Fund for Nature and the Kenya Ministry of Tourism and Wildlife. 38pp.+ figures+appendices
- Samoilys, M.A. (2011). Exploration of a Payment for Ecosystem Services (PES) approach to conservation in the Mnazi Bay – Ruvuma Estuary Marine Park, Tanzania. This volume.
- Samoilys, M.A. and Harrison, P. (2009). Livelihood opportunities for coastal communities in Kiunga, Kenya. Prospects for livelihood diversification amid improved natural resources management in the Kiunga Marine National Reserve. Kilimankiyika/CORDIO Report to Kibodo. 64pp.
- Samoilys, M.A. and N.W. Kanyange. (2008). Natural resource dependence, livelihoods and development: Perceptions from Kiunga, Kenya. *IUCN ESARO 2008*. 31 pp.
- Semesi, A. (1998). Mangrove management and utilisation in East Africa. *Ambio*. 27: 8 620-626.
- Thayer, G.W., Colby, D.R. and W.G. Hettler Jr. (1987). Utilization of red mangrove prop roots by fishes in south Florida. *Mar. Ecol. Pro. Ser.* 35: 25-38.
- Tiensongrusmee, B. (1991). Mangrove conservation and management – Kenya. Report on brackish water/coastal aquaculture development. Field document No. 1
- Tychsen, J. (ed.) (2006). *KenSea: Environmental sensitivity atlas for coastal area of Kenya*. Copenhagen: Geological Survey of Denmark and Greenland (GEUS) 76pp.
- UNEP. (1998). *East African atlas of coastal resources: Kenya*. United National Environment Programme, Nairobi. 119pp.
- Wamukoya, G. M., Kaloki, F. and J. Mbendo. (1996). Kipini community conservation centre technical reports: sea turtle recovery action plan for Kenya. Kenya Sea Turtle Conservation Committee Technical Report TR-1
- Wamukoya, G.M., Ottichilo, W.K. and Salm, R.V. (1997). Aerial survey of dugongs in Ungwana Bay and the Lamu Archipelago, Kenya. Kenya Wildlife Service Technical Series Report No. 2
- Wanyonyi, I., B. Crona, and S. Rosendo. (2011). Migrant fishers and fishing in the Western Indian Ocean: socio-economic dynamics and implications for management. Final Report of Commissioned Research Project MASMA/CR/2008/02.
- Weis, J.S. and P. Weis. (2005). Use of intertidal mangrove and sea wall habitats by coral reef fishes in the Wakatobi marine park, Indonesia. *Raffles Bull. Zoo.* 53 (1): 119-124.
- Wells, S., Makoloweka, S., and M. Samoilys. (eds.) (2007). Putting adaptive management into practice: collaborative coastal management in Tanga, northern Tanzania. IUCN Eastern Africa Regional Office, x +197pp.
- Wiggins, S.M. (2010). Cultural heritage preservation meets modern port development: securing the integrity and authenticity of the lamu town world heritage site in the face of current and future challenges. ISP Collection. Paper 822. http://digitalcollections.sit.edu/isp_collection/822
- Wilkinson, C. (2000). Status of coral reefs of the world: 2000. Townsville, Australia, Australian Institute of Marine Science. 363 pp.
- WWF (2002). Proceedings of the eastern African marine ecoregion visioning workshop. WWF Eastern Africa.
- WWF- Eastern African Marine Ecoregion (2004). Towards a Western Indian Ocean dugong in conservation strategy: the status of dugongs in the Western Indian Ocean region and priority conservation actions. Dar-el-Salaam, Tanzania: WWF 68pp.