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Participatory assessment of priority fishery profiles in an overfished urban inshore seascape in Kenya

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Abstract

This study presents a participatory assessment of overfished small-scale fisheries from selected landing sites in coastal Kenya using mixed quantitative and qualitative research methods. A seven-criteria ranking using a modified Delphi questionnaire with a 5-point Likert scale was used. Through a process of scoring the fisheries on these criteria, marine aquarium fishing ranked highest with 86.7%, while beach seine ranked lowest at 55.3%. Averaging of scores and ranking across focus group discussions (FGDs) and key informant interviews (KIIs) at individual sites resulted in the following highest scorers: handlines (58.6%), octopus (55.9%), and basket traps (52.5%) for Bamburi; aquarium fishing (86.7%), handlines (85.5%), and reef-seines for Marina/Mtwapa; mixed pelagic (60.7%), octopus (60.5%), and rabbitfish (58.4%) for Nyali; and basket traps (70.4%), handline (57.8%), and monofilament nets (64.3%) for Reef. Destruction of critical habitats and prohibitive costs of fishing crafts were key management issues identified through scoring and ranking criteria, while 22 management issues were identified through FGDs. These findings suggest an existing spatial mixture of differences and commonalities among fisheries profiles and management issues. This study revealed trade-offs that should be incorporated in the co-management plans of the respective Beach Management Units (BMUs) in coastal Kenya.

Keywords: Mixed participatory approaches, Co-management value addition, Socio-ecological systems, Fishery profiling

Introduction

There is growing promotion for the uptake of, and capacity building for, co-management in the coastal fisheries of Kenya. This is based on the proposition that resource-user participation in management decision-making, commonly referred to as co-management, is likely to produce legitimacy and effective regulations (Wilson *et al.,* 2003; McClanahan *et al.,* 2008a). Successful management of small-scale fisheries, especially those characterized by mixed habitats, multiple gears, multiple species and multiple stakeholders, is vital to ensure continued provision of food, fishery-related jobs, economic profits and other ecosystem services for many resource-dependent communities locally, regionally, and globally.

The Kenyan inshore marine artisanal fishery resources, including the Nyali-Mtwapa urban seascape, continue to be heavily relied on by the coastal artisanal fishers as their main source of income, employment and food security (Okeyo, 2010; Hicks and McClanahan, 2012; FAO, 2014). Due to this high

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dependence, the fisheries in the studied locations continue to exhibit Malthusian over-fishing, exemplified by heavily exploited, multi-species, mixed-gear fisheries (Mangi *et al.,* 2007; McClanahan *et al.,* 2008b; Hicks and McClanahan, 2012).

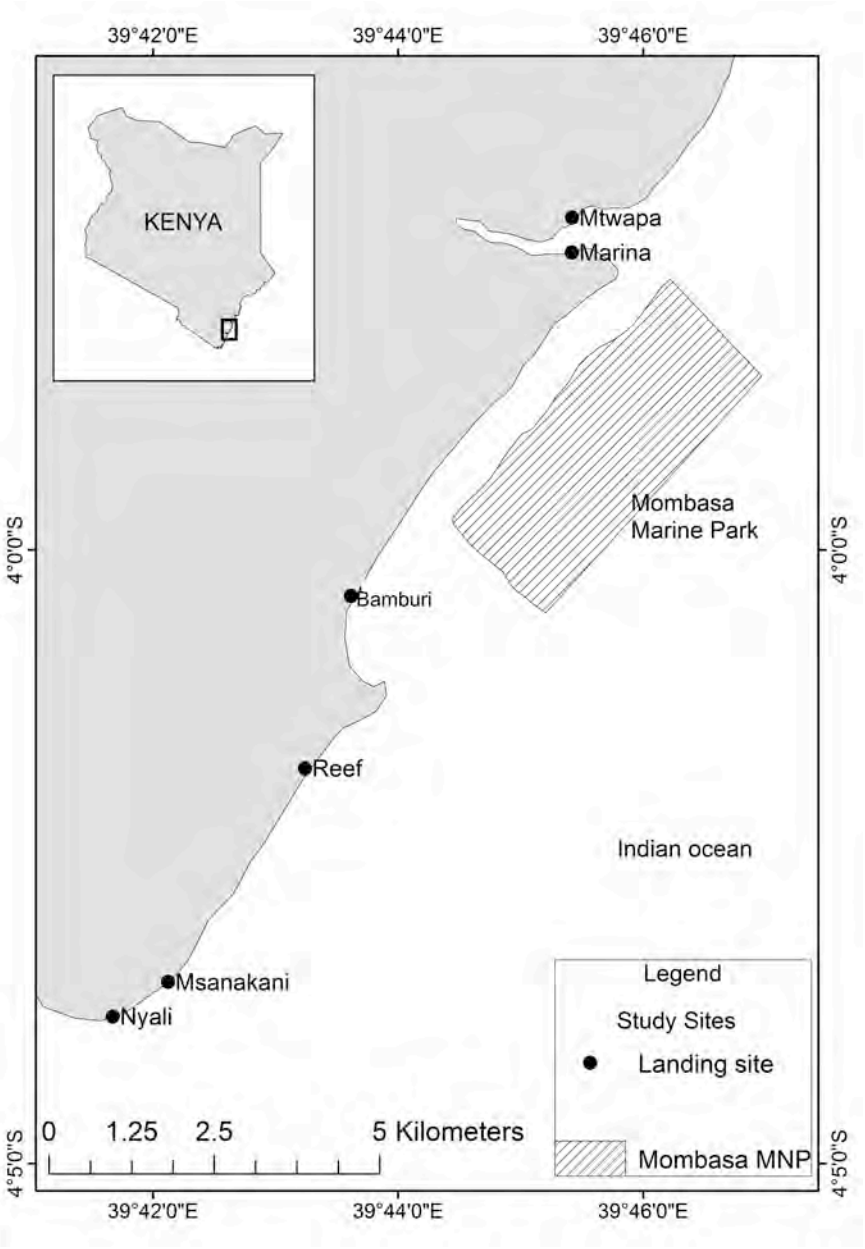

Figure 1. Map of the study sites showing Kenya (inset) and the inshore urban seascape of Nyali-Mtwapa along the Kenyan coastline.

Aswani *et al.,* 2012) have been proposed to ensure sustainable fisheries. While co-management is plausible, compliance to management measures have always been hindered by, among other factors, high poverty levels, over-dependence on inshore fisheries resources, and the use of fishing gears that are simple and inexpensive with many fishers making their own gears such as spear guns and basket traps (Mangi *et al.,* 2007). Currently, marine and coastal resources in Kenya are managed at three main levels: the national level; the county level; and the community

Different management strategies such as traditional systems (e.g. *kayas* in coastal Kenya), gear regulations, size controls, fisheries closures, co-management (BMUs), and the ecosystem approach to fisheries (McClanahan *et. al,* 2005; McClanahan *et al.,* 2008a, b; McClanahan and Mangi, 2001; McClanahan, 2007;

level (Aswani *et al.,* 2012). At the community level, the BMU movement is slowly increasing the capacity of local communities to manage resources within their fishing grounds (Aswani *et al.,* 2012).

One of the drawbacks with the BMUs in Kenya is the lack of focus and/or specific fisheries management objectives or measures, due to low or no technical capacity in community-generated fisheries management plans. Therefore, there is a need to support technical analysis to make the provisions in community fisheries management plans more specific and easy to identify and implement. To add value to co-management planning for artisanal marine fisheries in the Nyali-Mtwapa seascape, this study sought to support technical analysis of priority fisheries management needs. The study aimed at researching fisheries that are considered priority fisheries because of their high economic and social importance in this urban seascape. The study included investigating the management issues and priorities at local levels based on the views and perceptions of the resource-dependent communities. This was to help identify and provide an assessment of the status and local management needs of these priority fisheries, and support the incorporation of these needs in future fisheries co-management plans.

Materials and Methods

Study area

This study covered four BMUs representing five main landing sites of Nyali, Reef, Bamburi, Marina and Mtwapa within the Nyali-Mtwapa urban seascape (Fig. 1). These sites were selected based on their characteristic mix of different gear types, stakeholder interests, habitat types and multispecies fishery. Furthermore, this stretch of coast has been indicated in previous studies as experiencing Malthusian overfishing (McClanahan *et al.,* 2008a, b; McClanahan and Mangi, 2001). There is a marine no-take area (Mombasa Marine National Park) north of the Bamburi landing site. Around the park is the Mombasa Marine National Reserve (MMNR) that stretches about 1 km north of the park where the Marina and Mtwapa landing sites are located, and 12 km south of the Park where Bamburi, Reef and Nyali landing sites are located (McClanahan *et al.,* 2008b). About 500 fishermen and 50 fish traders derive their livelihoods and income from this seascape while fishing activity is controlled by the monsoon seasons affecting fishermen behaviour concerning target species and fishing methods (Obura, 2001).

Sampling

Purposive sampling that included eight fishers (at least 1 fisher per main gear type), two BMU officials, two female fish traders, two male fish traders, three non-governmental conservation organization representatives, and two government officers per workshop session were used for the participatory rural appraisal (PRA) approach. Thirty two fishers, eight BMU officials, seven female traders, eight male traders, four NGO representatives, and two government officers were involved in the FGDs and the Key Informant Interviews (KII). These stakeholders represented the resource users, researchers, and managers within the seascape.

Data collection procedure

A number of PRA tools were used for data collection based on the objectives of the study to enable different forms of cross-checking on responses, hence securing the validity and reliability of findings (Flick, 2004). The tools included Community Resource Maps (CRM), FGD, KII, and pair-wise scoring and ranking of fisheries management challenges (Fig. 2). This mixed approach used both quantitative and qualitative methods to answer the research question or questions by all means available (Tashakkori and Creswell, 2007; Wiggins, 2011) and for triangulation purposes.

Community Resource Maps

The stakeholders were taken through a community resource mapping exercise where the distribution of fishing grounds in relation to the shoreline, their names and relative positions, were sketched at the FGD workshop using a flipchart and felt pens of different colours. For all the fishing grounds, the main gears used were identified as well as the main species/fish groups targeted. The types of priority fisheries were thus identified based on the fish groups targeted as well as the gears used.

Focus Group Discussions

FGDs were guided by a modified Delphi questionnaire with a 5-point Likert scale (Appendix 1). The fishers were guided through a multi-criteria scoring system (scale of 1 (lowest) to 5 (highest)) that examined specific issues for each identified fishery based on seven criteria. These were: (i) level of community participation; (ii) income levels from the fishery; (iii) perceived catch production and trends; (iv) co-management initiatives; (v) ecosystem impacts of fishing; (vi) types of gears used; and (vii) types of vessels used. Each criteria included various questions (Appendix 1).

Figure 2. Triangulation between different PRA exercises for the participatory fishery profiling.

These scoring criteria were later used to rank the fisheries and the ranks were compared to see if the fisheries satisfied a specified level of compliance for the composite scoring criteria.

Key Informant Interviews

Five to six members representing the different stakeholders with experience in fishing, fish trade, conservation issues, and fisheries management were selected for priority fishery selection criteria scoring using the same questionnaire tool and procedure as above for validation of the FGD. These five to six respondents were considered as key informants. They were identified through a majority vote by the participants in the focus group discussions.

Pairwise scoring and ranking of management issues

The stakeholders identified major challenges faced in the fishery without any order of priority. Pair-wise ranking procedure was then used to score and rank the listed main challenges. Whenever there was a tie in the pair-wise ranking, the tied issues were compared and the one issue that was selected by the FGD as the most important among the two was given a higher ranking than the one considered as subordinate. Pairwise scoring and ranking methods provide a vital starting point, and sometimes the only practical means, for systems whose underlying complexities are not fully understood or agreed (Tucker *et al.,* 1996). The disadvantages of this technique are mainly associated with the arbitrary nature of assigning scores and these being described as overly simplistic (Thompson, 1990). However, if this is kept in mind, such scoring methods, if uniformly applied, can be designed to successfully compare a variety of different issues.

Data analysis

All scored criteria from FGDs and KIIs were converted to percentages of the maximum possible scores for each scoring item. The items were then aggregated to a percentage of the scoring criteria setting a lower cut off of ³40% based on the classical expectations of performance of an open access fishery (being 50% at MSY). The approach of scoring used in the study was similar to other studies aimed at selecting indicators of performance in a fishery (Rademeyer *et al.,* 2007; Schnute *et al.,* 2007; Williams *et al.,* 2011) and specifically, a framework for selecting suitable indicators for fisheries management and development (Rice and Rochet, 2005). The environmental (ecosystem impact) percent scoring criteria was set at £25% based on the principles of the Natural Capital Index (NCI) Framework (PBL, 2012). NCI measures human impact on biodiversity and has been implemented in national, regional and global assessments (Czúcz *et al.,* 2012; Mayunga, 2007; Hambrey and Armstrong, 2010). The NCI is not so much one single-fixed indicator, but rather a flexible indicator framework which can be tailored to specific scale, available data, and demand. Stakeholder-specific profiling (scoring and ranking) across the FGDs and KIIs by site was done as well as overall scoring and ranking through averaging individual scores across

them. The identified management issues were examined for patterns in their distribution among the landing sites using De-trended Correspondence Analysis (DCA), with sites as the independent variables and the ranks as the dependent variables.

Results

Criteria based assessment of priority fisheries in the Nyali-Mtwapa seascape

There were mixed categorizations of the coastal fishery into 14 main categories based on either gears used or the species/group of fish caught (Table 1). The marine aquarium fishery scored the highest at 86.7%, thus ranking first while the beach seine fishery scored the least at 55.3%, and was ranked last. Overall, there was highest scoring for criteria 6 on types of gears used, followed by criteria 3 on production and catch trends, and criteria 1 on community participation. The order of criteria however varied by individual BMUs and hence the differences observed in some of the priority fisheries.

Average ranking across FGD and KII indicated that the handline fishery scored the highest at 58.6%, while the gillnet fishery scored the lowest at 49.3% for Bamburi (Table 2). At Marina/Mtwapa the marine aquarium fishing scored highest at 86.7%, and beach seine fishing scored lowest at 55.3%. The Mixed pelagic fishery scored highest of 60.7%, and mixed demersal fishing the lowest at 56.5% for Nyali. The Reef landing site had the basket trap fishery scoring highest at 70.4%, while spear fishing scored least at 50.8% (Table 2).

Further analysis and pooling of the fishery by target species groups indicated four main fisheries in the seascape. These were marine aquarium fishing with a score of 86.7%, mixed pelagic fishery (mainly reef seine) at 79.7%, mixed demersal fishery (handlines, demersal longlines, spearguns and beach seines) at 71.7%, and octopus fishery (spearguns and spears) at 67.1%. The results are discussed based on these four target species group categories.

Table 1. Overall priority fisheries types identified for the Nyali-Mtwapa seascape at all sites based on average scores across all the FGDs, KIIs and sites pooled. Scores ≥40% indicates higher ranking except for criteria 5, where ≤25% is used.

No.	Criteria	Criteria 1: Community Participation	Criteria 2: Income	Criteria 3: Production and Catch	Criteria 4: Co-Management	Criteria 5: Ecosystem Impacts	Criteria 6: Types of Gears Used	Criteria 7: Fishing Crafts Used	Overall	Ranking
	Criteria benchmark	**≥40%**	**≥40%**	**≥40%**	**≥40%**	**≤25%**	**≥40%**	**≥40%**	**≥40%**	
	Fishery									
1	Marine aquarium fishing	66.7	61.7	76.7	56.7	23.7	96.7	53.8	**86.7**	**1**
2	Reef seines	67.8	49.2	63.3	58.3	25.0	94.4	39.5	**79.7**	**2**
3	Longlines	78.3	57.5	86.7	67.5	41.0	60.0	57.1	**78.8**	**3**
4	Handline	73.3	48.8	66.8	52.8	34.4	88.3	36.9	**67.3**	**4**
5	Monofilament nets	67.5	49.2	83.3	51.3	41.3	96.7	36.7	**64.3**	**5**
6	Basket traps	69.8	50.7	75.3	49.7	34.2	71.9	33.7	**61.4**	**6**
7	Spear guns	77.5	51.7	100.0	48.3	38.0	100.0	7.6	**61.2**	**7**
8	Mixed Pelagic	63.0	55.0	44.0	55.5	40.0	61.3	41.1	**60.7**	**8**
9	Spear	61.4	39.3	64.5	47.6	27.5	100.0	18.1	**58.9**	**9**
10	Rabbitfish	70.0	49.0	24.0	59.0	39.6	62.7	32.6	**58.4**	**10**
11	Octopus	77.8	46.6	46.7	51.2	31.7	69.0	23.5	**58.2**	**11**
12	Mixed demersals	79.0	54.0	28.0	54.5	42.4	62.7	28.6	**56.5**	**12**
13	Gillnets	71.3	43.3	56.7	47.7	39.8	75.4	33.4	**55.4**	**13**
14	Beach seines	77.5	56.7	30.0	51.7	48.0	94.4	22.4	**55.3**	**14**

Table 2. Important fisheries types identified for Nyali-Mtwapa seascape at all sites based on average scores across all the FGDs and KIIs per landing site surveyed. Scores ≥40% indicate higher ranking, except for criteria 5 where ≤25% is used.

Criteria	Criteria 1: Community Participation	Criteria 2: Income	Criteria 3: Production and Catch	Criteria 4: Co-Management	Criteria 5: Ecosystem Impacts	Criteria 6: Types of Gears Used	Criteria 7: Fishing Crafts Used	Overall	Ranking
Criteria benchmark	**≥40%**	**≥40%**	**≥40%**	**≥40%**	**≤25%**	**≥40%**	**≥40%**	**≥40%**	
Nyali									
Mixed Pelagic	63.0	55.0	44.0	55.5	40.0	61.3	41.1	60.7	1
Octopus	78.0	44.0	40.0	56.5	30.8	78.7	17.1	60.5	2
Rabbitfish	70.0	49.0	24.0	59.0	39.6	62.7	32.6	58.4	3
Mixed demersals	79.0	54.0	28.0	54.5	42.4	62.7	28.6	56.5	4
Reef									
Basket traps	68.0	53.0	100.0	51.5	34.4	96.0	36.0	70.4	1
Handline	56.4	37.1	57.1	44.3	30.3	100.0	26.9	57.8	2
Monofilament nets	67.5	49.2	83.3	51.3	41.3	96.7	36.7	64.3	3
Gillnets	64.2	39.2	63.3	49.6	40.7	100.0	38.6	61.4	4
Speargun	77.5	51.7	100.0	48.3	38.0	100.0	7.6	61.2	5
Spear	53.6	37.9	65.7	41.4	27.4	100.0	5.3	50.8	6
Bamburi									
Handlines	81.7	52.5	63.3	46.7	33.7	64.5	29.1	58.6	1
Octopus	77.5	49.2	53.3	45.8	32.7	59.4	29.8	55.9	2
Basket traps	71.7	48.3	46.7	47.9	34.0	47.8	31.4	52.5	3
Gillnets	78.3	47.5	50.0	45.8	39.0	48.6	28.3	49.3	4
Marina/ Mtwapa									
Marine aquarium	66.7	61.7	76.7	56.7	23.7	96.7	53.8	86.7	1
Handlines	81.7	56.7	80.0	67.5	39.3	96.7	54.8	85.5	2
Reef seines	67.8	49.2	63.3	58.3	25.0	94.4	39.5	79.7	3
Longlines	78.3	57.5	86.7	67.5	41.0	60.0	57.1	78.8	4
Spear	69.2	40.8	63.3	53.8	27.7	88.9	31.0	67.1	5
Beach seines	77.5	56.7	30.0	51.7	48.0	94.4	22.4	55.3	6

All the fishery types prioritized by the participants scored highly on criteria 6 (types of gears used), and criteria 1 (community participation), indicating that these fisheries use gears that are locally available, affordable, legal, repairable and environmental-friendly, except the beach seines that were indicated to be destructive, and that the fishery is operated mainly by local community fishers (Table 2).

The participatory resource maps indicated that catches within the seascape included a mix of demersal finfishes from the families Lutjanidae (snappers), Lethrinidae (emperors), Siganidae (rabbitfish), Scaridae (parrotfish), Acanthuridae (surgeonfish and unicorn fish), Mullidae (goat fish), Haemulidae (sweetlips) and Serranidae (groupers); octopus; and mixed pelagics such as jacks and trevallies (family Carangidae), tuna and mackerels (family Scombridae), barracudas (family Sphyraenidae), halfbeaks (family Hemiramphidae), dolphin fishes (family Coryphaenidae) and sardines (family Clupeidae) (Appendix 2 and 3). Species identified included *Lethrinus lentjan*, *Siganus sutor*, *Leptoscarus vaigiensis*, *Lethrinus mahsena*, *Lutjanus fulviflamma*, *L. argentimaculatus*, *Sphyraena barracuda*,

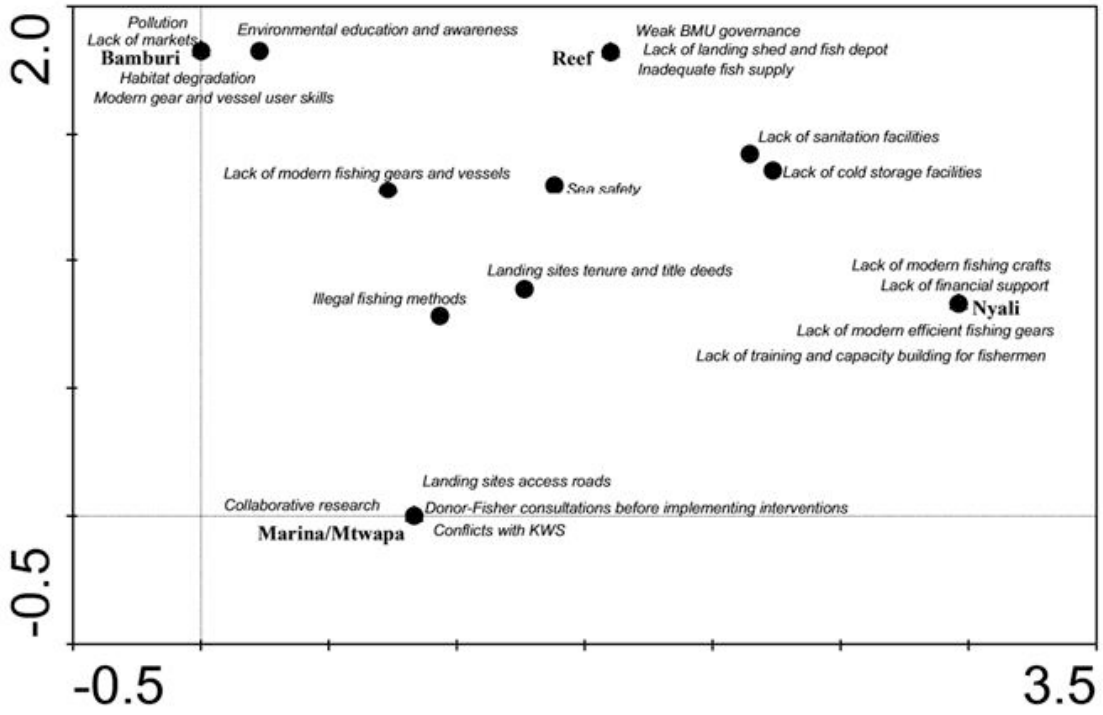

Figure 3. Spatial representation of the 22 management issues identified across the studied landing sites.

S. jello, *Hemiramphus far*, *Scomberoides tol*, *Plectorhinchus gaterinus* and *P. gibbus*.

Management issues

Pair-wise ranking of the various management issues showed a total of 22 management issues for all sites pooled (Fig. 3). Out of these, illegal fishing methods, lack of modern fishing gears and vessels, and lack of landing site title deeds were common across the three sites of Nyali, Bamburi and Marina/Mtwapa. The need for environmental education and awareness, lack of cold storage facilities, lack of sanitation facilities, and sea safety concerns were common issues across two sites (Fig. 3).

Discussion

This study utilized participatory rural appraisal approaches in the context of mixed methods research to examine fishery profiles and management issues in the Nyali-Mtwapa urban seascape in Kenya. The study broadly discusses marine aquarium, mixed demersal, mixed pelagic and octopus fisheries within this seascape that are targeted with a mix of gears relevant to each fishery type as prioritized by the participants in the FGD and KII.

Profiles for each selected priority fishery

Marine aquarium fishery

The Marine aquarium fishery was ranked highest based on criteria 3 that gears are locally available, easy to maintain and environmentally-friendly, and criteria 1 that local fishers are involved in it. The marine aquarium fishery in Kenya dates back to the 1960s, and since then it has grown in terms of volumes in numbers, species diversity, fishing effort, fishing grounds and trade (Draft Marine Aquarium Fishery Management Plan, 2016). This would be the reason why the fishery scored well on criteria 3 on participant perception that it had high production and catch trends. Marine aquarium products include live fish, invertebrates (soft corals, shrimp, and small clams), and coral rocks. Aquarium fishing is conducted by snorkelling in shallow depths of up to 3 metres, or diving using underwater breathing apparatus (SCUBA or hookah) in deeper depths. Barrier nets of varying mesh sizes and hand-held scoop nets are used to trap and collect the fish and invertebrates, while live rock is handpicked from the bottom. The organisms are temporarily stored in plastic buckets while in the water, and transported in oxygenated plastic bags to holding facilities. Among the targeted finfishes are wrasses, damselfishes, anthiases, blennids, scorpionfishes, angelfishes, surgeonfishes, gobies, butterflyfishes, dartfishes and pufferfishes. The main export market for live aquarium products from Kenya is the United States of America. Others include the European Union (dominated by Germany and United Kingdom), South Africa, Israel and Japan. Currently there are eight established companies exporting to 26 countries.

Up to 90% of the aquarium fish catches are collected from five main fishing grounds off Shimoni (33%), Kanamai (20%), Mtwapa (18%), Kilifi (12%) and Ukunda (5%) (Draft Marine Aquarium Fishery Management Plan, 2016).

Despite the benefits indicated, there has been an increase in resource use conflict reported between aquarium fishers and other artisanal fishers. According to Okemwa *et al.* (2016), 57 marine aquarium fish species were recorded in artisanal catches, dominated by wrasses making up 39%, and comprising of 19 species of which handlines captured the highest diversity of marine aquarium fish species and also had the highest resource interaction constituting 46% the total marine aquarium catches in relative abundance. This was followed by spear guns (26%) and basket traps (17%). Over-exploitation of target species has also been indicated, thus negatively impacting on the sustainability of the fishery. To address these management challenges, the Marine Aquarium Fishery Management Plan (2016) is being developed following the Food and Agriculture Organization of the United Nations (FAO) Ecosystem Approach to Fisheries (EAF).

Mixed demersal fishery

This study established that the resource users within the seascape still prioritized mixed demersal fishes as a mainstay for their livelihood. The fishery scored highly on criteria 6 and 3 indicating prevailing perceptions among fishers that the gears they use are readily available, affordable, and repairable, and that production trends are stable. These mixed demersal fish species are targeted by a broad array of gears including beach seines, small meshed gill nets, monofilament nets, spear guns, longlines, handlines, and basket traps. From 70-80 percent of the marine fish catches in Kenya is demersal, mainly from the inshore shallow water coastal habitats (ICAM, 1996; Matiru *et al.,* 2002). The catch composition of the mixed demersal fishery generally consists of a very large number of species with greatly varying sizes. A large number of juveniles are also recorded in the demersal catches (Hicks and McClanahan, 2012). The possible reason why this fishery scored negatively on environmental impact was due to beach seine effects. Catches normally include finfish of the families Lethrinidae (emperors), Siganidae (rabbitfish), Scaridae (parrotfish), Lutjanidae (snappers), Acanthuridae (surgeonfish and unicorn fish), Mullidae (goat fish), Haemulidae (sweetlips) and Serranidae (groupers). The inshore reef fisheries are generally considered to be at maximum sustainable yields, or over-exploited (Matiru *et al.,* 2002; McClanahan *et al.,* 2008b; Mangi *et al.,* 2007; Tuda and Wolff, 2015). Although diverse, about 75 percent by weight of the 15 most abundant landed demersal fishes is composed of 3 species, namely *Lethrinus lentjan*, *Siganus sutor*, and *Leptoscarus vaigiensis*. Other species include *Lethrinus mahsena*, *Lutjanus fulviflamma, L. argentimaculatus, Plectorhinchus gaterinus* and *P. gibbus* (McClanahan *et al.,* 2008b, Hicks and McClanahan, 2012). These species were among those identified through the participatory resource mapping exercise. These fish groups are experiencing intense levels of fishing pressure in the seascape; however, the status of the stocks remains minimally described. There are general observations that most of the populations are showing evidence of growth and recruitment overfishing (McClanahan *et al.,* 2008b). Contributory factors include the use of non-selective gears such as beach seines, which are well documented to capture high numbers of juveniles; up to 80% in some areas (Hicks and McClanahan 2012), and targeting of spawning aggregations of especially groupers and rabbitfishes. Use of beach seines is banned, however, this gear is still popular in Nyali and Marina landing sites despite efforts to curb their use. These conflicts between fishermen and the Kenya Wildlife Service (KWS) were identified as one of the management issues at Marina/Mtwapa. There is evidence of the need for management interventions to enhance compliance in the regulations on mixed demersal fisheries.

Octopus fishery

The octopus fishery was prioritized highly based on criteria 6, as it is cheap and easy to make spears and spear guns that are the main fishing gears used in this fishery. The octopus fishery in Kenya is dominated by the common octopus (*Octopus vulgaris*) which contributes the bulk of all cephalopods landed on the Kenyan coast, and is one of the most desirable octopus species for food and commercial purposes for the majority of fishermen (Kivengea, 2014). The octopus catches have been reported to show an increase from values of 49 metric tonnes in 1992 to values of nearly 290 metric tonnes in the year 2008, with some high peaks in octopus landings occurring in the same time period when finfish landings were at their lowest (Kivengea, 2014). This may be an indication that, due to poor catches of finfishes, fishermen turn to the capture of invertebrate species such as octopus, but this needs further investigations (Kivengea, 2014). There is need for further research and assessment of the octopus fishery for detailed stock assessment status. There are

no management interventions put in place specifically for this fishery, despite it being prioritized as important socio-economically in the studied seascape.

Mixed Pelagic Fishery

The mixed pelagic fishery was prioritized based on criteria 6 on perceived affordability, availability and maintenance of the gears involved, as well as criteria 1 on community involvement in the fishery. Mixed pelagic species are targeted by a variety of gears including reef seines, beach seines, small meshed gill nets, and longlines. The catch composition of the pelagic fishery generally consists of jacks and trevallies (Carangidae), tuna and mackerels (Scombridae), barracudas (Sphyraenidae), halfbeaks (Hemiramphidae), dolphin fishes (Coryphaenidae) and sardines (Clupeidae) (Munga *et al.,* 2016). In the Nyali-Mtwapa seascape this group was dominated by the small and medium pelagic fishes that include rainbow sardines, white sardinella, barred needle fishes, rainbow runners, trevallies, mackerel scads, chub mackerels, Indian mackerels, stripped bonitos, kingfish, queenfish, and great barracuda (pers. obs.). The full potential of small and medium pelagic fisheries along the Kenyan coast is not yet assessed. Consequently, these pelagic resources are assumed to be under-exploited due to lack of capacity of the artisanal fishers to venture far offshore.

The management of this fishery was initially captured in two draft management plans: the Draft Ringnet Fishery Management Plan (RFMP) (2013), whose broad objective was to enhance responsible exploitation of pelagic fish stocks through regulation of ringnet fishing practices that minimize resource use conflicts while providing long term biological and socioeconomic benefits; and the Draft Small and Medium Pelagic Fisheries Management Plan (SMP-FMP) aimed at management of the pelagic species to optimize social and economic benefits of the small and medium pelagic fisheries to the local community, national and regional economy, and to ensure long-term biological sustainability and ecological integrity of the pelagic fisheries, and develop and improve governance of the fishery locally, nationally and regionally. The Small Scale Purse Seine Fishery Management Plan (SSPSFMP) (2015) is currently under development. Its objectives include: regulating the small scale purse seine fishery in terms of catches, fishing effort, fishing grounds and trade; minimizing conflicts through capacity building of resource user organizations, benefit sharing strategies, licensing schemes, and environmental management; enhancing research and monitoring to support the development of optimum harvest strategies; improving the net income of small scale purse seine fisher communities and national revenues through value chain development and improvement; and developing mechanisms to enhance enforcement and compliance to prescribed measures for sustainable ecosystem management. These are emphasized in the current study due to the perceived importance of the fishery by the resource users within the seascape.

Priority fisheries and management issues

The findings of this study indicated both heterogeneities and homogeneities that exist in the priority fishery profiles over this short stretch of coastal urban seascape of the Nyali-Mtwapa system. This could be attributed to differences and similarities in resource use patterns by the users, as well as different or similar levels of local ecological knowledge (LEK). Similar findings were observed by Crona (2006), who indicated that differences in local ecological knowledge do occur even at small-scale level in coastal communities, although these have not been well studied to determine their interactions and associated outcomes. Likewise, LEK has been shown to be homogenous within Kenyan landing sites and may overlap groups of landing sites (Evans, 2010), as also indicated in this study. Points of consensus (homogeneity) and variance (heterogeneity) are important in adding value to the co-management initiatives in coastal Kenya since it entails integrated management where diverse stakeholder views, including trade-offs, are incorporated. This is because homogeneity amongst key individuals can often be a hurdle towards internalisation and recognition of changing ecological conditions (Bodin and Crona, 2008). Fishery systems that are open access and where multiple resource users exist would be characterised by scenarios where each user find ways to maximize utilization of resources for their individual benefit. Consequently, through participatory community processes, whose success is dependent on meeting practical needs, it was found that stakeholders within the seascape were mainly interested in ways of increasing their production and wealth, thus concurring with the study by Hirsch (1990), that changes in production relations may be linked with diversity among producers, emerging heterogeneity of interests, and the problems this produces for cooperative development interventions. There is therefore need to address observed heterogeneities among users as synergies are embraced in consensus towards improved co-management planning for fisheries management.

The priority fisheries identified through the participatory approaches are typical of those that have been studied in the seascape by various researchers over time (McClanahan *et al.,* 2008b, Mangi *et al.,* 2007, McClanahan and Mangi, 2001). These priority fisheries reflect the mixed species, mixed gear fishery of the Nyali-Mtwapa seascape as described and discussed in previous studies (McClanahan *et al.,* 2008a, b; McClanahan and Omukoto, 2011; Mangi *et al.,* 2007), thus resulting in the heterogeneity observed in the fishery. The participatory survey indicated a perceived mix of declines and stability of catch over the past 10 years for all the priority fisheries. This concurs with similar reports from previous studies that indicate these catches to be stable but with shifts towards the lower trophic groups such as the herbivores and detritivores (McClanahan *et al.,* 2008b).

The mix of artisanal fishing gears and techniques that included basket traps, handlines, beach seines, longlines, gillnets/set nets, monofilament nets, reef seines, spears, and spear guns were common across the study sites. The use of these gears and techniques is primarily driven by a range of geographical, contextual, financial and socio-cultural factors such as resident village, choice of landing site, financial capital, social networks, and age (Evans, 2010; Mangi *et al.,* 2007).

Management issues such as the landing of undersized fish and juveniles of other species were attributed to the use of deleterious fishing methods, especially beach seines, monofilament gillnets, undersized mesh gillnets and basket traps. Furthermore, the impacts of these gears on the habitats, amplified by environmental degradation due to pollution, were also among the key management issues requiring intervention. The issue of title deeds or entitlement to land ownership for BMUs remains critical in determining the stability and infrastructural developments for the fishers and BMUs.

Conclusions and Recommendations

The priority fisheries for the Nyali-Mtwapa system can be described at different levels depending on the method of resource extraction (different gear types and crafts), the target resource (fish species or groups) or a combination of the two. For management purposes and stock status assessments, addressing fisheries by species or species groups is advised. In this study, mixed demersals, mixed pelagics, octopus and marine aquarium fisheries have been broadly discussed within this seascape, that are targeted with a mix of gears relevant to each fishery type. The incorporation of these in co-management planning or for technical analysis purposes would be important. It was, however, noted that three main gears used in the seascape fishery (beach seines, monofilament gillnets, and spearguns), were illegal and therefore it is recommend that these should be the key focus of any future interventions, and a priority in co-management planning. While there are plans underway to finalize management plans for the marine aquarium fishery and the small and medium pelagics, the mixed demersal and octopus fisheries are still operational without management plans. There are a number of management gaps that require addressing in the selected priority fisheries. These include: fishery specific legislation and regulations; Monitoring, Control and Surveillance (MCS); development of the small-scale fishing fleets; addressing challenges in landing site ownership; and facilitating the training needs of fishers. It is recommended that the identified mix of both differences and commonalities in spatial variations in fishery profiles and management issues are incorporated in the co-management plans of the respective BMUs in Kenya, as added value to enhance legitimacy and acceptance of the co-management approaches and networks.

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Appendix 1. Modified Delphi questionnaire tool with a 5-point Likert scale.

The following criterion based on a scale of 1 – 5 is proposed for selecting priority fisheries profiles for the Nyali-Mtwapa Seascape based on stakeholders' consultation:

Criteria 1: Community Participation [Level are lowest (1) to highest (5)]

		Fishery types				
No	**Questions**					
i.	Are indigenous the main fishers involved in the fishery?					
ii.	Are the fish species eaten by the indigenous communities?					
iii.	Are women involved in the fishery?					
iv.	Are the youth involved in the fishery?					

Criteria 2: Income [Level are lowest (1) to highest (5)]

		Fishery types				
No	**Questions**					
i.	Does the fishery provide adequate income to the fishers?					
ii.	Does the fishery provide adequate income to fish traders?					
iii.	Is the fish traded beyond the local area?					
iv.	Does trading fish outside the fishing area give better income?					

Criteria 3: Production and Catch [Level are lowest (1) to highest (5)]

		Fishery types				
No	**Questions**					
i.	Do the fishers get enough catch on a daily basis?					
ii.	Have catches declined in the past 10 years?					
iii.	Are catches expected to be stable in the next 10 years?					

Criteria 4: Co-Management [Level are lowest (1) to highest (5)]

		Fishery types				
No	**Questions**					
i.	Is the BMU involved in managing the fishery?					
ii.	Does the BMU provide any services at the landing site?					
iii.	Is the BMU involved in marketing of the fish?					
iv.	Does the BMU have infrastructure for marketing?					
v.	Are there any illegalities in the fishery?					
vi.	Does the BMU participate in controlling these illegalities?					
vii.	Is the BMU effective in implementing regulations?					
viii.	Does the BMU collaborate with other partners?					
ix.	Are there clear management measures for the fishery?					
x.	Are legislations and regulations known to the BMU Assembly?					

Criteria 5: Ecosystem Impacts [Level are lowest (1) to highest (5)]

		Fishery types				
No	**Questions**					
i.	What is the intensity of fishing in the coral reefs?					
ii.	Does the fishing interfere with the corals?					
iii.	What is the intensity of fishing in the sea grass beds?					
iv.	Does the fishing interfere with the sea grasses?					
v.	Does fishing take place in the estuaries?					
vi.	Does the fishing interfere with the estuarine ecosystem?					
vii.	Does the fishery catch any juveniles of the targeted species?					
viii.	Does the fishery catch juveniles of non-targeted species?					
ix.	Does the fishery catch sea turtles?					
x.	Does the fishery catch dolphins and dugongs?					
xi.	Does the fishery catch sharks?					
xii.	Does the fishery catch rays and skates?					

Criteria 6: Types of Gears Used [Level are lowest (1) to highest (5)]

		Fishery types				
No	**Questions**					
i.	Are the gears used in the fishery available locally?					
ii.	Are the gears used in the fishery affordable? (probe for prices)					
iii.	Are the gears used in the fishery legally acceptable?					
iv.	Are the gears used in the fishery left in the sea or carried back to the shore after fishing?					
v.	Are the gears easy to repair?					
vi.	Do the gears last for a long time? (Durability)					
vii.	Are the gears frequently lost at sea?					

Criteria 7: Fishing Crafts Used [Level are lowest (1) to highest (5)]

		Fishery types				
No	**Questions**					
i.	Are the fishing crafts used in the fishery constructed locally?					
ii.	Are the fishing crafts used in the fishery affordable? (Probe cost)					
iii.	Are the fishing crafts used in the fishery considered seaworthy?					
iv.	Are the fishing crafts used in the fishery easy to maintain/repair?					
v.	Are the fishing crafts used in the fishery made of timber?					
vi.	Are the fishing crafts used in the fishery made of fibreglass?					
vii.	Are the fishing crafts used in the fishery made of metal?					
viii.	Are the fishing crafts propelled by paddles?					
ix.	Are the fishing crafts propelled by sail?					
x.	Are the fishing crafts propelled by outboard engines?					
xi.	Are the fishing crafts propelled by inboard engines?					