AN EVALUATION OF THE SOCIO-ECOLOGICAL IMPACTS OF FISHING IN THE MARINE ECOSYSTEM: A CASE STUDY OF MOMBASA MARINE PROTECTED AREA, KENYA

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Background

Marine ecosystems play an important role in people's livelihoods in many parts of the world. This is due to their ability to various goods and services that support people's livelihood. Marine ecosystems are complex and maintain a high degree of biodiversity (Dayton, 2002; Richmond, 2011) that are balanced despite the chaotic existence of life on coral reefs. Marine species interact and depend on each other for survival but if a disturbance alters the balance, it can result into an ecological imbalance. Natural and anthropogenic causes interfere with the ecological balance of marine life, and fishing is considered one of them.

In the Western Indian Ocean region rapid population growth and urbanization has been experienced especially in the Kenyan Coast which led to high rates of unemployment. Due to this, many people have opted to fishing as a last resort;- this has led to increased pressure on traditional inshore fisheries resources (Dayton, Thrush and Coleman (2002); Richmond, 2011) and this can contribute to altered ecosystem structure and function. In Kenya, fishing has been practiced for decades along the coast where intensive fishing occurs within marine reserves near Marine Parks. However, climate change impacts and other human induced stresses including coastal developments have had negative effects on fish resources and their habitats. More than 500 fishermen fish within the Mombasa Marine Reserve (personal observation) and most of them lack information and awareness regarding the marine ecosystem and fish population status which leads to devastating reduction in fish populations.

Marine Protected Areas are an effective management tool when it comes to conservation of biodiversity, including the maintenance of critical habitats and fish stocks. They are a spatial approach to marine management and conservation aimed at protecting and restoring multispecies assemblages and the structure and function of marine ecosystems (Micheli et.al., 2004).
The 1992 United Nations Convention on Biological Diversity (CBD) obligated; "each Contracting Party to, as far as possible and as appropriate: establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity", and affirms further that each State is responsible for conserving their biological diversity and using their biological resources in a sustainable manner (UN, 1992). MPAs have been established as a strategy of interest in fishery management and biodiversity conservation, with an observation that some of the 25% of world fisheries have been over-exploited or are recovering from over-exploitation (Louis et al 2006). Kenya is a signatory to the CBD and had already

established and gazetted a number of Marine Parks and Reserves for instance, Malindi marine Park and Reserve in 1968, Watamu National Park and Reserve in the same year, Kisite Mpunguti National reserve in 1972 and Mombasa Marine National Park and Reserve in 1986. These MPAs are designed in zoned schemes that entail two management regimes within their borders: park and a reserve (Tuda and Mohamed 2012). The Park is a “No-take” zone, meaning that no extractive activities such as fishing, mining, oil exploration and others are permitted (KWS, Mombasa Marine Management Plan, 1999-2005). However, recreational activities such as diving, snorkeling, surfing, jet skiing, swimming and boat excursions are allowed only if they are done in a manner that is not detrimental to the marine ecosystem. The end goal of this regime is to minimize anthropogenic impacts by preserving or protecting spawning and nursery grounds provided by coral reefs.

MPA targeted in this study has demonstrated efficacy towards reaching their goal to enhance ecological integrity and support local fisheries. Reports of increasing density and biomass in coral reef fish have been documented in numerous studies over the years (Humphries et al 2014; McClanahan et al 2007; Muthiga 2009). Mombasa Marine Protected area was gazetted to protect, conserve and manage marine ecosystem including corals, fish, invertebrates, starfish, sea weeds and grass, mangroves, and pristine beaches. Therefore to assess the performance of MPAs, ecological and socio-economic benefits are of importance to assess and monitor adequately as highlighted previously (Muthiga 2009).

Method

The Underwater Visual Census (UVC) methods, specifically line-belt transects technique as described by Kawaka et.al., (2016) were used to survey or assess ecological data sets (fish, benthic and invertebrates) for comparison between the park and reserve. At each sampling site, fish counts were done to minimize interference with fish behaviour and then followed by benthic and macro-invertebrate along the same transects. Identification of fish family groups was done using guides by Richmond (1997) and Denis King (1996).

To record habitat characteristics of a sampling site, a 10 meter transect tape was used to measure categories of benthic substrates on the seabed, recording all the major substrate groups observed to the nearest centimeter.

Socioeconomic data on fishers’ perceptions was collected through semi-structured interviews that used a pre-determined open- and closed-ended questionnaires.

Results

Results revealed that the overall fish family density in the Park (full protection) is higher than in the Reserve area (partial protection) especially on species of high commercial value and ecologically important fish groups. All the recorded macro invertebrate between Park and Reserve were found in low densities except sea urchins (Echinometridae) family that was in high densities in the Reserve than in the Park. Mean benthic substrates cover were calculated in percentages with high values of hard coral cover, macro algae, and turf algae in the Park and high percentages of coralline algae, bare rock, rubbles and sea grass in the Reserve were observed.

Fishing vessels used by most of the fishers are dugout canoes which limit them from going to deep sea hence few catches and fishing in the same site daily, meaning that most species are caught before they mature to reproduce.

Conclusion

Fully protected area showed ecologically healthy status as evident in higher coral cover, less macroalgae and abundant higher herbivore density/biomass. The reserve, however, appears to be in a poor ecological state, as evident by lower coral cover, higher macroalgae, higher abundance of sea urchins and lower fish abundance, particularly of herbivorous and commercially important fish groups.