



Potential for conflicts in recreational and artisanal billfish fisheries on the coast of Kenya

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ABSTRACT

The Western Indian Ocean (WIO) region is home to several species of billfish that are important ecologically as top predators and as a source of local livelihoods both within and outside the country's borders, thus targeted by multiple resource user groups. However, little attention has been paid to the characteristics of recreational and artisanal billfish fishers, and the potential conflicts that may arise in shared fishery resources in the Western Indian Ocean. Our paper examines the characteristics of recreational and artisanal billfish resource users, particularly the factors that often can lead to potential conflicts. We conducted semi-structured interviews with a total of 130 recreational and artisanal fishers at two study sites along the Kenya coast. We identified three primary drivers of potential conflict: perception of billfish as an open access resource, the competing uses, and internal and external issues related to fisheries governance. Some potential conflicts including social, ecological, governance and economic conflicts are discussed. These findings provide key insights about the complexities of multiple resource user groups and governance in exacerbating fisheries conflicts in this resource system. The findings also highlight the need to develop strategies to decrease conflicts, such as fisheries co-management, in the light of multiple billfish resource user groups and the species' ability to traverse various transnational boundaries.

1. Introduction

Billfish populations are highly depleted, yet various resource user groups continue to target the remaining populations [1–4]. The open access nature of many fisheries in regions where billfish occur compound the global decrease in existing populations, pointing to the need to better understand the characteristics of billfish user groups. However, relatively few studies have systematically examined the potential differences in user groups, including demographic traits, perceptions of and motivations for targeting billfish, how users participate in billfish fishing, and more general attitudes about billfish resources, especially in developing nations [5–7]. Given that many fisheries are facing collapse, the paucity of information on the needs of fisheries user communities may negatively affect the fish populations and the livelihoods of those who rely on them, resulting in conflicts between fisheries resource user groups. Understanding the differing needs of fisheries user groups is particularly critical for managing shared resources [8–10].

Conflict plagues the management of fisheries, especially when there

are many resource users. Sources of conflicts can be complex, multi-dimensional and diverse. Evaluating conflicts and the trade-offs required to resolve them can provide valuable insights into strategies for common-pool resource use and conflict mitigation. Fishery conflicts may be defined as internal and external incompatibility of opinion or interests arising from the use of a shared resource. Charles [11] categorized various types of fisheries conflicts: (i) internal conflicts arising from allocation of scarce fisheries resources between users in a system, (ii) internal or external management conflicts resulting from fishery institutional structures and (iii) external conflicts associated with direct or indirect competition between multiple resource uses. Arlinghaus [12] described two forms of conflicts in recreational fisheries. The first is user intra- and inter-sectoral conflicts, which refer to conflicts within and between user groups. The second is management conflicts, which may involve parties or management systems that are related to the fishery.

Intra-sectoral conflicts, like those between recreational and artisanal fisheries, may result from several factors. These include competition for limited resources and fishing grounds, the open access nature of most

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fishery resources, overexploitation, unequal distribution of benefits accrued from shared resources, social-cultural and demographic differences, fisheries management failures, threatened livelihoods, and food insecurity, among others [12–15]. Conflicts between artisanal and industrial fisheries due to ineffective formal management systems have been documented in Senegal and Ghana [16,17] and between recreational and artisanal sectors in Algeria [18]. In some cases, recreational and artisanal fishers overlap in fishing grounds, leading to conflicts due to competition for space as observed in Anegada Bay in Argentina [15]. Conflicts between the recreational and artisanal marine fisheries exploiting the same fish species have been documented in Italy [19]. Other studies show that fisheries conflicts are inter-linked with civil conflict and war, illegal fishing and over-exploitation, all of which may result in decreases in fish populations. Tanzania and the Lake Victoria Basin provide examples [20,21]. Fewer studies have focused on the factors that suggest potential for conflicts between recreational and artisanal sectors of billfish and other transnational fisheries resources in the Western Indian Ocean (WIO).

The objectives of this paper are to (i) examine the characteristics of the recreational and artisanal billfish fisheries and (ii) evaluate how artisanal and recreational billfish resources use can lead to potential conflicts. A theoretical framework for intra-sectoral conflicts forms the analytical scope of this study. We use a combined inductive and deductive approach to analyze the data from semi-structured interviews completed with recreational and artisanal fishers at two study sites along the Kenya coast. The present paper makes two significant contributions to the study of conflicts in open access shared fisheries among users and countries, particularly for transboundary species. First, we define key indicators of conflict between recreational and artisanal billfish fisheries, supported by evidence. Second, we describe potential pathways for fisheries governance frameworks to address and mitigate conflicts in the face of competing resource user groups.

Recreational fishing for billfish, also referred to as sport fishing or big game fishing, is practiced off the coast of Kenya. Major billfish fishing zones include fishing grounds off Watamu, Malindi, Kilifi, Diani, Shimoni and Lamu. Billfish occur year-round, but the period between October and March marks the peak billfish season comprised by the sailfish (November–January) and marlin runs (December–March). Periods of high billfish fishing for recreational fisheries coincide with the Northeast Monsoon (NEM) season. The recreational billfish fishery consists of private and charter sporting operations. Private sport fishing operators refer to recreational fishers that target billfish on a self-owned or rented boat on a seasonal basis mainly for leisure. Charter sport fishing operators consist of fishers that either own a boat or are employed on a boat and conduct for-hire fishing trips predominantly for income generation. Despite the prominence of big game fishing in Kenya dating to the 1950s [22,23], there are no current studies describing associated conflicts with other user groups. This paper provides a new approach to evaluating existing and future sources of conflicts between recreational and other fisheries resource user groups or potential importance in solutions to address and manage conflicts in the use of shared resources.

The artisanal fishery accounts for about 80% of the national fishing fleets along the Kenya coast [24]. A recent survey estimated a total of 197 artisanal fish landing sites and about 13,000 fishers [24]. The definition of artisanal fisheries varies between locations and countries, but these fisheries use relatively small amounts of energy and capital in Kenya and are often restricted to inshore fishing areas. The daily catch is mainly for household consumption, but in some cases this activity does generate income. Artisanal fishers use various fishing gears, such as basket and fence traps, wooden spears, and gillnets operated from small to medium size fishing crafts and vessels [25]. Most studies in Kenya have focused on the socioeconomic role and impacts of artisanal fisheries have been based on small and medium pelagic fisheries [26,27]. Fewer studies have explored evidence for conflicts in the use of fisheries resources among small-scale fisheries in the East Africa region [20,28].

There are major gaps in research in Kenya and the wider WIO region on how to identify potential sources of conflicts between different user groups in space and time. Limited information can impede managing fisheries and contribute to conflicts over shared resources.

The remainder of this paper is organized as follows: Section two provides a detailed description of the methodologies used for this study of the relationships between billfish resource use and the potential to develop conflicts between recreational and artisanal fisheries on the coast of Kenya. Section three presents the results and discussion while section four concludes with recommendations.

2. Materials and methods

2.1. Study site selection

The study was conducted at two study sites (Malindi and Watamu) situated in Kilifi County on the Kenya coast (Fig. 1) where most sport fishing tournaments in the region take place, which is reflective of the number of sport fishing operations in the area and billfish presence throughout the fishing season [29]. Most recreational charter operators belong to sportfishing clubs that are members of the Kenya Association of Sea Anglers (KASA), an organization that represents private and charter sportfishing captains. The Malindi Sea Fishing Club established in March 1959 is the oldest sport fishing club in East Africa. The sites have a high proportion of artisanal longline and gillnet (bottom-set and drift) fisheries that capture a variety of target and by-catch species including billfish [24]. Six billfish species that occur in the Indian Ocean are caught directly or incidentally by recreational and artisanal fishers in these two study sites [30,31]. The species include the blue marlin, black marlin, striped marlin, sailfish, swordfish, and the short-billed spearfish, although the latter species is rarely reported in catch records.

2.2. Research design

A multiple case study design was used because case studies allow a detailed analysis of not only *what* happens in a given set of circumstances, but also an examination of the context and processes that affect the outcomes in the phenomenon under study [32–34]. Case studies are increasingly used to understand natural resource management and conflicts over natural resources [35–37]. The exploratory case study is an appropriate design when a researcher wants to understand “how” and “why” one or more outcomes evolve over time or through complex interactions [34]. This study focuses on understanding how the artisanal and recreational fishers use billfish in Kenya, how they differ with regard to objectives and values, and how the two sets of users interact over time and space.

Artisanal and recreational billfishers comprise two separate populations in this study, defined in the existing literature based on critical differences in how the two utilize the billfish resource. Basing our study on the existing body of work that has characterized these two types of user groups, generally referred to as theoretical populations in the social scientific literature, establishes the populations to which we can extend the conclusions that we draw from this research [38,39]. The first theoretical population is the artisanal fishers who are defined as those fishers that predominantly catch fish for consumption. The second theoretical population is the recreational fishers who mainly catch fish for leisure, competition or as a social activity. The accessible population where we sampled is limited to fishers that operate in Malindi and Watamu areas. For purposes of generalizing the conclusions of any study, regardless of whether data are analyzed quantitatively or qualitatively, an accessible population must share critical traits with the theoretical population. The two target populations closely resemble those found in other fishing areas along the Kenya coast such as Kilifi, Mtwapa and Shimoni and are typical of fishery user populations in developing nations in Asia and Latin America [5,40].

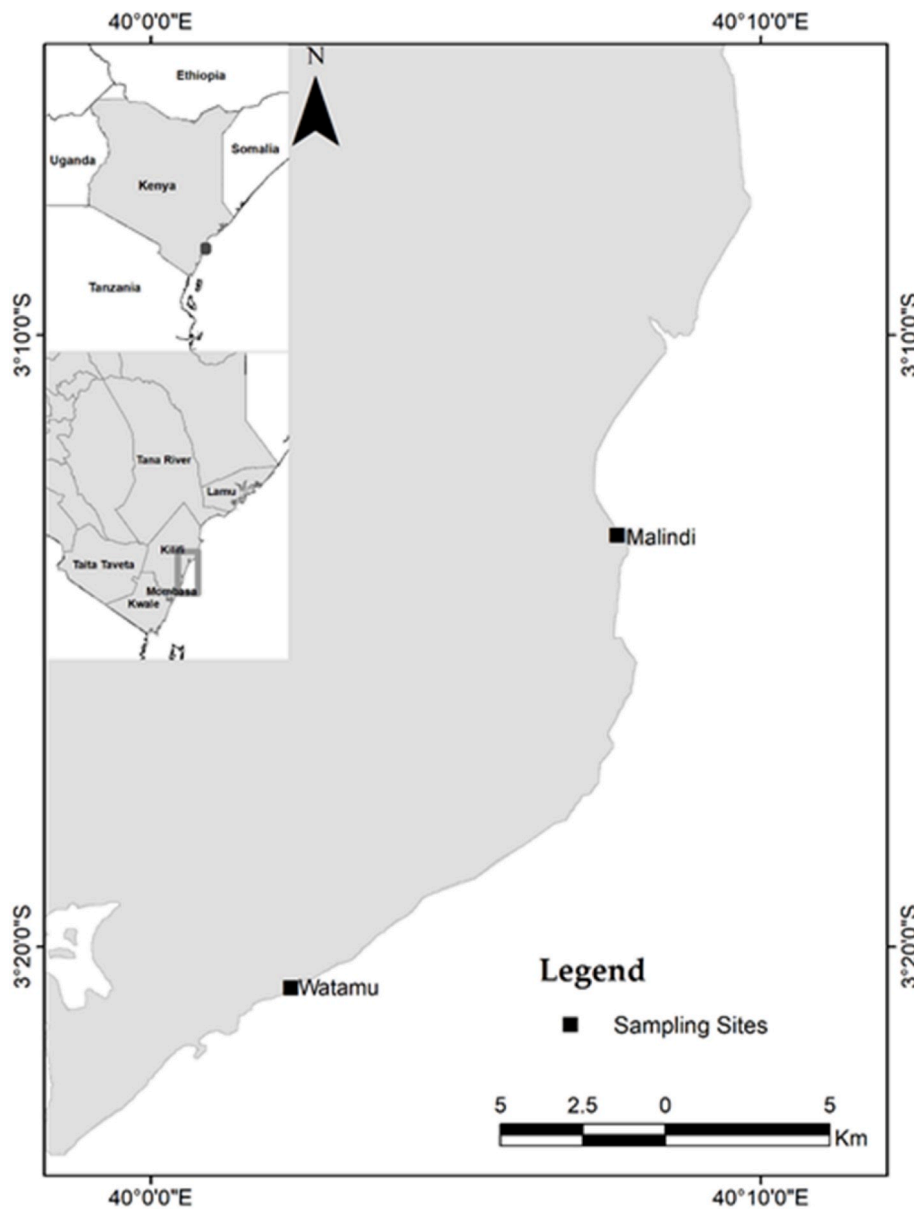


Fig. 1. Map showing the location of the two study sites, Watamu and Malindi in Kilifi County for sampling recreational and artisanal fisheries, with inset of Kenya and Africa.

2.3. Sampling method and sample collection

Respondent-driven sampling was used to identify potential participants for this study. This is a non-random sampling technique used when there are no reasonably accurate lists of the members of the accessible population(s) of interest, the case for this study. A sampling frame, a roster of the members of a group to be sampled, are a requirement for all probability samples. However, such lists are often either inaccurate or do not exist. Alternatives to the classic random sample are therefore necessary. Volunteer samples where the prospective participant seeks enrollment in a study and purposive or judgmental samples where the researcher uses in-depth knowledge about members of the accessible population to select specific individuals to participate in a study are examples.

Respondent-driven sampling (RDS) is a distinct approach to sampling that has evolved from the better-known snowball sampling approach [41]. In RDS, potential participants that meet the selection criteria for participation in a study are first identified by key informants, individuals external to the population who can identify members of the

target population [42]. The individuals in the target population who are identified and agree to participate in the study constitute the first tier or wave of respondents. The researcher requests each participant in this tier to identify additional potential respondents, who then comprise a second tier or wave of respondents. They then identify a third tier of respondents, and so forth. The degree to which RDS produces a sample that is representative of the target population when compared to random samples or censuses depends on a number of factors. These include variance in the population, the quality of the initial references (seeds) provided by non-participants, the number of individuals that each participant provides, and the resources available to the researcher to continue the referral process [43].

We employed several recommended procedures to reduce the potential bias that is an inherent threat to all non-probability samples [44–46]. We relied upon individuals who are highly knowledgeable of the billfisher population in the study area and called upon written records to identify the first tier of respondents to the degree possible. We took care to identify sub-populations that might be excluded from the sample because they were unknown or had limited interactions with the

initial external referents. We did identify one sub-population that had been excluded and sampled this sub-population. We continued the referral process until we reached equilibrium meaning that no or few additional participants could be identified, which is an indicator that bias in the original set of participants identified (tier 1) is no longer reflected in the sample [47].

Identification of the key informants [42] who provide the list of names for the first tier of sampling is critical in RDS. Bias at this step can persist throughout the extended sampling process. The key informants that provided us with contacts for tier 1 sampling included representatives of artisanal groups (also referred to as Beach Management Units (BMUs), fisheries managers and researchers, and non-governmental organizations. For example, the African Billfish Foundation (ABF) provided information about recreational fishers who targeted billfish based on the tagging records. For artisanal fishers, BMU officers or members knew which fishers predominantly landed billfish. From the ABF tagging database, it was also possible to identify the areas where billfish were landed, and fishers who caught billfish based on the tag-recapture information. Fisheries managers in-charge of both Watamu and Malindi advised on the landing locations where artisanal fishers aggregated.

The first tier of participants (Appendix 1) in the recreational fisher community consisted mostly of charter boat captains or crews of boats that fished for pleasure. They were predominantly of British extraction, but also included some Kenyan crewmen employed on charter fishing boats and recreational fishers who did not participate in the tagging. For artisanal fishers, the first tier consisted of respondents who were aware of the ABF tagging program through reporting recovered billfish tags and some were involved in the ABF education program. Most were Kenyan and from Kilifi County. They owned small boats through cooperative arrangements or were crew on artisanal boats. These traits of respondents remained constant throughout the sampling process. Two potential sources of bias emerged and were addressed. The first tier of artisanal fishers were aware of the billfish tagging program, which could affect their practices, and we therefore extended sampling in tiers two and three to include respondents not familiar with the program. The recreational fishery exhibited social clustering based on the national origin of the captains and fishers. We therefore took care to include a variety of meeting places and venues to reduce potential bias due to national origin. Sampling terminated for both recreational and artisanal fishers after three conditions were met: (1) repeated attempts had been made to reach all of the individuals referred to us in all three tiers, (2) few new names emerged in the referrals suggesting that we had identified a very large proportion of the population of interest, and (3) little new information or understanding was emerging from the final respondents contacted in tier three.

A semi-structured interview guide developed in English and in the local Swahili language was used to collect the data. While the study had specific topics that needed to be covered, semi-structured interviews provided flexibility where the researcher was able to probe based on the responses provided by respondents. In addition, semi-structured interviews provide flexibility for respondents to provide further details of information which improves the richness and quality of the data [48, 49]. The questions focused on fishers' motivations and perceptions for catching billfish, opinions of current management actions, opinions about challenges affecting the billfish fishery, and perceptions about the future of billfish fishery. Interviews were carried out between June 2016 and April 2017 in the two study sites. Individual interview duration ranged from 45 to 60 min. Most of the artisanal interviews were carried out at fish landing sites whenever fishers returned from a fishing trip while most recreational fishers' interviews took place at the gantry (fish weigh-in place) or a local social venue. In some cases, interviews were conducted in places preferred by the respondents such as their homes and community school.

2.4. Sampling size, composition and response rate

In total, 63 recreational and 67 artisanal fishers were interviewed. In addition to the steps taken in sampling to ensure that the sample is robust, we relied on Malterud et al. [50] concept of information power to guide sampling and the nature of the conclusions that we can draw. Malterud's approach incorporates five components that decrease required sample size in case studies: (1) A more narrowly defined aim for the study, (2) a theoretical basis for the research, (3) extensive knowledge or experience among respondent regarding the topic of the study, (4) quality of the dialogue, referring to the degree to which researcher and respondent share experiences and knowledge relevant to the topic of the research, and (5) the use of explanatory, cross-case designs in which the researcher focuses on understanding how and why rather than simply describing a set of conditions and outcomes. Our study design meets all five criteria and the sample size we acquired is far higher than the small sample sizes (10–20 in most cases) normally considered adequate for studies that do meet these criteria. The data represent the responses of all of those who agreed to participate in the study. Although the overall response rate (the number of people who completed the interviews divided by the total number of people approached for interviews) was high, 90%, some participants were reluctant or unwilling to provide information pertaining to their fishing operations. Hence, only complete answers were considered in the analysis to minimize non-response bias. Respondents in both fisheries were predominantly male, 67% between 21 and 45 years of age, 19% more than 45 years of age and 9% less than 20 years of age. Mean age for recreational respondents was 39 years compared to 33 years for artisanal fishers. All artisanal fishers were male as were 94% of recreational fishers. The average years of fishing experience differed slightly, a mean of 18 years for recreational and 15 years for artisanal fishers.

2.5. Data analysis

There are numerous techniques for qualitative data analysis [51], although some general procedures are common to most analyses [52]. This study used a four-step process. Step one was the development of many highly specific codes extracted from the actual comments made by each participant [52,71]. For example, some respondents mentioned that anyone should be able to catch billfish. In this case, the code "ALL-CAN-CATCH" was used to reflect the content of the response. Some respondents said that anyone with a fishing license should be able to catch billfish, which was coded "ALL-CAN-CATCH-LIC". Over 200 codes were generated in this first phase of the analysis. In step 2, codes that reflected the same or very similar ideas were assigned to categories that reflect the key concept or idea shared among the individual codes from step 1 [48,53,54]. For instance, several codes referred to procuring food as a motivation for catching billfish. The codes were grouped together to form a category called "Importance of billfish as a source of food". A total of 14 categories were generated (Table 1). Steps one and two relied on inductive reasoning, e.g., the codes derived from the data. In the third step the categories were refined and grouped into three overarching themes representing larger conceptual frames [55]. This is a deductive process because many of the themes are based on the theoretical concepts that informed the research, although identification of unanticipated or emergent themes remained inductive [48]. Emergent themes provide unexpected and additional information that may not exist in the literature or theoretical concepts that underlie a body of knowledge. The fourth step involved creating models that show how billfish resource use affects the potential for conflicts. Models provide an understanding of the research question by showing the relationship between factors and are similar in concept to the structural models that result from statistical data analysis [53,56].

Table 1

Categories associated with the topic of ‘how recreational and artisanal fisheries use billfish, and perceived causes of potential conflicts arising from these uses’ and examples of responses and corresponding level two quotes.

CATEGORIES	TYPE OF THEME	EXAMPLES OF RESPONSES
Importance of billfish as a source of food	Theoretical	Respondents noted the use of billfish as a source of food Species such as sailfish could be smoked to provide a source of protein Landing a marlin could feed as many as twenty people
The open access nature of fishery as a source of conflict	Theoretical	Some respondents mentioned that anyone should be allowed to catch billfish Other respondents mentioned that access to fishing should be regulated
Resource use conflicts	Emergent	The perception that billfish should be predominantly recreational The perception that billfish should not be tagged and released as it contradicts the need for food Space and time overlap resulting to conflicts in fishing grounds and over access to same resources
Contribution of billfish to community livelihoods	Theoretical	Capture of one marlin by a provided adequate income for a day’s fishing Present of billfish supported local economies by provided jobs to crews and other beneficiaries in the value chain
Socio-economic contribution of billfish	Theoretical	Recreational fisheries provide employment to crews and other beneficiaries in the value chain Billfish are a tourist attraction and their reduction pose a serious threat to local economy Many of the old captains have closed business, and the other left to Cape Verde Presence of local market for billfish meat contributing to income generation Potential of developing the recreational fishery as a viable income generator
Challenges in fisheries governance	Theoretical	Regulations on billfish landings and licensing were a source of conflict Some respondents lacked licenses to fish Over-regulation of the billfish fishery is a challenge particularly where participants were required to obtain multiple licenses High cost of fishing due to increasing costs of fuel, maintenance and regulatory measures such as licenses
The billfish fishery is overfished	Theoretical	Billfish catches have declined drastically Fishing number of participants in the fishery have increased over time Emergence of medium to high powered artisanal vessels which outnumber recreational boats Increasing pressure on the billfish fishery
Migrant fishers impact billfish populations	Emergent	The Pemba fishermen are unlicensed and unregulated The landings by especially sailfish are unregulated
Issues relating to national/ maritime security	Emergent	The issue of piracy in the Northern border negatively impacted tourism which in turn directly affects the recreational fishery Many recreational boats have closed business or transferred to other areas

Table 1 (continued)

CATEGORIES	TYPE OF THEME	EXAMPLES OF RESPONSES
		due to the safety and unavailability of fishing clients Hotels that used to support recreational tourism have closed or reduced their operations due to piracy and insecurity incidents Insecurity issues resulted in travel bans which affected the recreational/sport fishing industry
Subsidies required to improve fishery and offset fishing cost	Emergent	Some respondents wanted to be subsidized with larger boats and modern fishing gear Some respondents mentioned that the over-subsidization of smaller boats “dinghies” was a cause of competition and billfish decline
Contradicting and differences in billfish resource use	Theoretical	Tag and release in recreational fisheries contradicted belief of fish as a “God-given” food Other respondents viewed tag and release as disrespectful to God and waste of food Some respondents expressed prevailing conflict where one party releases billfish while the other party kills Conflicts arising from who conserves billfish and who does not Respondents from each side felt that the other had the most negative impact on the billfish species
The impact commercial fisheries	Theoretical	Respondents mentioned the negative impact of commercial/ industrial fishing fleets Perception that commercial fisheries were fishing the billfish population down
Technological development in the artisanal fishery	Theoretical	More artisanal fisheries are switching from traditional fishing vessels to powered boats Increase in opportunities to fish in the same areas as recreational fishers thus potential for spatial conflict
Political instability	Emergent	Respondents mentioned the declining catches resulting from increasing number of fishing vessels concentrated in the same areas Political unrests within the country contributed to decline in the number of tourists and thus fishing tourism

3. Results and discussion

The results of the 130 semi-structured interviews we conducted show that artisanal and recreational fishers use the same resource for different ends (Fig. 3). The study also shows that resource use influences the potential for conflicts between artisanal and recreational billfish fisheries. Below, the first section describes the three main themes generated from the semi-structured interviews and links the themes to potential sources of conflicts in the recreational and artisanal billfish fisheries (Fig. 2). The second section details the conceptual framework for the four types of conflicts identified (social, economic, ecological and management conflicts) and identifies the causes of potential conflicts (Figs. 4 and 5).

3.1. Sources of potential conflicts between recreational and artisanal billfish fisheries

Overlap in resource use, conflicting fisheries management structures and the open access nature of the billfish fishery were commonly

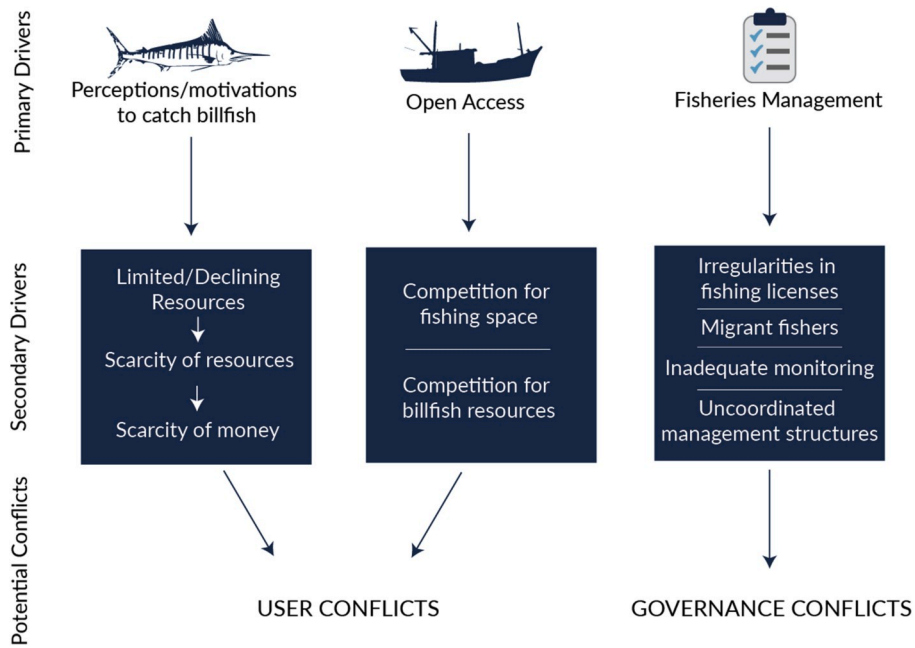


Fig. 2. A framework of primary and secondary drivers of potential conflicts in recreational and artisanal billfish fisheries.

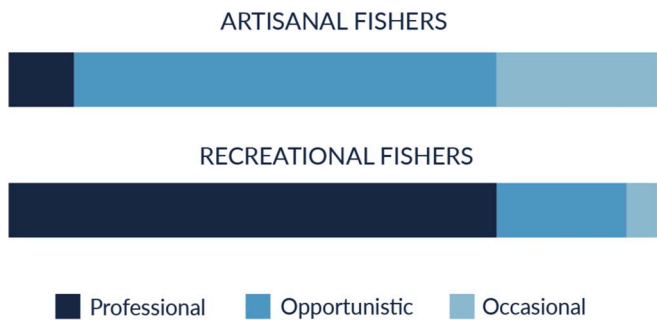


Fig. 3. A representation of three categories of billfish resource exploitation between recreational and artisanal fisheries.

articulated as causes of potential conflicts among the respondents (Fig. 2). Overlap in resource use between recreational and artisanal fishery resulted in competition for species such as sailfish and marlin, which are considered as “bread and butter” for sport fishers and “a good fishing day” for artisanal fishers. In addition, overlap in resource use led to competition in fishing grounds. Notably, most respondents reported a decline in billfish resources which made it difficult to catch billfish and thus affected income. The study also revealed contradictory fisheries management strategies as a driver of potential conflict between recreational and artisanal fishers. Most notably, there were differences in the licensing systems for the two groups. Licenses for recreational fishers were restricted to ‘fishing for pleasure and no sell of catch’ while the

artisanal fishers’ license is not restrictive, which allows them to sell their catch or use it for consumption. Inadequate monitoring of both internal and migrant fishers together with uncoordinated management structures also contribute to potential conflicts. Taken together, the drivers of open access and motivation to catch billfish resulted in potential user conflicts, while governance conflicts resulted from irregularities in law enforcement and weak fisheries management structures. The following section explores in detail the primary and secondary drivers of potential conflicts.

3.1.1. Theme 1: conflicts between recreational and artisanal fishers over billfish resource exploitation

This study revealed overlaps in billfish resource use between artisanal and recreational fishers that fall into three categories based on the degree to which the two groups target billfish (Fig. 3). The artisanal sector consists of opportunistic, occasional and professional categories, of which the opportunistic category is largest. Opportunistic fishers own their own small boats and sometimes catch billfish for sale or consumption during periods of abundance or by chance when fishing for other species. The occasional recreational fishers comprise about one-fourth of the artisanal sector. These fishers switch from artisanal to recreational charter fishing when there is an abundance of tourists looking for inexpensive charters. Their clients consist of tourists who are interested in fishing, but only if they can do so at a lower cost than that of a standard recreational charter. The professional artisanal billfish fishers mainly landed billfish for sale, especially during the high fishing season, unlike the recreational fishers who mostly practice catch and release. For example, the migrant fishers from Pemba in Tanzania

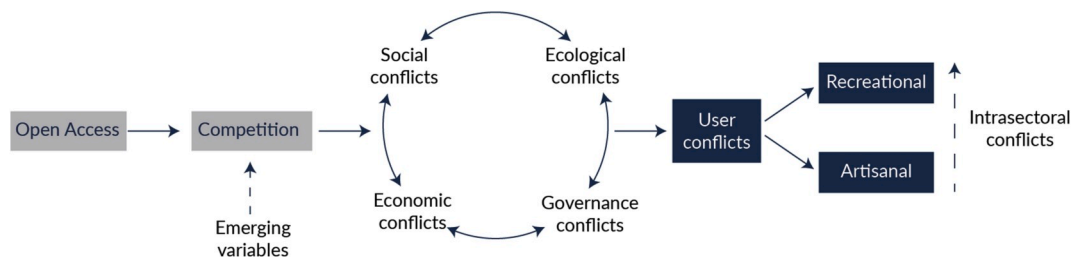


Fig. 4. Comprehensive framework showing sources of intrasectoral conflicts in recreational and artisanal billfish fishery in Malindi and Watamu.

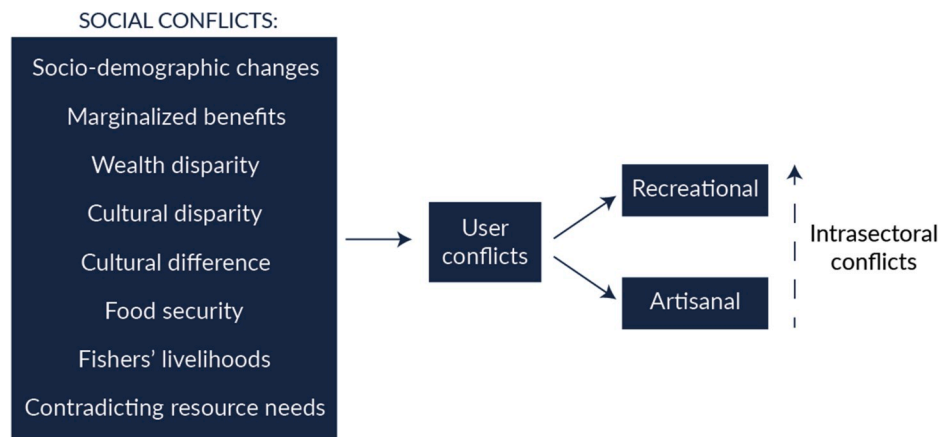


Fig. 5. Conceptual framework displaying sources of sociological conflicts in recreational and artisanal billfish fishery in Malindi and Watamu, located in Kilifi County, Kenya.

specifically target billfish in Kilifi and Watamu, making it available for sale at local fish shops (Kadagi, pers. obs).

The recreational sector also consisted of the same three categories of professional, occasional and opportunistic fishers. Professional recreational fishers comprised three-fourths of the recreational group. This category operated as recreational/sport fishing charters on for-hire charter boats or their boats. The primary source of income for professional recreational fishers was from sport fishing tourists who charter for either half or full-day trips. The occasional fishers go out a few times within a fishing year or season. This category of recreational billfish fishers consisted of individuals who owned private boats ranging from small to medium sized and are either self-operated or have a captain for short periods of time. The fishers in this category of recreational billfish fishing were either family members or friends who predominantly fish for leisure. The opportunistic recreational fishers consist of those respondents who were largely involved in fishing tournaments and competitions. These fishers mostly conducted their fishing during periods of high fishing activity, especially on weekends and during holidays when most fishing tournaments and competitions are held.

While the current literature presumes only two groups of billfish users, artisanal and recreational billfish fisheries [5,6], we found that there are three categories or sub-groups of billfish fishers within each of the two distinct billfish fishing populations. Further, these three categories in the artisanal and recreational fisheries overlap within each type of fishery and within each as well. That is, both artisanal and recreational fisher groups can be classified into three categories (Occasional, Opportunistic and Professional billfish fishers) and the members of each category or group may not be completely distinct at any point in time. This reconceptualization of two actor groups into three categories based on motivation and how frequently they fish reflects the finding that individuals' reasons for targeting billfish can differ for recreational and artisanal fishers, fish as sport catch or fish as food. Nonetheless, the similarities across these two types of fishers in each of the three categories makes it problematic to treat the recreational and artisanal billfish fishers as independent groups, particularly in terms of development of management schemes and fisheries policy. The different categories of users may have several implications for billfish fishers, especially when they simultaneously capitalize on the same resource. It is possible that the overlapping traits of artisanal and recreational fishers may generate competition for the same resource and have a direct effect on the billfish stocks. These findings build upon a previous study that demonstrated the presence of competitive interactions between recreational and artisanal fisheries [57]; *in review*).

All fishers perceived billfish as a critical source of income. For recreational fishers, the economic benefits of billfish also extended to other associated businesses, such as tourist hotels, travel companies and

fishing tackle shops. However, the communities of Malindi and Watamu were affected by the changes in the billfish fisheries, particularly the decrease in sailfish numbers and reduction in the number of game fishing tourists. The availability of fish and fishing clients has reportedly had an influence on the surrounding entities that directly benefit from billfish fishing as a sport. Respondents among the recreational fishers often said that the decrease in sailfish over the past seven years has led to closing sport fishing businesses and related business entities. A recreational respondent stated that, "The sailfish have declined in number - used to be the breadbasket of Kenyan fishery. You see there is no domestic marketing for charters and most of the people are going out of business." For artisanal fishers, the sale of landed billfish generated benefits in that it provided income for crews. Artisanal respondents cited, for example, "It is a good catch because we are able to sell it to the local hotels and market and get income", and, "Billfish fetch good money especially when I get a marlin, it is enough to pay crew shares and costs of running the boat."

The importance of billfish as a food source was more pronounced within the artisanal fishing population. The perception of artisanal fishers about catch and release differed greatly from that of the recreational fishers who use the practice. This is another potential source of conflict based on the differing needs of resource users. One respondent noted that, "We cannot throw them back to the ocean like the sport fishers do. It is like playing with food." Some artisanal respondents felt that billfish should be landed and not released back into the ocean: "You see if you tell us that billfish should be recreational, it is not possible. People need to eat. Those guys catch fish and throw it back. What is the point of struggling then you let it go?" On the contrary, some respondents in the recreational sector supported the catch and release of billfish, stating for example, "I think we tag and release - most of us, but the guys on the other side kill everything." The artisanal fishers perceived catch and release as 'throwing away food' and 'disrespect for God-given food'. Recreational fishers who practice catch and release regarded landing billfish using artisanal fishing gear as detrimental to billfish stocks and the reason for decline in the number of billfish species over the years. Billfish play a significant role in the economic security of fishers who depend on either recreational or artisanal billfishing for their livelihoods, whether fishing is for food, income or enjoyment. Unabated resource depletion can threaten these uses of billfish. Dwindling resources increases the potential for conflict due to competition, as has occurred in several fisheries [58–60].

3.1.2. Theme 2: potential for conflict arising from open access nature of the billfish fishery

Most respondents viewed the billfish species as a common-property resource that should benefit everyone as a source of food, enjoyment

and income. Nonetheless, some respondents among the artisanal and recreational populations also indicated potential sources of conflict arising from the shared resource. There were differences in the perception of who should catch billfish and who is responsible for the negative impacts on billfish populations. A recreational respondent stated, for example, “Anyone could catch billfish - you see it is hard to stop the commercial guys. They have really hammered the population.” This response indicates that although it is apparent that anyone can catch billfish, there is a need to be specific about the type of fishers. Another recreational respondent stated for example, “It is not possible to restrict billfishing. I think anyone can fish for billfish, but it must be known whether the fishing is commercial or recreational.”

Artisanal fishers want to catch billfish though they did not perceive prevailing negative implications on the billfish stocks if everyone caught billfish. One artisanal respondent cited that, “Anyone should be allowed to catch billfish – you see, it used to be just the canoes and now we have the boats that can go to further grounds.” The perception that everyone can catch billfish is also evident where artisanal fishers feel billfish should not be predominantly for sport. For instance, another artisanal respondent stated, “We all are fishermen whether on big boats or small boats – and we can catch billfish. So why would it be just sport fishing?”

Competition for billfish was associated with the open-access nature of the billfish fishery. The recreational and artisanal billfish fishers seemed to compete for the same resource, but their motivations for fishing differed. Respondents from the recreational population often wanted billfish to be primarily a gamefish species. Competition for billfish occurred in cases where recreational fishers felt that billfish were also being landed by other user groups. Alternatively, artisanal fishers had dissimilar views regarding treating billfish mainly as a sport resource and cited the benefits of landing a marlin as a ‘very good day,’ especially in the periods of low yields for other fish species. “There is a market for billfish meat – marlin fetches 250 Kenya shillings for a kilogram. So, on days when we catch one big one, we make good money.” In some cases, artisanal fishers trailed recreational boats because they know that billfish may be released or because the recreational boats may lose a fight with a billfish, which makes the fish vulnerable and much easier to catch. Interestingly, the presence of artisanal fishers in the vicinity of recreational fishers was perceived to increase the chances that an artisanal fisher could catch a billfish that is exhausted from the fight with a charter boat.

Billfish as a shared resource has the potential to generate user conflicts. These conflicts can be related to perceptions of ownership. For example, who should catch billfish? – Are billfish just for sport or for other users as well? The perception that the declining billfish resource base is caused by the ‘other’ user group is apparent.

3.1.3. Theme 3: fisheries management as a potential source of conflicts between the two sectors

The issue of fisheries management was highlighted as a source of potential conflict based on internal and external factors. Internal factors were related to the inconsistency in the fisheries licensing system and lack of regulations regarding the number of fishers or boats, while external factors were associated with the problem of unregulated migrant and commercial fishers. The recreational fishers are licensed to fish for pleasure and therefore cannot sell any catch they make. The artisanal fishers’ license is not restrictive, and hence they can sell their catch or use it for consumption.

There seemed to be a consensus among recreational fishers that the billfish fishery needed to be regulated particularly in terms of the growing number of users. As cited by several recreational respondents, “It needs to be regulated and perhaps proper licenses. Need to check who raises what and where it is taken – there is a market for smoked sailfish, and it is also locally sold.”

Respondents noted that the fishery was overcrowded and overfished because of migrant fishers, primarily from neighboring Tanzania, stating that, “but it is not easy to regulate the fishery – they can’t stop Pemba

fishermen in Kilifi – how now would it work for billfish? Maybe if they monitored the licenses? But you see anyone can just fish,” and, “There are times when Pemba fishermen are here. There is not much to catch.” Some studies have explored the dynamics of migrant fishers on the coast of East Africa [61,62]. These studies found that certain landing sites ranging from Mozambique to Kenya receive a large enough number of migrant fishers to create an impact on governance measures, the ecology of the resources, and the economic impacts of effort invested in fishing, all of which generate conflicts with the local fishers and authorities. The migrant fishers used their indigenous knowledge on oceanographic processes and reproductive biology of fishes to exploit the fishing grounds, resulting in high catches of target resources [63]. The impacts of migrant fishers on the recreational and artisanal billfish fishery was not surprising.

The differences in the licensing stipulations, especially when artisanal fishers can land billfish whether they are local or migrant, is likely to be a source of potential conflict [14,64]. Thus, the motivation of the fishers and management requirements can exacerbate the potential conflict for shared resources. Conflicts resulting from the governance of fisheries are worthy of attention, especially for billfish species caught by different resource users from different nations. The perception that ‘someone needs to regulate the fishery or provide licenses’ without explicitly stating who that person or entity should be points to the reliance on traditional ‘top-down’ management approaches used in many fisheries. The discord regarding use of billfish suggests the need for a localized management approach that incorporates collaborative strategies and strengthens institutional capacity in order to reduce conflicts. These findings add to the body of evidence that conflicts associated with governance of fisheries may have negative consequences on the social, cultural and economic well-being of resource users [65].

3.2. Conceptual framework for understanding sources of potential conflicts

A framework that illustrates an integrated approach to understanding sources of potential conflicts in recreational and artisanal billfish fisheries was developed. The main types of conflicts included social, ecological, economic and governance conflicts which are multidirectional (Fig. 4). Although conflicts between recreational and artisanal billfish fishers can be a result of any of factors belonging to the four major categories, the potential for intrasectoral conflicts increases when the four occur in conjunction.

The primary driver of these complex interactions is the open access nature of the billfish fishery. Our study revealed that the perception that the billfish fishery is a common pool resource increases the demand for fish, which stimulates competition. Other factors classified as ‘emerging’ based on the respondents’ insights were also likely to increase competition. Such emerging factors include the influence of industrial fishing fleets, increasing fishers, gear and technological advances, type of fishing vessels, and migrant fishers. Further, open access combined with competition and the other emerging factors could result in multiple forms of potential conflict that we define as social, ecological, economic and governance. Overall, both internal and external factors can play a role in generating the four types of conflicts we identify. Internal factors comprise of a variety of characteristics within the recreational and artisanal fisheries (e.g., preferences in resource type and competition) which may result in potential conflicts. External factors refer to outside influences (e.g., effect of other sectors, political changes, and maritime security) that may impact the potential for conflicts in the populations of study. Although there have been no studies on conflicts specific to billfish fisheries in the WIO region, these findings are consistent with previous studies in Italy and Argentina, both of which identified fisher competition for resources and space as primary drivers of conflicts between artisanal and recreational fisheries [15,19]. Conflicts between fisheries are also related to factors such as demographic change, cultural differences, threatened livelihoods, declining fish populations and

socio-political factors [14,21]. These same factors are evident in the Kenyan recreational and artisanal billfish fishery where they may generate social, ecological, economic and governance conflicts.

Social conflicts can arise due to differences in various structures and processes at play in a given setting. Several factors that may result in social conflicts included changes in socio-demographics, marginalized benefits, wealth disparity, cultural differences, food security, fishers' livelihoods, and divergent resource user needs (Fig. 5).

Social and demographic changes in the region have included the movement of people from one area to another or an increase in the number of people using a fishery. Some respondents noted there had been an increase in the number of fishers in the past few years, especially for artisanal fisheries. Changes in the numbers of fishers were more pronounced where fishers cited a lack of alternative sources of income, resulting in increased pressure on the fishery. Marginal benefits and wealth disparities are likely to occur and cause social conflicts. This is especially true in cases where the 'disadvantaged group' perceived that they can gain more or accumulate resource use benefits if they a social position equal to that of the group perceived as advantaged. Historically, marine recreational fishing, particularly for billfish in Kenya, has been viewed as a European and North American people's pastime or an activity of the wealthy and foreigners. This is because the key participants (captains and anglers) are predominantly white. Very few local black people own sport fishing boats. Based on some of the artisanal respondents, not having a strong boat was perceived as a disadvantage. Artisanal fishers reported that they would do better with modernized boats that had the capability to withstand strong waves and fish in areas that their less motorized vessels could not reach. Cultural differences and contradicting resource needs were apparent. Emphasis among the recreational fishers was associated with catch-and-release angling for pleasure. There were several justifications for catch and release. First, there is a perception that a released billfish is worth more than a landed fish because releasing a billfish is seen as a demonstration of a strong conservation ethic that ensures the survival of the fish and increases the chances of (re)catching the billfish in the future. Secondly, releasing billfish, particularly females, helps ensure sustainability of stocks given that billfish take a long time to reach maturity. Third, catch and release creates a high potential for jobs and contributes to the local and national economy.

Economic conflicts are defined as conflicts due to competing interests in economic benefits drawn from the fishery. As mentioned, conflicts may result in hardship for the 'disadvantaged group' whose members perceive unfair distribution of benefits, or when actions of one group threatens the well-being of another group. In this study, respondents indicated potential for economic conflicts as a result of competition for the same resources. On the one hand, recreational fishers perceived artisanal fishers as competitors who accrued higher benefits from landing billfish than do recreational fishers. On the other hand, artisanal fishers perceived the lack of highly motorized boats as an impediment to enjoying the economic benefits that recreational billfish fishers accrue. Further, the reported decline in the overall billfish fishery resulting from an increasing number of boats is an important potential root of economic conflicts given its implications on recreational fishing. Several recreational fishing boats had closed their businesses or moved to other areas at the time of this study. Ecological conflicts are related to the changes in the fishery resources related to population declines. The perceived 'sailfish drought' and general decline in billfish catches point to the potential conflicts based on competition for limited resources. The limitation in availability of billfish resource combined with different resource user needs can potentially lead to widespread and long-term competition. Governance conflicts are related to internal and external fisheries management decisions. Our study revealed that factors like differences in regulatory requirements for the two fisheries were a source of potential governance conflicts. In addition, the weak implementation of regulatory mechanisms, particularly for migrant fishers were perceived as driving potential governance conflicts in the various

segments of the fishery.

4. Conclusion and recommendations

This study represents a first-time attempt to examine the characteristics of recreational and artisanal billfish fisheries in Kenya and identify potential sources of intrasectoral conflicts (conflicts between the two fisheries, recreational vs. artisanal fishers). The biological and economic importance of billfish demonstrate the need to understand the features of recreational and artisanal billfish fishers and identify potential conflicts between multiple user groups where billfish are a source of food, income, and leisure [30,31,57]. The existence of the different subgroups of recreational and artisanal billfish fishers reflects the multi-level complexities, which challenge the traditional dichotomous understanding of the billfish fishing populations. Understanding the characteristics of these fisheries is critical for the ongoing efforts to enhance the conservation and management of billfish at a national and regional level. These complexities are particularly salient in defining a fishery as either artisanal or recreational. Recent advancements in the Kenya Fisheries and Development Management Act (FMDA) 2016 provide a comprehensive legal framework that outlines the conditions under which recreational and artisanal fishing vessels can operate. Notwithstanding these advances, the overlaps in resource use combined with the open-access nature of the Kenyan billfish fishery present a prime example of the need to find a balance that fosters cooperative relationships between these two user groups in order to mitigate conflicts.

Although this study provides a starting point for evaluating the potential for conflicts in the recreational and artisanal billfish fishery, these findings are limited in scope and point to the need for follow up studies to support management efforts at the regional level given the highly migratory nature of billfish species. Between 2016 and 2017, for example, the Indian Ocean Tuna Commission (IOTC) under the Working Party on Billfish (WPB) developed a project to enhance data collection and reporting from sport fisheries that targeted tuna and tuna-like species in the Western Indian Ocean (WIO) region [29]. Findings from this project revealed the importance of billfish species as one of the main target species in recreational fisheries at a national and regional scale. Given the growing interest for Kenya and countries in the WIO region to harness the benefits of the Blue Economy (BE) for development, it is important to build synergies among resource users and governments to reduce governance and user conflicts caused by social, economic and ecological factors. Kenya has made great strides in recent years through the Fisheries Advisory Council within the FMDA 2016 that addresses conflicts. Under section 36, the FMDA makes provisions for conflict resolution mechanisms within counties which extend to the Beach Management Units (BMUs), which represent the management of fisheries at the community level. The multifaceted nature of the billfish fishery makes a case for the application of these new legal frameworks in enforcing co-management and devising methods for assessing factors that may result in conflicts and mitigation measures.

The recreational/sport and artisanal billfish fisheries currently operate as separate entities in various countries across the WIO, yet they fish in the same areas and may target similar resources at the same time [57]. Thus, fisheries co-management could facilitate communication among the resource users and governance systems therefore minimizing social, economic and governance conflicts. Further, the history of sport fishing on the coast of East Africa, particularly for billfish species, combined with the significance of these species to livelihoods and food security [29,57] creates an opportunity for rethinking their sustainability for socio-economic transformation and thereby unlocking the potential of a Sustainable Blue Economy. Based on the researchers' personal experiences and observations, the coast of Kenya in Watamu and Malindi has been known as a 'hotspot' for billfishing where anglers have the chance of catching a 'grand' slam (three major billfish species caught on one day) or a 'fantasy' slam (five species of billfish caught in one day). Recognizing billfish as an important economic driver presents

an opportunity for Kenya and coastal counties to leverage advantages of coastal tourism under the Third Medium Term Plan (MDP) of Kenya’s Vision 2030 to increase the employment ratio and Gross Domestic Product (GDP).

It is evident that populations of the billfish like other pelagic apex predatory fish species have declined in the Indian Ocean while species such as striped marlin, blue marlin, black marlin and sailfish are subject to overfishing [4]. Therefore, accounting for sources of fisheries conflicts, combined with other biological and socio-economic characteristics of billfish could contribute to the effective management, monitoring and rebuilding of billfish stocks. Finally, our findings point to the necessity in considering conflict resolution mechanisms in the process of developing a national and regional plan of action for the conservation and management of billfish considering the highly migratory nature of billfish.

Author statement

Nelly Isigi Kadagi and Marylyn Swisher conceptualized the study. Nelly Isigi Kadagi and Nina Wambiji collected the data. Nelly Isigi Kadagi, Marylyn Swisher and Nina Wambiji analyzed and interpreted the data. All authors equally contributed to drafting of the manuscript and its critical revisions.

Appendices.

Appendix 1. Recruitment network of respondent-driven sampling for recreational and artisanal billfish fisheries, starting with key informants

RESPONDENTS	TIER 1	TIER 2	TIER 3
Recreational fishers	Recreational boat captains or crews identified by key informants (e.g., African Billfish Foundation tagging database) Mostly aware of the billfish tagging program	Recreational fishers identified respondents in tier 1 that were aware of billfish tagging Sampling extended to respondents not aware of billfish tagging	Recreational and artisanal fishers identified respondents in tier 2 that were aware of billfish tagging Sampling to include social clustering
Artisanal fishers	Artisanal fishers identified through key informants (E.g., fisheries officers, Beach Management Units (BMUs)) Mostly aware of the billfish tagging program	Artisanal fishers identified respondents in tier 1 that were aware of billfish tagging Sampling extended to respondents not aware of billfish tagging and recoveries program	Artisanal fishers identified respondents in tier 2 that were aware of billfish tagging Sampling extended to respondents not aware of billfish tagging and recoveries program

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.marpol.2020.103960>.

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