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Original Article

Diversity of Fishery Organisms and Their Contribution to The Community Sustainability of Kilifi Creek, Kenya

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ABSTRACT

Fishery organisms are a source of food and income in local societies surrounding any water body. Investigations were carried out to study the diversity and distribution of fishery organisms of the Kilifi estuarine creek and their contribution to community sustainability. Sampling took place at Sea horse, Fumbini, Konjora, and Rare on the northern arm and at Nkoma, Mazioni, Fumbini, and Kombeni on the southern arm of the creek. All fishery organisms obtained were identified, counted and length dimensions taken. The 1444 prawns obtained were Fenneropenaeus indicus and Penaeus monodon while the 207 were four crab species Portunus armatus, Portunus sanguinolentus, Scylla serrata, and Thalamita crenata. F. indicus was the most abundant of the prawn species whereas P. armatus and S. serrata were caught at all study sites in smaller class sizes. 7,258 finfishes identified were 85 species belonging to 14 orders, 46 families. Biodiversity indices analysed showed that Margalef's species richness index was highest (8.293) at Sea horse and lowest (3.874) at Rare. Pielou's evenness was highest (0.7286) at Nkoma and lowest (0.5319) at Rare. Simpson's diversity index was highest at Nkoma (0.8917) and lowest at Rare (0.6672). Bray-Curtis similarity grouped all fishes into three ecosystems, open sea waters, the mudflats, and river channels. The most abundant finfish species were Leiognathus equula (20.17 %) followed by Mugil cephalus (17.64%), Gerres filamentosus (10.25%), and Pomadasys multimaculatum (7.37%). Most abundant finfish species and crustaceans were in small class sizes hence for local consumption by communities around the creek.

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INTRODUCTION

Variability in the abundance of populations in shallow marine coastal areas has been presented by various researchers mainly to establish natural rate of change in species abundance (Worthington *et al.*, 1995). The structure of any estuarine fish community depends on both biotic and abiotic factors (Whitfield, 1994). Studies on composition, abundance, and seasonal distribution of fish fauna has been carried out in different aquatic ecosystems in various parts of the world (Jowett & Richardson, 1996; Sutton & Hopkins, 1996; Garcia *et al*., 2001; Potter *et al*., 2001). In these monitored areas of shallow marine tropics, environmental destruction due to pollution and over-exploitation is proceeding at an accelerating rate (Hatcher *et al*., 1989). The most vulnerable and most frequently disturbed of these habitats occur in estuaries and sheltered bays. At the Kenya coast, reports on fish fauna have been documented in some ecosystems (Little *et al.*, 1988; Wakwabi, 1999; KMFRI, 2018) and participatory monitoring of shallow tropical marine fisheries by artisanal fishermen in Diani (Obura, 2001). Estuaries provide nursery areas for juvenile fish and there is a complexity of fish movements between estuaries and marine environments (Melville-Smith & Baird, 1980). Little *et al.* (1988) reported that in tropical regions, most fish feed and grow in estuaries and coastal lagoons. This is because such areas provide protection from predators and ensure high food availability for a number of marine species. The Kenyan coast extends through four latitudes south of the equator; hence, all creeks, bays, and estuaries have different ecological characteristics. Kilifi creek is relatively pristine with less industrial development in the areas surrounding it. The purpose of this paper is to elucidate fishery resources and their importance in sustaining the surrounding community.

MATERIALS AND METHODS

Study Area

Kilifi creek (3º 38'S and 39º 50'E) is located 55 Km north of Mombasa city (*Figure 1*). There is approximately four kilometres long, half a kilometre wide channel separating the Indian Ocean from the creek whose area is approximately 22.4 Km^2. The creek is characterized by scattered fringing mangrove trees around the open lagoon and a large mangrove stand on the western side. The northern arm of the creek has Ndzovuni and Rare streams while the southern arm has Kombeni stream. Eight sites sampled were Sea horse, Fumbini, Konjora, Rare, along the northern arm and Nkoma, Mazioni, Kidundu, Kombeni, along the southern arm of the creek. A motor boat with an outboard engine was used to access the sampling sites which were located more than two to three kilometres apart. Fishing took place every four days around neap tides of every month from January 2001 to September 2004. Fishing was done from a

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canoe using gillnets and/or a cast net in all sites during the day. The monofilament gillnets used were of three different sizes [5, 6½ and 7½ cm mesh sizes, (each 160 cm depth, 150 m long)] and were set in deeper waters while the nylon cast net (2 cm, 7.6 m²) was used in shallow areas. All fishery resources obtained at each site were identified, length measurements taken, counted, and recorded. Fishery resources identification was done using, Biology and Ecology of Fishes in Southern African Estuaries (Whitfield, 1998); A Guide to the Sea shores of Eastern Africa and the Western Indian Ocean Islands (Richmond, 1997); Smith's Sea Fishes book, (Smith & Heemstra, 1986); and FAO Species identification sheets for fishery purposes, (Fischer and Bianchi 1984).

Statistical Analysis

Diversity indices calculated using the PRIMER 5 (Plymouth Routines in Marine Ecological Research) software (Clarke & Warwick 2001).

Margalef's species richness (1958) formula (Krebs, 1978):

$$R = \frac{(S-1)}{(lnN)} \quad (1)$$

S = number of species, N = Total number of specimens.

Pielou's evenness (J) was then carried out using the formula (Zar, 1996):

$$J = (\frac{H}{H_{max}}) \quad (2)$$

Hmax = log n.

Simpson's index of diversity, 1949 (Krebs, 1978) was calculated using the formula:

$$D = 1 - \sum {p_i}^2 \quad (3)$$

D = Simpson's index of diversity, p_i = proportion of individuals of species *i* in the community.

To facilitate comparison of the fish communities, Bray-Curtis clustering was carried out using the PRIMER 5 to examine fish assemblages between study sites.

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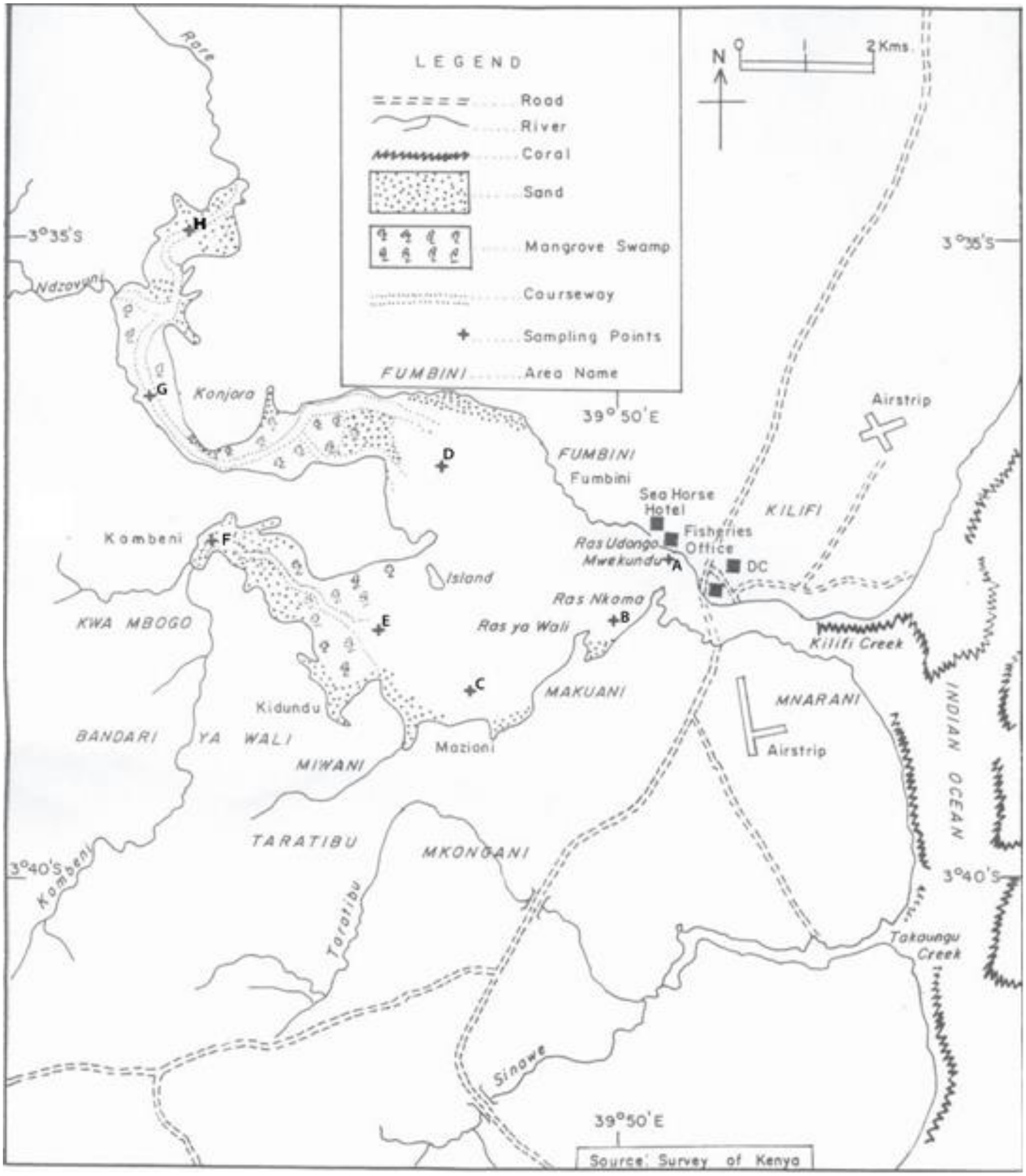
Figure 1: Map of Kilifi creek showing the study sites (A- Sea horse, B- Nkoma, C- Mazioni, D- Fumbini, E- Kidundu, F- Kombeni, G- Konjora and H- Rare).



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RESULTS

Crustacean diversity

The fishery resources obtained during this study comprised crustaceans and finfishes. The crustaceans were from the order Decapoda made up of prawns (Family Penaeidae) and crabs (Family Portunidae). The Family Penaeidae were composed of two species. The white Indian prawn *Fenneropenaeus indicus* H. Milne Edwards, 1837 was obtained at all sites except Mazioni and Sea horse but was abundant at Kidundu and Rare. The giant Tiger prawn *Penaeus monodon* Fabricius, 1798 was present in low numbers only at Kombeni, Rare and Konjora (*Table 1*). In the Family Portunidae, four species were caught. A total of 163 *Portunus armatus* A. Milne-Edwards, 1861 and 35 mudcrab *Scylla serrata* (Forskål, 1775) were caught from all study sites. However, threespot swimming crab *Portunus sanguinolentus* (Herbst, 1783) and *Thalamita crenata* Latraille, 1829 were caught from two sites each and were very few.

Classification of finfishes

From 7,258 finfishes obtained, 14 orders, 46 families and 85 species were identified during this study period. The order Perciformes had the largest number of finfish families and species among the sites, followed by Clupeiformes, the remaining orders were represented at scattered sites (*Table 2*). The highest number of orders was at Sea horse (nine) while Konjora had the lowest (two) belonging to Clupeiformes and Perciformes. The order Perciformes had 63 species distributed at various sites with a maximum of 47 species at Sea horse. Again, Sea horse had the highest number of number of species (60) followed by Nkoma and Kidundu (42). Konjora and Fumbini both had equal species number (34) but Fumbini had a higher diversity (six) than Konjora (two). Kombeni had 31 species while Mazioni and Rare had 27 species each with equal diversity (four). Kombeni, Konjora and Rare were sites within riverine channels bordered by mangroves. Kombeni was on the southern arm while Konjora and Rare on the northern arm. Perciformes were the most abundant species (63) followed by Clupeiformes species (six). The calculated mean number of species was highest at Sea horse (4.286) and lowest at Mazioni and Rare (1.929).

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Table 1: The distribution of Penaeid prawns and Portunid crabs among the study sites.

Species	Nkoma	Mazioni	Kidundu	Kombeni	Rare	Konjora	Fumbini	Sea Horse	Total
Fenneropenaeus indicus	2	0	1048	4	354	12	1	0	1421
Penaeus monodon	0	0	0	13	4	6	0	0	23
Portunus armatus	7	20	39	1	4	1	81	10	163
Portunus sanguinolentus	0	0	3	0	0	0	4	0	7
Scylla serrata	4	2	3	4	7	2	9	4	35
Thalamita crenata	0	0	0	0	0	0	1	1	2
Total	**13**	**22**	**1093**	**22**	**369**	**21**	**96**	**15**	**1651**

Table 2: Finfish orders and species number including the mean number of species per study site.

Orders	Nkoma	Mazioni	Kidundu	Kombeni	Rare	Konjora	Fumbini	Sea Horse	Total
Anguilliformes	1	1	1	0	0	0	1	1	5
Atheriniformes	0	0	0	0	0	0	0	1	1
Aulopiformes	1	0	1	0	0	0	0	1	3
Beloniformes	0	0	1	0	0	0	0	0	1
Beryciformes	0	0	0	0	0	0	0	1	1
Clupeiformes	5	5	4	1	4	4	3	4	30
Elopiformes	0	0	0	1	0	0	0	0	1
Gonorhynchiformes	2	0	0	1	1	0	0	0	4
Myliobatiformes	1	0	1	0	1	0	1	0	4
Perciformes	30	20	32	28	21	30	26	47	234
Pleuronectiformes	1	1	1	0	0	0	2	1	6
Siluriformes	1	0	1	0	0	0	1	0	3
Scorpaeniformes	0	0	0	0	0	0	0	2	2
Tetraodontiformes	0	0	0	0	0	0	0	2	2
Total	**42**	**27**	**42**	**31**	**27**	**34**	**34**	**60**	**297**
Mean	**3.000**	**1.929**	**3.000**	**2.214**	**1.929**	**2.429**	**2.429**	**4.286**	**21.214**

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Finfish Diversity Indices at the Study Sites

The means of diversity indices, Margalef's species richness index, Pielou's evenness index and Simpson's are given by *Table 3*. Sea horse, Nkoma, and Mazioni were sites directly connected to the Indian Ocean while Fumbini and Kidundu were mudflat areas adjacent to the mangrove stand facing the open lagoon. Rare, Konjora, and Kombeni were at the extreme ends with incoming fresh water streams on the northern and southern arms respectively. Margalef's index measures the number of species present for a given number of individuals and includes influx of migratory species. Margalef's species richness index was highest at Sea horse (8.293) followed by Nkoma (5.994), and was lowest at Rare (3.874). Pielou's evenness index measures how evenly individuals are distributed among the different species, the maximum that can be achieved is one. Nkoma had the highest evenness (0.7286) followed by Mazioni (0.72), Konjora (0.7046), and the least evenness was observed at Rare (0.5319). Simpson's index is a dominance index giving relatively little weight to the rare species and more weight to the common species in describing the community structure. It was highest at Nkoma (0.8917) followed by Sea horse (0.8789), Fumbini (0.8737), and was least at Rare (0.6672).

Table 3: Finfish biodiversity indices at the study sites [S (the total number of species per site), N (the total number of individuals), d (Margalef's species richness index), J' (Pielou's evenness index and 1-Lambda' (Simpson's dominance index)].

Sampling sites	S	N	d	J'	1 – Lambda'
Nkoma	41	791	5.994	0.7286	0.8917
Mazioni	27	274	4.632	0.72	0.848
Kidundu	42	1932	5.419	0.5892	0.8217
Kombeni	31	407	4.993	0.6024	0.7634
Rare	26	635	3.874	0.5319	0.6672
Konjora	34	459	5.384	0.7046	0.8734
Fumbini	34	1530	4.501	0.6707	0.8737
Sea Horse	60	1230	8.293	0.6853	0.8789

Finfish Assemblages

Bray-Curtis's similarity dendrogram gives the overall finfish species similarity among the studied sites (*Figure 2*). The overall similarity (45%), grouped fin fish species into marine sites (Sea horse, Nkoma, Mazioni, Fumbini, and Kidundu) and stream sites (Rare, Kombeni, and Konjora). At 46% marine areas were separated into Sea horse, Nkoma, and Mazioni which had scattered mangrove trees at the edge of water with Mazioni being completely separated from the other four sites. The similarity between Fumbini and Kidundu was at 62 %, the sites with mudflats while Sea horse and Nkoma were similar at 64 %, areas completely marine. The riverine sites were 57.5 % similar and Rare was completely separated, being at the fresh water influx. Konjora and Kombeni were similar at 61 % and were riverine channels.

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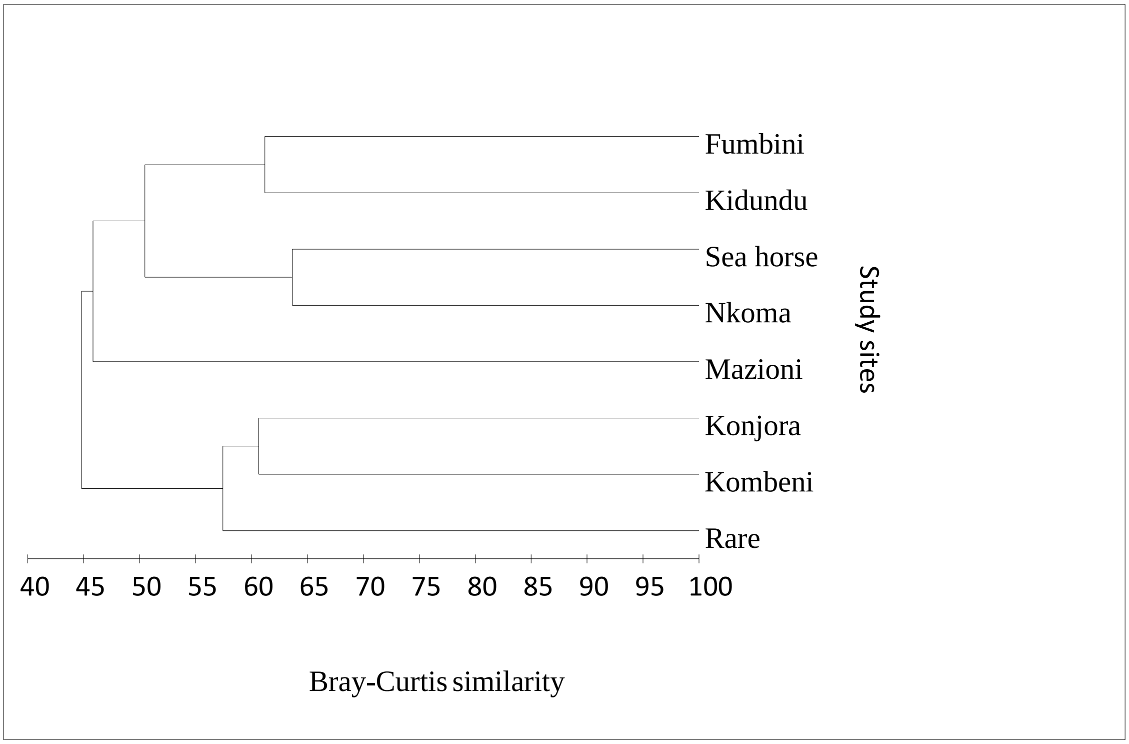
Figure 2: Bray-Curtis's similarity dendrogram displaying the distribution of fin fish species among the study sites.



Classification of Finfishes

From 7, 258 fin fishes obtained 14 orders, 46 families and 85 species were identified during this study period. The order Perciformes had the largest number of finfish families and species among the sites, followed by Clupeiformes, the remaining orders were represented at scattered sites (*Table 2*). Sea horse had the highest number of orders (nine) while Konjora had the lowest orders (two) belonging to Clupeiformes and Perciformes. The order Perciformes had 63 species distributed at various sites with a maximum of 47 species at Sea horse. Again, Sea horse had the highest number of species (60 species) followed by Nkoma and Kidundu (42 species). Konjora and Fumbini both have equal species number (34) but Fumbini had a higher diversity (four) than Konjora (two). Kombeni had 31 species while Mazioni and Rare had 27 species each with equal diversity (four). Kombeni, Konjora, and Rare were riverine sites within channels in the mangroves. Kombeni was on the southern arm while Konjora and Rare on the northern arm. Perciformes were the most abundant species (63) followed by Clupeiformes species (six). The calculated mean number of species was highest at Sea horse (4.286) and lowest at Mazioni and Rare (1.929).

Finfish species abundance

The total numbers of finfish species from all study sites were pooled and ranked (*Table 4*). The ponyfish *Leiognathus equula* (Forsskal, 1775) was the most abundant (20.17 %), obtained from all sites except at Nkoma. The mullet *Mugil cephalus* (Linnaeus, 1758), the whipfin silver biddy *Gerres filamentosus* Cuvier, 1829, Cock grunter *Pomadasys multimaculatum* (Playfair, 1867), bigeye trevally *Caranx sexifasciatus* Quoy & Gaimard, 1825, and Common silver biddy *Gerres oyena* (Forsskal, 1775) were obtained from all sites. The remaining species were specific to some sites and not others.

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Table 4: Most abundant fin fish species in (pooled) numbers and percentages

Scientific name	Total	Overall Percentage
Leiognathus equula	1464	25.06%
Mugil cephalus	1280	21.91%
Gerres filamentosus	744	12.73%
Pomadasys multimaculatum	535	9.16%
Pellona ditchella	504	8.63%
Leiognathus leuciscus	454	7.77%
Valamugil buchanani	357	6.11%
Caranx sexifasciatus	204	3.49%
Gerres oyena	189	3.23%
Trichiurus lepturus	112	1.92%
Total	**5843**	**100.00%**

The Contribution of Kilifi Fishery Resources to Community Sustainability

Crustaceans

In order to establish the contribution of the fishery resources to the community, length dimensions of the fishery resources were recorded. The carapace lengths of prawns, carapace width of crabs and total length of finfishes were measured to establish the sizes available at Kilifi creek. Both prawns had class size distribution ranging from 15 mm to 64 mm. *F. indicus* was most abundant at class size 34 - 54 mm Carapace length (73.9%). *P. monodon* occurred in low percentages in all the size classes with 34.8 % being the highest percentage in class size 25 – 34 mm (*Figure 3*). In crabs, the carapace width class size distribution of *Portunus armatus*, *Scylla serrata*, and *Portunus sanguinolentus* are shown by *Figure 4*. All their carapace width sizes ranged from 35 – 44 mm to 165 – 174 mm. Many *P. armatus* were in larger CW class sizes between 115 – 124 mm to 150 – 164 mm. *S. serrata* was distributed in all the class sizes though in few percentages. *P. sanguinolentus* were in low percentages but occurred in various class sizes.

Figure 3: The Percent distribution of *F. indicus* and *P. monodon* carapace length class sizes at the study sites.

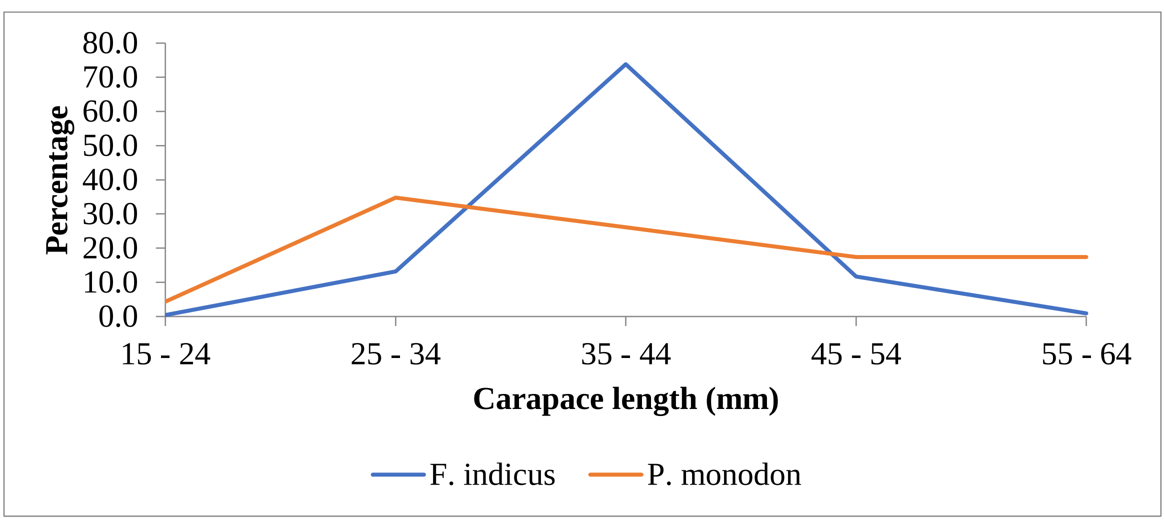

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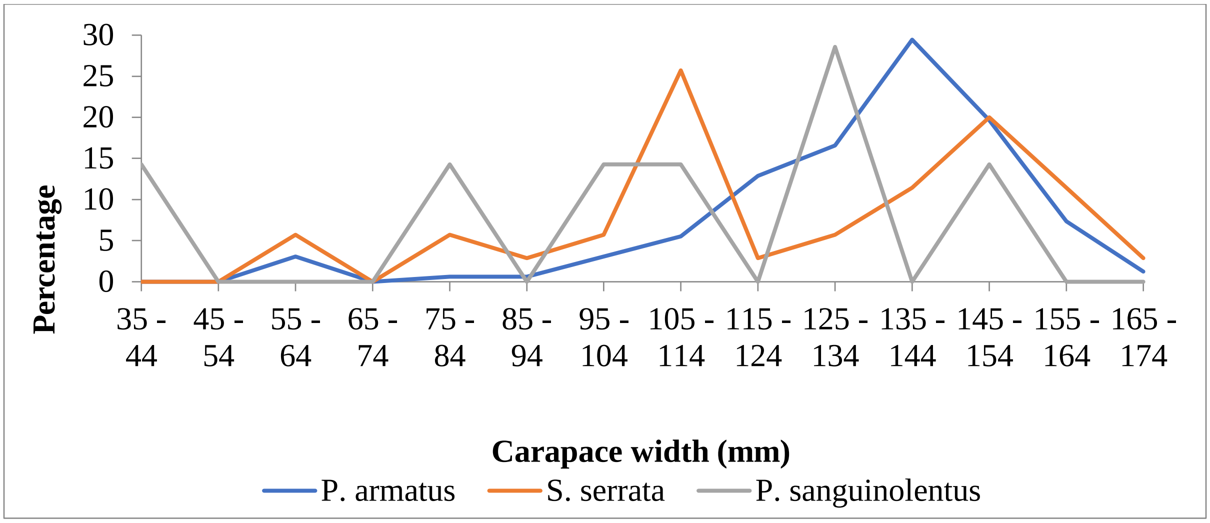
Figure 4: The carapace width class size distribution of *P. armatus*, *S. serrata* and *P. sanguinolentus*.



Finfishes

Finfish species by order of importance at each study site are given by *Table 5*. Leiognathidae (*L. equula* and *L. leuciscus* (Gunther, 1860)) dominated most sites either at first, second or third positions except at Mazioni and Fumbini. *M. cephalus* was also abundant at most sites except at Nkoma and Sea horse. Mazioni had relatively low finfish numbers throughout the study period.

Table 5: The abundance by total numbers of fin fish species at each study site.

Sites	Most abundant	Second position	Third position
Nkoma	*L. leuciscus* (175)	*L. equula* (122)	*G. filamentosus* (112)
Mazioni	*G. filamentosus* (85)	*P. ditchella* (50)	*M. cephalus* (28)
Kidundu	*M. cephalus* (617)	*P. ditchella* (396)	*L. equula* (276)
Kombeni	*M. cephalus* (179)	*L. equula* (64)	*P. multimaculatum* (47)
Rare	*L. equula* (349)	*P. multimaculatum* (84)	*M. cephalus* (63)
Konjora	*L. equula* (117)	*M. cephalus* (74)	*T. lepturus* (53)
Fumbini	*P. multimaculatum* (280)	*M. cephalus* (277)	*G. filamentosus* (252)
Sea horse	*L. equula* (354)	*L. leuciscus* (177)	*G. filamentosus* (96)

Distribution of Most Abundant Finfishes by Class Sizes.

The most abundant finfishes were from families Leiognathidae, Mugilidae, Gerreidae and Haemulidae.

Family Leiognathidae

This family was composed of *Leiognathus equula*, *Leiognathus leuciscus*, *Leiognathus elongatus* (Gunther, 1874), *Gazza minuta* (Bloch, 1787) and *Secutor insidiator* (Bloch, 1787). Two species *L. equula* and *L. leuciscus* were the most abundant hence their class size distribution graphed. The most abundant class size of *L. leuciscus* was between 10.5 – 11.4 and 15.5 – 16.4 cm while *L. equula* had two peaks at 5.5 – 6.4 and 10.5 – 11.4 cm both of which were less than 45 % percent (*Figure 5*).

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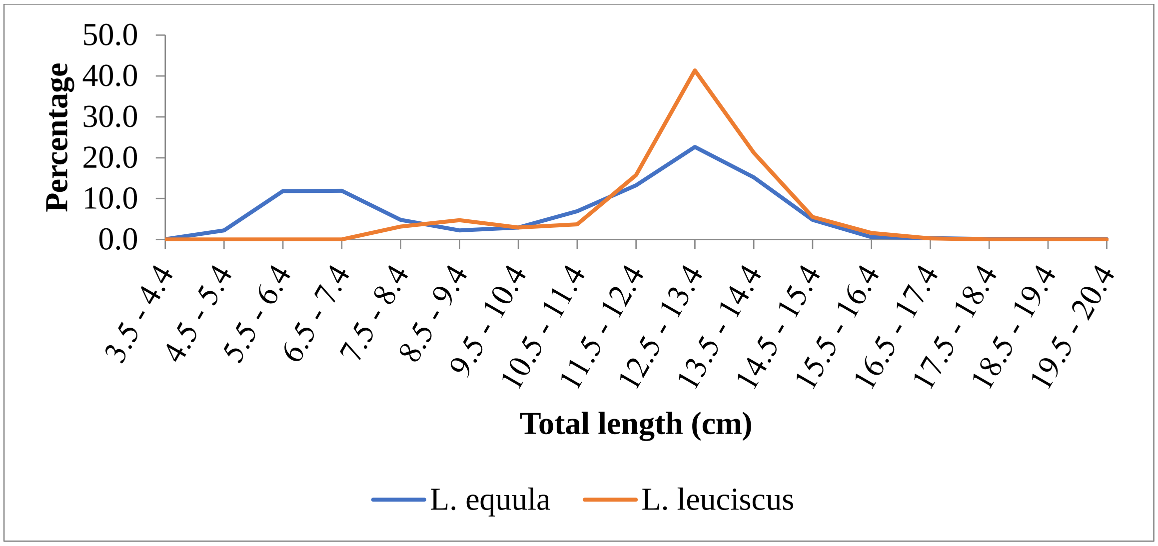
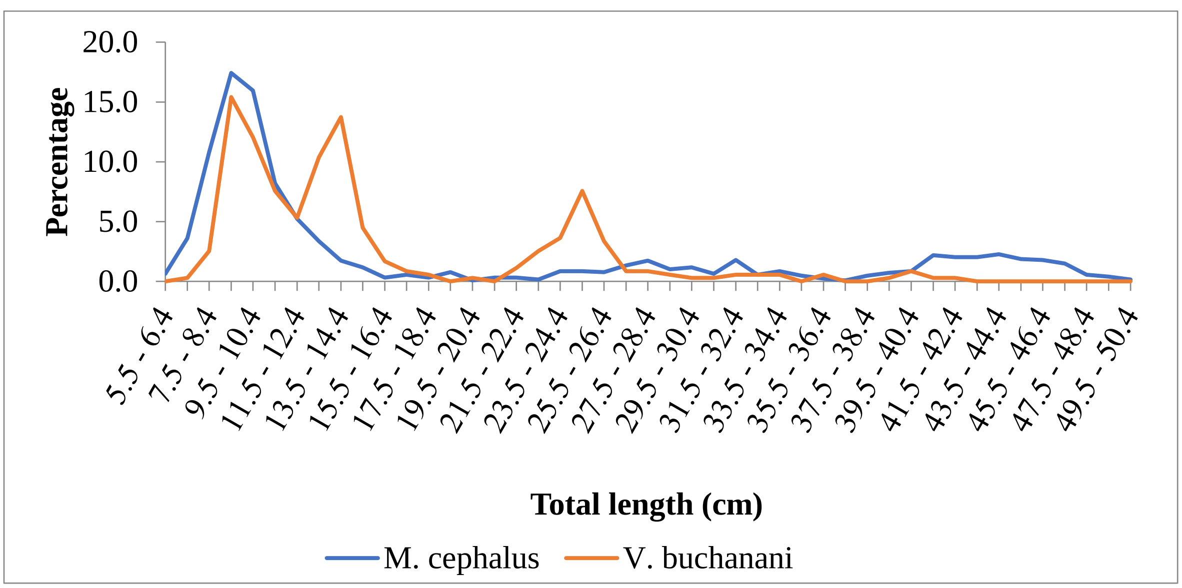
Figure 5: Total length distribution of *L. equula* and *L. leuciscus* at the study sites.



Family Mugilidae

This family commonly known as the mullets, was composed of *Mugil cephalus* (Linnaeus, 1758), *Valamugil buchanani* (Bleeker, 1853), *Myxus capensis* (Valenciennes, 1836), and *Liza vaigiensis* (Quoy & Gaimard, 1825). Only eleven *Myxus capensis* and three *Liza vaigiensis* were caught in Rare and Fumbini respectively. Both *Mugil cephalus* and *Valamugil buchanani* were obtained from all sites, *Mugil cephalus* was the most abundant and *Valamugil buchanani* was however, in low numbers. These species grow to large sizes though *Figure 6* shows that majority were small fishes with less than 16.4 cm total length and few large fishes of 50.4 cm were obtained during the study period indicating that the creek is a nursery area. The overall percentage at all class sizes was less than 18%.

Figure 6: Total length distribution of *M. cephalus* and *V. buchanani* within Kilifi creek.



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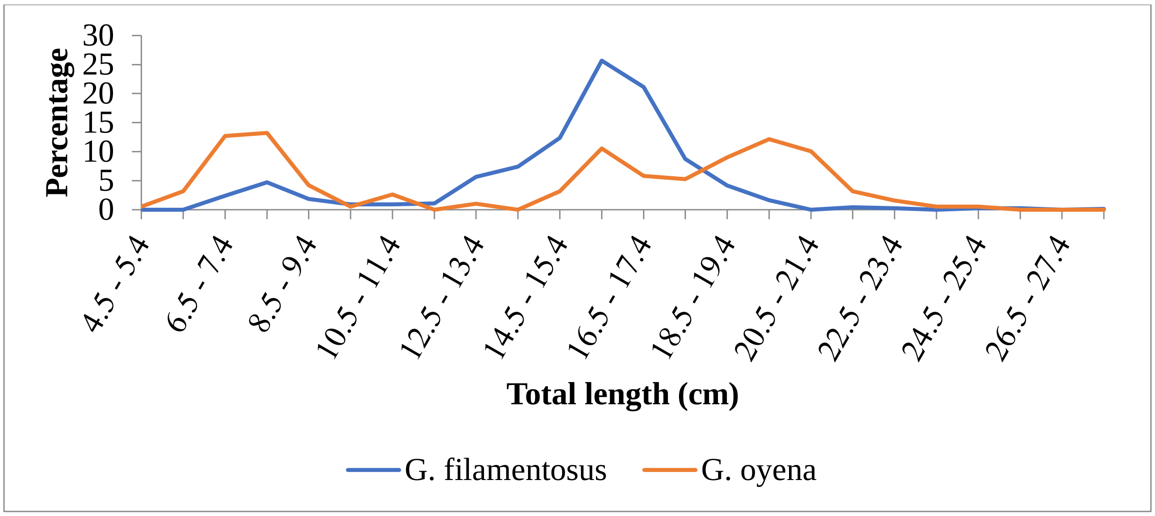
Family Gerreidae

The two species in this family were *Gerres filamentosus* and *Gerres oyena G. filamentosus* were the most abundant being caught at all sites though at Kombeni, Rare and Konjora only less than 20 specimens were obtained. *G. oyena* was present in low numbers at all sites with less than 20 specimens except at Nkoma and Fumbini. In both species, the most abundant size classes were between 12.4 cm and 24.4 cm (*Figure 7*). Their overall percentages were less than 30 %.

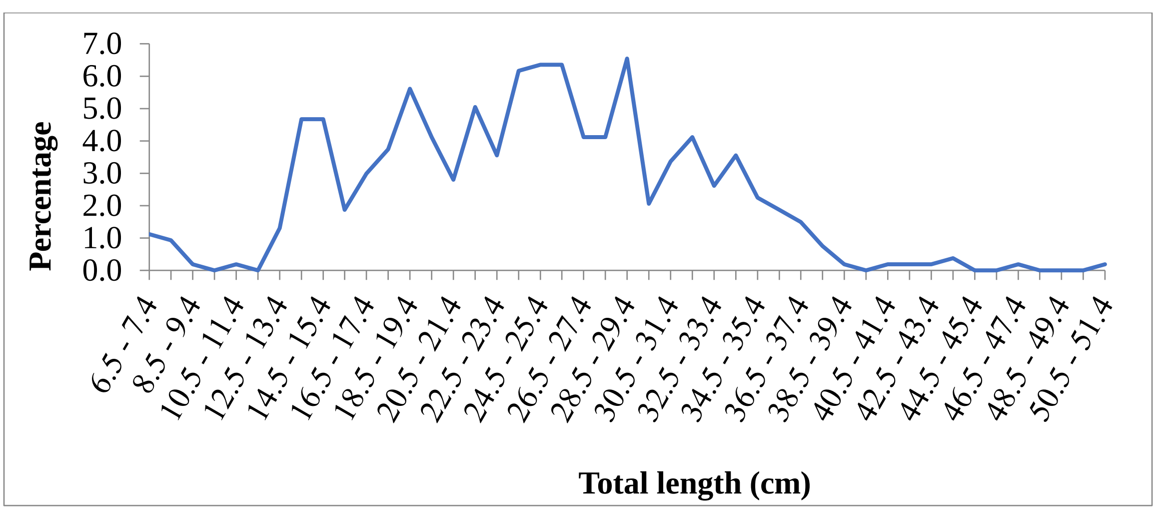
Figure 7: Class size distribution of *G. filamentosus* and *G. oyena* at Kilifi creek.



Family Haemulidae

The four species of the family Haemulidae obtained were *Pomadasys mulimaculatum*, *Pomadasys kaakan* (Cuvier, 1830), *Plectorhynchus flavomaculatum* (Erenberg, 1830), and *Plectorhynchus schotaf* (Forsskal, 1775). The most abundant at all sites was *P. multimaculatum* with most specimens in class size distribution ranging from 12 to 40 cm (*Figure 8*), however, few in class size 51.4 cm were obtained. All class sizes were less than 7 % of the total though they were caught at all study sites.

Figure 8: Class size distribution of *Pomadasys multimaculatum* at Kilifi creek.



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DISCUSSION

The fishery resources of Kilifi creek are those organisms harvested by artisanal fishers for income and consumption by the local community around the creek. Artisanal fishers are limited in terms of gear and craft hence are in inshore areas and shallower areas of the continental shelf (Vandick et al., 2014; van Hoof & Steins, 2017). The artisanal fishery is characterized by low investment in simple and relatively inefficient labour-intensive technology to capture and supply sea food mainly to the domestic market (Abila, 2010). In this study, the artisanal resources were prawns, crabs, and finfishes.

White Indian prawn (*Fenneropenaeus indicus*), Giant tiger prawn (*Penaeus monodon*), Green tiger prawn (*Penaeus semisulcutus* De Haan, 1844), and Kuruma prawn (*Marsupenaeus japonicus* Spence Bate, 1888) are the major species of prawns harvested along the Kenyan coast (KMFRI, 2018). At Kilifi creek only *F. indicus* and *P. monodon* were obtained out of the four species cited by KMFRI, (2018). Rashid *et al.* (2019) worked on length weight relationships of penaeid prawns at Malindi-Ungwana Bay reporting the carapace length measurements of *F. indicus* ranging from 24.8 mm to 50.3 mm and *P. monodon* carapace lengths between 37.8 mm and 77.5 mm. At Kilifi creek, the size range of both prawns was between 15.5 mm and 64.4 cm with majority being in class sizes 25.5 mm and 54.4 mm. From this study, Kilifi creek does not produce prawns in volumes of economic benefit because majority were small in size, low in percentages and the large ones were very few in number, hence less economic sustainability. The prawns from this creek were therefore, for local consumption only (personal observation).

Brachyuran crab families commonly found along the Kenyan include Xanthidae, Cancaridae, Portunidae, Majidae, Ocypodidae, Grapsidae, Gecarcinidae, and Potamonidae. At the Kenyan coast, edible Portunid crabs are *Scylla serrata*, *Thalamita crenata*, *Portunus sanguinolentus*, and *Portunus pelagicus* Linnaeus, 1758 (Nyawira, 1986). *Portunus pelagicus* has since been revised to *Portunus armatus* (Linnaeus, 1758). Of these crab species, only *S. serrata* attains large marketable size and is of economic importance, the rest are for local consumption (Nyawira, 1986). Portunid crabs are swimmers, a factor that contributed to their being caught by fishing nets. Sigana, (2002) reported that carapace width (CW) of *S. serrata* ranged in class sizes less than 80.5 mm to 170.44 mm at Ramisi river estuary. However, *S. serrata* at Kilifi creek had few smaller crabs less than 80.5 mm, CW, and in low percentages which were not economically viable. Likewise, the numbers of the other portunid crabs were in smaller class sizes and in low percentages which are not of economic benefit but for local consumption (personal observation).

The estuarine fish community depends on both biotic and abiotic factors, which tend to vary (Whitfield, 1994). Vidthayanon and Premcharoen, (2002) recorded 199 finfish families in Thailand; Loneragan *et al.* (1987) reported 26 finfish families in Australia; Akin *et al.* (2005) recorded 29 finfish families in Turkey; Lin and Shao, (1999) had 14 finfish families in Taiwan while Blaber and Milton, (1990) reported 42 fin fish families from the Solomon Islands. At the Kenyan coast, Little et al. (1988) reported 38 finfish families from Tudor creek while Kimani *et al*., (1996) reported 50 finfish families from Gazi. In this study, 46 fin fish families were recorded at Kilifi creek. Whitfield, (2005) categorized the major fish group utilizing estuaries and in this study, most finfish species were marine immigrants. The order Perciformes had the largest number of species which determined the diversity indices. In the tropics, species diversity and diversity within genera are higher while species distribution is patchier and population size smaller.

Sea horse recorded the highest number of species, the least being Rare and Mazioni concurring with the observations of Gatwicke and Speight (2005) that complex marine habitats support a greater

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number of fish species than less complex ones. In this study, both Clupeiformes and Perciformes utilized all the study sites while other finfish orders were found at specific sites and not others indicating either spatial or temporal distribution. Species composition indicates preferred habitat use by different species (Jung & Houde 2003), and this is shown by the similarity dendrogram, hence spatial distribution observed. Almost all study sites had similar species except for a few. Sea horse and Nkoma exhibited high Margalef's species richness, Pielou's evenness and Simpson's diversity index while Rare had low values in all the indices. This study confirms that Sea horse and Nkoma has seasonal influx of migratory marine species because of a diversity of ecosystems within the sites while Rare, being at the fresh water end had few species because of the dynamics in physico-parameters and lack of ecosystem diversity.

The diversity indices in aquatic microcosms are controlled by a number of historic, biotic, and abiotic factors, however abiotic variables mostly influence biodiversity (Therriault & Kolasa, 1999). Sea horse had nine orders and largest number of species in the order Perciformes contributing to the highest species richness observed. Konjora recorded two orders Clupeiformes and Perciformes while Rare had four orders and few Perciformes, hence the lowest species richness observed. The mean number of species was highest at Sea horse followed by Nkoma, and Kidundu, Mazioni and Rare had lowest. Diversity indices are used in attempts to establish the seasonal patterns of fish in estuarine habitats (van den Broek, 1979). Akin et al., (2005) reported that physiological tolerances of organisms to the dominant gradient, determine the frame of the community structure and this study shows the biotopes visited by marine immigrants specially to feed. Moore, (1978) reported that the appearance of indicator species and the species composition of the community provide information about the ecological conditions and not the numerical index.

Kilifi was composed of a few dominant species only though relatively high numbers of fish species were recorded. This is a common feature of bay, inshore, and estuarine fish assemblages in both temperate and sub-tropical environments (Quinn, 1980). At Kilifi, four species comprise 69% of the total number, a situation similar to Tudor creek (Little et al. 1988). Among the families of importance at Kilifi creek which grow to large sizes are the Mugilidae (21.29 %) and Haemulidae (9.16 %) (*Pomadasys multimaculatum*). The family Leiognathidae (33.37 %) was made up of two species *L. equula* and *L. leuciscus* while family Gerreidae (15.96 %) comprised *G. filamentosus* and *G. oyena*. These two families are small fishes (20.4 cm TL and 28.4 cm TL respectively) and are the most abundant within the creek supporting artisanal fishery (Smith & Heemstra, 1986). Mugilidae caught within the creek were juveniles, probably because the creek is a nursery area and these were of no economic value but for local consumption. Larger Mugilidae are important in fisheries and in aquaculture within tropical and subtropical regions of the world (Blel et al., 2008). Haemulidae, at the Kenya coast are not among the fishes of high economic value but are acceptable for local consumption.

CONCLUSIONS

From this research study, it can be concluded that there is spatial distribution in species composition from the creek mouth to the freshwater end. This is because fish species of Konjora, Rare and Kombeni were distinctly different from those at Fumbini, Kidundu, Mazioni, Sea horse, and Nkoma (within Bahari ya Wali). It also proves the use of various biotopes within the study area and that marine immigrants visit the area specifically to feed.

Recommendations

Within this creek, Sea horse, Fumbini, and Kidundu were utilized most by fishery organisms and therefore require conservation by fisheries

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managers. The fishery sustaining Kilifi creek community is based on four regular species contributing 69 % and in small class sizes. The study also provides baseline data for future comparisons with marine coastal ecosystems, however further research to study feeding habits of each species needs to be carried out to discern the importance of each study site in supporting the fisheries.

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