

Original Article

Patterns of juvenile reef fish assemblages across a mangrove-seagrass-coral continuum in Shimoni, Kenya

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Abstract

Understanding juvenile fish distribution across habitat mosaics is essential for interpreting ecosystem connectivity and function. This study assessed seasonal variations in juvenile reef fish assemblages across a mangrove-seagrass-coral reef continuum in Shimoni, southern Kenya. Using a beach seine net, sampling during the Northeast Monsoon (NEM) and Southeast Monsoon (SEM) seasons, a total of 8,575 individuals representing 228 species and 52 families were recorded. Species richness and diversity (H') were highest in the coral adjacent site ($n = 168$; $H' = 3.77$), followed by the seagrass adjacent site ($n = 132$; $H' = 3.69$) and the mangrove associated site ($n = 119$; $H' = 3.64$). Two-way ANOVA and Kruskal-Wallis tests revealed significant differences in diversity and mean species richness, respectively across habitats, with post-hoc pairwise tests identifying the most pronounced differences between coral and mangrove adjacent sites. While 69 species were common to all three habitats, multivariate analysis demonstrated distinct species-habitat associations, particularly in the mangrove associated habitat, influenced by salinity and temperature. The Kolmogorov-Smirnov test further confirmed differences in the trophic signatures of the assemblages between mangrove-coral and seagrass-coral interfaces. These findings underscore the importance of the coastal habitat mosaic in sustaining fish recruitment and population dynamics, highlighting the need for integrated seascape management in the Western Indian Ocean.

Keywords: Ecosystem function, Trophic structure, Species-habitat interactions, Spatio-temporal dynamics

Introduction

Ecological linkages across nearshore habitats, specifically mangroves, seagrass beds, and coral reefs, are fundamental drivers of fisheries productivity and marine biodiversity. These ecosystems function as a complementary mosaic, providing essential nursery grounds where juvenile fishes find shelter and forage before migrating to offshore reefs (Bauer and Hoyer, 2014; Nagelkerken *et al.*, 2015). Despite the recognized importance of this “seascape connectivity”, much of the existing evidence remains indirect, relying on

spatial distribution patterns rather than direct migratory observations (Mumby, 2006; Tamario *et al.*, 2019).

In tropical regions, the habitat continuum across mangroves, seagrass beds, and coral reefs sustains small-scale fisheries and local livelihoods. Studies have established the general nursery value and connectivity of these three habitats (Honda *et al.*, 2013; Du *et al.*, 2020). This is particularly exemplified in the Western Indian Ocean (WIO) region, which is characterized by high-diversity nearshore seascapes that

serve as critical habitats for juvenile reef fishes (Igulu *et al.*, 2014; Samoilyis *et al.*, 2015; Berkström *et al.*, 2020). This habitat continuum offers accessible fishing grounds for local communities who utilize traditional fishing gears such as basket traps, gillnets, and handlines, to capture diverse species throughout their life cycles (Okemwa *et al.*, 2017). Species from ecologically and economically important families, including Siganidae (rabbitfishes), Mullidae (goatfishes), Scaridae (parrotfishes), and Lutjanidae (snappers), often utilize mangroves and seagrasses as transient nurseries before being recruited into adult populations on coral reefs (Igulu *et al.*, 2014; Mwaluma *et al.*, 2022).

Despite their importance in sustaining fisheries, these habitats are under increasing pressure from

over-exploitation, habitat degradation, and the burgeoning impacts of climate change (McClanahan *et al.*, 2019; Dzoga *et al.*, 2020). To inform area-based management interventions, localized studies aimed at understanding the ecological linkages and nursery roles are essential. Currently, information documenting specific spatial and seasonal patterns of juvenile assemblages remains inadequate in Kenya. Furthermore, understanding how temperature and salinity drive local-scale assemblage patterns is vital for predicting how fish populations may shift under changing climatic conditions (Mwaluma *et al.*, 2022).

The aim of this study was to assess local-scale patterns of juvenile fish assemblages across a mangrove-seagrass-coral reef continuum in Shimoni, on the south

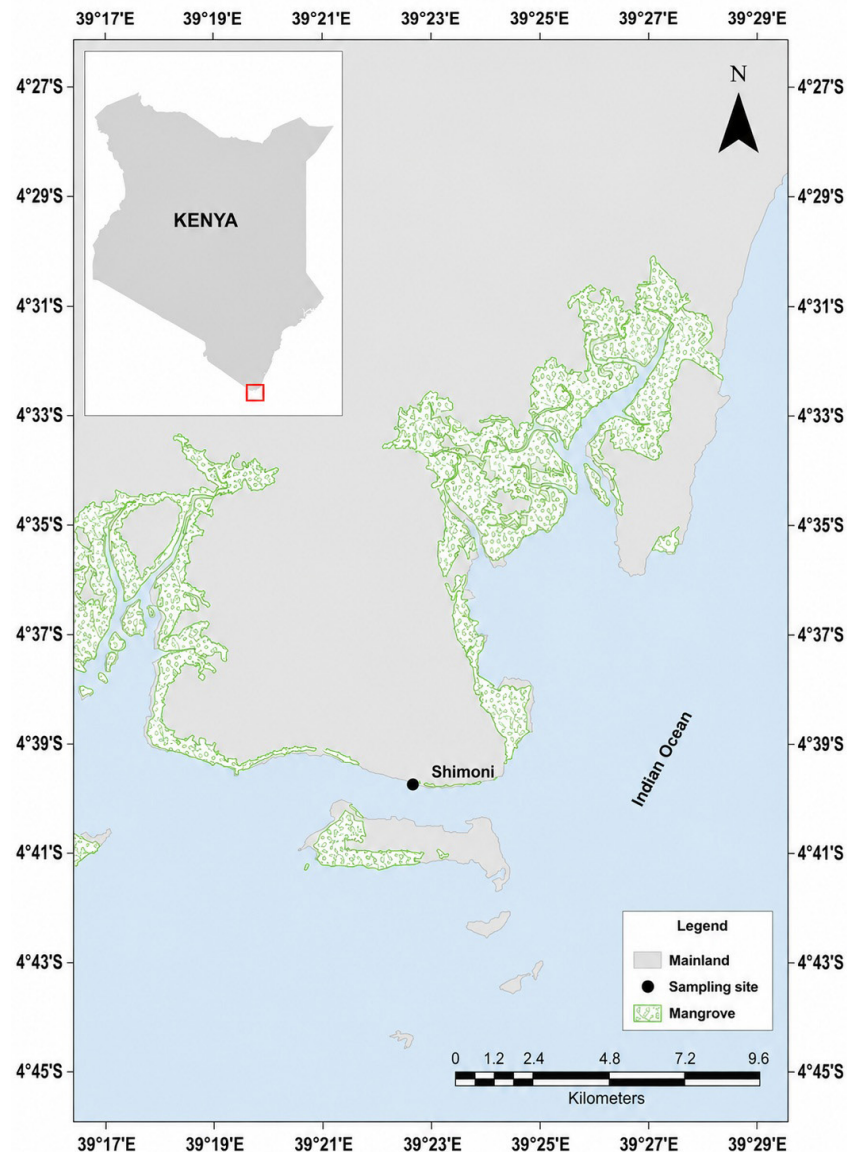


Figure 1. A map of Kenya showing the location of the study site.

coast of Kenya. The specific objectives were to: (i) examine spatial and seasonal variations in species abundance and composition across the habitats; (ii) compare spatial variations in the trophic structure of the assemblages; and (iii) evaluate species-habitat associations and the influence of temperature and salinity on fish assemblage composition.

Materials and methods

Study area

This study was conducted in Shimoni, located on the south coast of Kenya at latitude 4°38'51" S and longitude 39°22'54" E (Fig. 1). The sampling area was within a mangrove-seagrass-coral reef continuum. The sampled area covered approximately 2 km². Typical to the WIO region, seasonal and environmental conditions within the study area are driven by the movement of the Inter-Tropical Convergence Zone (ITCZ), resulting in two primary monsoon seasons (McClanahan, 1988). The Northeast Monsoon (NEM), occurring from November to March, is characterized by relatively calm seas, higher air temperatures and lower rainfall. In contrast, the Southeast Monsoon (SEM), spanning April to October, is associated with stronger winds, rougher sea conditions, and higher rainfall.

Fish sampling and laboratory analysis

Juvenile fish samples were collected monthly in each habitat during low tides using a beach seine net measuring 1 m by 150 m long, with a mesh size of 0.5 cm. Beach seining is reported to be an effective sampling method for diurnal nearshore fishes (Unsworth *et al.*, 2009; Borland *et al.*, 2017). Beach seines are known to be highly efficient in capturing juvenile fishes and are widely used in the WIO region (Okemwa *et al.*, 2025). However, due to documented ecosystem impacts on fish stocks, habitats and biodiversity, it is heavily regulated and even banned in some WIO countries including Kenya (Okemwa *et al.*, 2025). Despite the known impacts, beach seines are reported to be effective in experimental sampling because of cost-effectiveness in sampling large defined areas (Franco *et al.*, 2022). Authority to use a beach seine for this research was obtained from the Kenya Fisheries Service (KeFS).

Sampling consisted of a total of 60 hauls conducted over a 10-month period from November 2021 to August 2022. Each of the three habitats was sampled monthly over two consecutive days to provide replicates, totalling 20 hauls per habitat by the end of the study period. The hauls were standardized by fishing

time to 45 minutes, and each treated as a distinct sample. The fish specimens were labelled by haul, stored in ice-filled cooler boxes, and transported to the laboratory for freezing prior to taxonomic analysis. After thawing, specimens were identified to the species level using regional taxonomic guides (Smith and Heemstra, 1986; Anam and Mostarda, 2012). Scientific names were validated using FishBase and the World Register of Marine Species (WoRMS). Total length (TL) was measured to the nearest 0.1 cm using a graduated fish measuring board. Individuals were classified as juveniles if their total length was less than 25 % of the maximum recorded adult length (L_{max}) for the species (Okemwa *et al.*, 2019). The resulting juvenile subset data was then extracted for all subsequent statistical analyses. Sampling locations were recorded using a handheld Global Positioning System (GPS) unit.

Measurement of environmental parameters

Hydrographic parameters, specifically salinity and temperature, were measured at each habitat prior to fish sampling using a YSI multi-parameter probe. These measurements were taken *in situ* to allow for a direct association between the fish assemblage data and local environmental conditions.

Data processing and statistical analyses

Juvenile abundance, species composition, and diversity

Juvenile fish density was estimated as the number of fish per haul. Relative abundance (P_i) (%) was calculated following the formula by Achacoso *et al.* (2016):

$$P_i = \frac{n_i}{N} \times 100 \quad (i)$$

where n_i = number of individuals for each species i , and N = Total number of individuals.

The frequency of occurrence (FO) was calculated for each species by habitat, and for the combined data using the formula:

$$\% FO_i = \frac{L_i}{L} \times 100 \quad (ii)$$

where: %FO $_i$ = Percent frequency occurrence of Species i ; L_i = number of hauls that contain species i ; and L = total number of hauls.

The Kruskal-Wallis test was employed to assess differences in mean abundance per haul as the data did not meet the assumptions for a parametric test. Species

diversity was determined using the Shannon-Wiener diversity index (H'), which incorporates both richness and evenness (Shannon, 1948):

$$H' = - \sum_{i=1}^s p_i \ln(p_i) \quad (\text{iii})$$

where $\ln$ is the natural log; and p_i is the proportion of individuals belonging to the i^{th} species relative to the total number of individuals (n_i/N). Diversity indices were calculated for each haul. Higher values of H' represent higher species diversity; that is, a higher number of species or species being more evenly distributed. In contrast, low values of H' means lower diversity, where a few species dominate the habitat or are unevenly distributed (Olesen *et al.*, 2024). A two-way ANOVA was used to test for significant differences in H' across habitats and between seasons. Where significant differences were detected, a Tukey HSD post-hoc test was applied to identify specific pairwise differences between habitats.

Trophic structure

Each specimen was assigned to a broad trophic guild retrieved from FishBase (Froese and Pauly, 2024) as follows: 2.0 – 2.5 (herbivorous), 2.6 – 3.0 (omnivorous), 3.1 – 3.5 (carnivorous), 3.6 – 4.0 (invertivore), and 4.1 – 4.5 (piscivore). To visualize the trophic structure, a histogram was generated comparing total number of species (species richness) across each trophic level for each habitat. A trophic signature was then generated for each habitat as described by Stergiou and Karpouzi, (2002) and Froese *et al.*, (2005). This approach utilizes a cumulative frequency distribution curve, where the cumulative proportion of fish species (or abundance) is plotted against their corresponding trophic levels (TL). The resulting curve represents the functional organization of the fish assemblage. To statistically determine if the shapes of the cumulative distributions differed significantly between paired habitats, a two-sample Kolmogorov-Smirnov (K-S) test (Massey, 1951) was employed. The K-S test measures the maximum vertical distance (D) between two cumulative distributions.

Species-habitat associations and environmental influence

To evaluate juvenile fish habitat associations, a two-tiered approach was employed. First, species presence-absence was categorized to identify habitat specificity: single habitat (mangrove, seagrass, or coral), dual habitat (mangrove–coral, coral–seagrass, or mangrove–seagrass), and generalists present across all

three habitats (Du *et al.*, 2020). Second, multivariate analyses were used to examine assemblage structure. A Detrended Correspondence Analysis (DCA) was initially performed to determine the gradient length of the species data. Subsequently, Canonical Correspondence Analysis (CCA) was used to elucidate the relationships between the 40 most abundant species and the recorded hydrographic parameters (surface temperature and salinity). The analysis was restricted to the top 40 species to reduce “noise” from rare species and make the bi-plot readable. The results were then visualized using a CCA bi-plot to show species-habitat associations and the influence of environmental variables. All multivariate analyses were conducted using PAST software v. 4.13 (Hammer *et al.*, 2024).

Results

Juvenile abundance

A total of 8,575 juvenile fish belonging to 228 species in 52 families were sampled. The coral reef adjacent habitat had the highest number of individuals, with 3,648 belonging to 168 species. This was followed by the seagrass adjacent habitat, with a record of 2,718 individuals belonging to 132 species, and mangroves associated habitat, with 2,209 individuals belonging to 119 species. Overall, the mean number of individuals per haul was highest in the coral adjacent site (8.0 ± 2.8), followed by the seagrass site (6.9 ± 2.1) and mangrove site (5.6 ± 1.9). Seasonally, there existed differences in the mean number of individuals in each habitat: coral (NEM 8.6 ± 2.8 ; SEM 7.4 ± 2.8), seagrass (NEM 9.0 ± 2.6 ; SEM 4.8 ± 1.6), and mangrove (NEM 6.4 ± 2.0 ; SEM 4.8 ± 1.8) (Fig. 2a). Kruskal-Wallis tests revealed no significant difference in the mean number of individuals per haul across sites ($H(2, N = 60) = 4.81, p = 0.090$) and between seasons ($H(1, N = 60) = 2.10, p = 0.150$).

Species composition and diversity

Species richness varied across the three sites. The reef adjacent site had the highest mean species richness (21 ± 1.9) compared to the seagrass adjacent site (17 ± 0.1) and the mangrove adjacent site (14 ± 1.7) (Fig. 2b). Similarly, a seasonal difference in species richness was observed in each site. Species richness was highest in the coral site for both seasons (NEM: 22 ± 0.72 ; SEM: 20 ± 0.32) compared to the seagrass site (NEM: 18 ± 0.26 ; SEM: 17 ± 0.32) and mangrove site (NEM: 14 ± 0.5 ; SEM: 14 ± 0.52). The Kruskal-Wallis test revealed significant differences across the three sites ($H = 2, N = 60 = 7.27, p = 0.026$). Dunn's post-hoc multiple comparison tests confirmed significant differences between the reef and mangrove adjacent sites ($p = 0.0079$).

Shannon-Wiener diversity index (H') was highest in the reef adjacent site ($H' = 3.77$), followed by seagrass beds ($H' = 3.69$), and lowest in the mangrove site ($H' = 3.64$). Juvenile fish diversity showed a general trend toward higher mean values during the SEM season across all sites: reef (NEM: 1.97 ± 0.15 ; SEM: 2.38 ± 0.12), seagrass (NEM: 2.14 ± 0.11 ; SEM: 2.33 ± 0.17), and mangrove (NEM: 1.69 ± 0.21 ; SEM: 1.77 ± 0.20). However, a two-way ANOVA revealed that while diversity differed significantly across sites ($df = 2$, $F = 5.677$, $p = 0.006$) there was no significant effect of season ($df = 1$, $F = 0.818$, $p = 0.097$). Tukey HSD post-hoc comparisons further clarified these habitat-driven patterns, identifying a significant difference between the reef and mangrove adjacent sites ($p = 0.044$).

The distribution of the top 10 most abundant fish families varied across the three habitats (Fig. 3). The reef adjacent site harbored the highest fish species richness, especially for the families Labridae, Lethrinidae, and Pomacentridae. The seagrass adjacent site also supported relatively high richness, particularly for the families Labridae and Scaridae, whereas the mangrove adjacent site had the lowest. However, the family Apogonidae was more abundant in the mangrove site. Siganidae, Sphyraenidae, and Hemiramphidae showed a relatively balanced distribution across the three sites.

A total of 69 fish species were recorded across the mangrove-seagrass-coral reef continuum. Fish

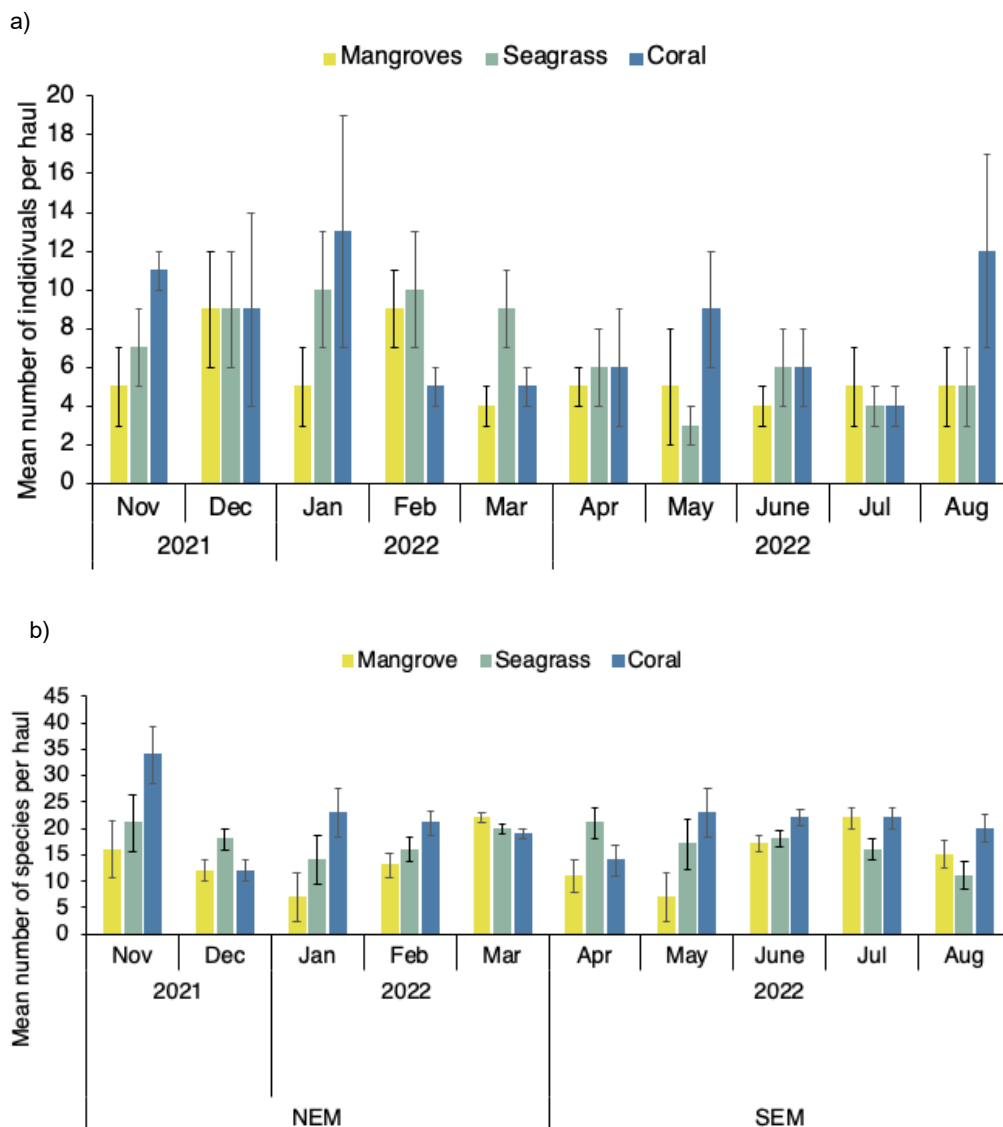


Figure 2. Monthly trend in juvenile fish community metrics from beach seine hauls across a mangrove-seagrass-coral continuum in Shimoni, Kenya: (a) Mean fish density and (b) mean species richness per haul ($\pm$ SE).

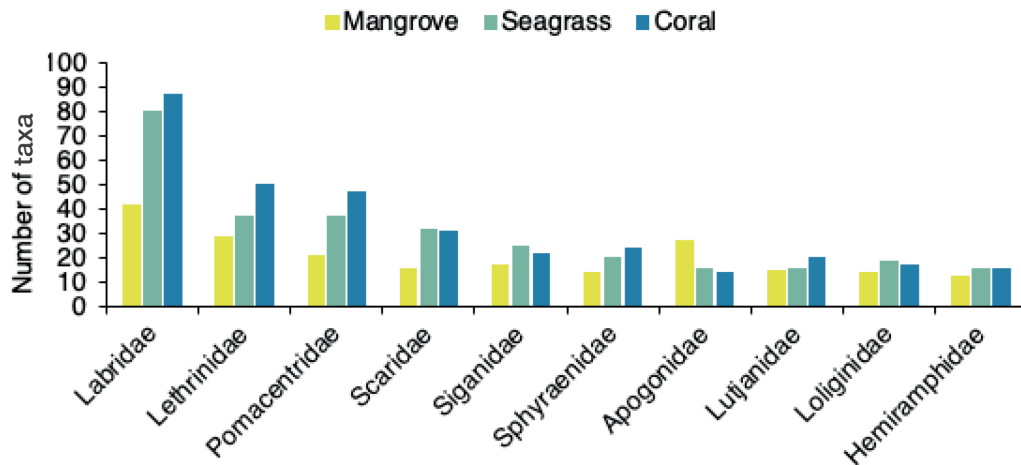


Figure 3. The number of taxa recorded among dominant (top 10) fish families recorded in beach seine hauls in a mangrove-seagrass-coral continuum in Shimoni, Kenya.

species composition was variable across the three sites. *Siganus sutor* had a high abundance in the mangrove-adjacent site (9 %). *Sphyraena barracuda* (19 %) and *Chromis viridis* (12 %) exhibited high abundances in the seagrass and reef sites, respectively (Fig. 4). Fish species richness varied across the different site combinations. For paired habitat combinations, the coral-seagrass sites recorded a total of 25 species, mangrove-seagrass (8 species), and mangrove-coral (15 species). Among the single habitats, the reef adjacent site recorded the highest species richness (59 species), followed by seagrass (28 species) and mangrove (23) (Fig. 5). A comprehensive summary of species utilization across the three habitats is provided in Appendix I. The results illustrate that fish diversity in habitats, predominantly the mangrove-seagrass-coral reef continuum, supports the highest species diversity.

Trophic structure

The species richness across trophic levels (Fig. 6a) showed a primary peak at TL (3.5 – 3.9), representing a high diversity of invertivores. Notably, the mangrove and seagrass adjacent sites were characterized by a higher number of herbivore species (TL = 2.0) compared to the coral reef associated habitat. The Kolmogorov-Smirnov (K-S) paired test of the trophic signatures (Fig. 6b) indicated no significant difference in the distribution of trophic signatures across the mangrove and seagrass sites ($D = 0.2308$, $p = 0.4402$). However, significant differences were observed between the mangrove and coral site ($D = 0.5385$, $p = 0.001$) and between the seagrass and coral reef habitats ($D = 0.4615$, $p = 0.005$).

Species-habitat associations and environmental influence

The Detrended Correspondence Analysis (DCA) of the 40 most abundant species revealed distinct clustering of juvenile fish assemblages across the three sites (Fig. 7). The primary axis (Axis 1) separated the mangrove-associated species from the coral reef and seagrass assemblages. The ordination showed that five species *Yarica hyalosoma* (#12), *Apogon fragilis* (#14), *Pristotis obtusirostris* (#17), *Taeniamia fucata* (#35), and *Pempheris mangula* (#36) strongly clustered with the mangrove associated habitat. Conversely, the coral and seagrass adjacent sites displayed high species overlaps, which suggests their role as transient habitat within the seascape mosaic.

Temporal trends in mean temperature and salinity are shown in Appendix III and reveal a distinct seasonal transition. The SEM is characterised by high environmental variability, reduced salinity and cooler temperatures while the NEM is characterised by warmer and more stable environmental conditions. The Canonical Correspondence Analysis (CCA) bi-plot (Fig. 8) elucidates the relationships between the 40 most abundant species and the measured hydrographic parameters revealed distinct species-specific associations with temperature and salinity gradients. Species such as *Scolopsis ghanam* (#23), *Lutjanus fulviflamma* (#13), and *Gerres oyena* (#4) exhibited a strong affinity for the coral adjacent site, clustering away from the influence of high-temperature fluctuations. Several species, including *Apogon fragilis* (#14), *Pristotis obtusirostris* (#17), *Taeniamia fucata* (#35), and *Pempheris mangula* (#36), showed a

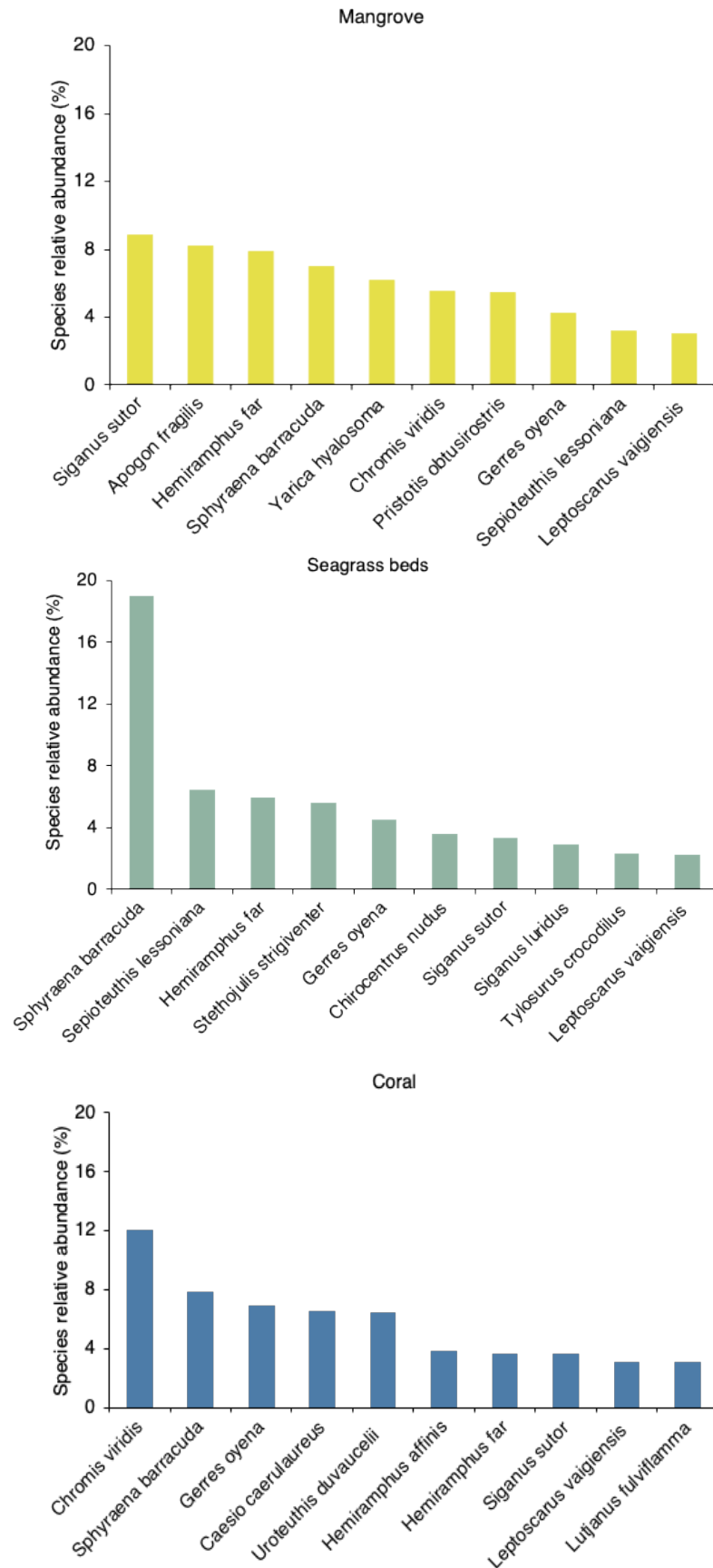


Figure. 4. Relative abundance (%) of the ten most abundant fish species pooled across a mangrove-seagrass-coral continuum in Shimoni, Kenya.

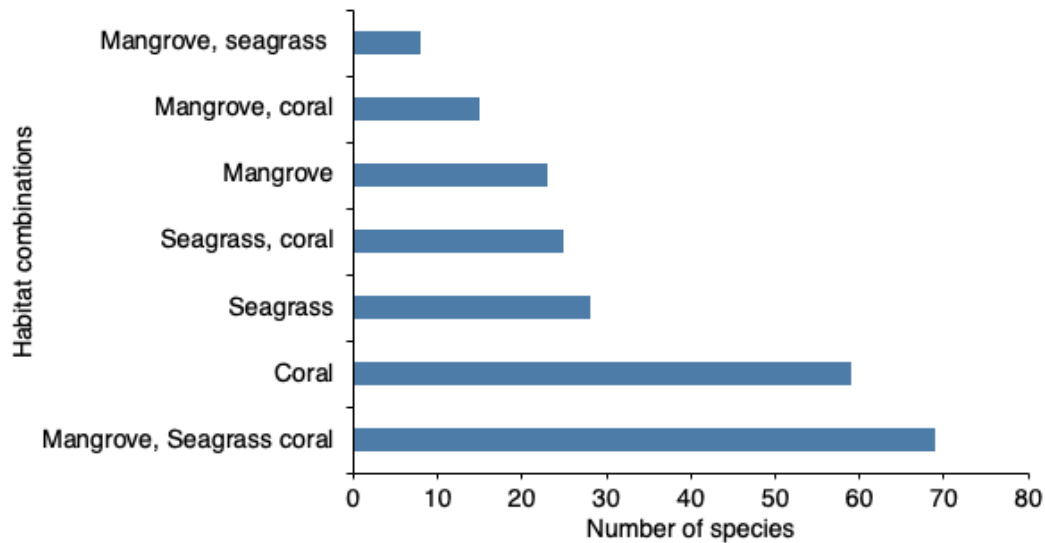


Figure 5. Species richness of juvenile reef fish recorded from a beach seine across a mangrove-seagrass-coral continuum in Shimoni, Kenya.

strong positive association with higher temperatures, which characterized the shallower mangrove environments. Assemblages in the seagrass adjacent site, notably *Sphyraena barracuda* (#1), *Chirocentrus nudus* (#16), *Siganus luridus* (#20), *Scarus psittacus* (#30), *Siganus stellatus* (#40), and *Thalassoma hebraicum* (#26), were positively correlated with increasing salinity levels. Species positioned near the origin (0,0) of the

bi-plot, such as *Leptoscarus vaigiensis* (#10) and *Lethrinus harak* (#25), appeared to be least influenced by the measured environmental variables, suggesting a broader tolerance or a more generalist distribution across the habitat continuum. In contrast, *Hemiramphus far* (#3) occupied a neutral position relative to both temperature and salinity increases.

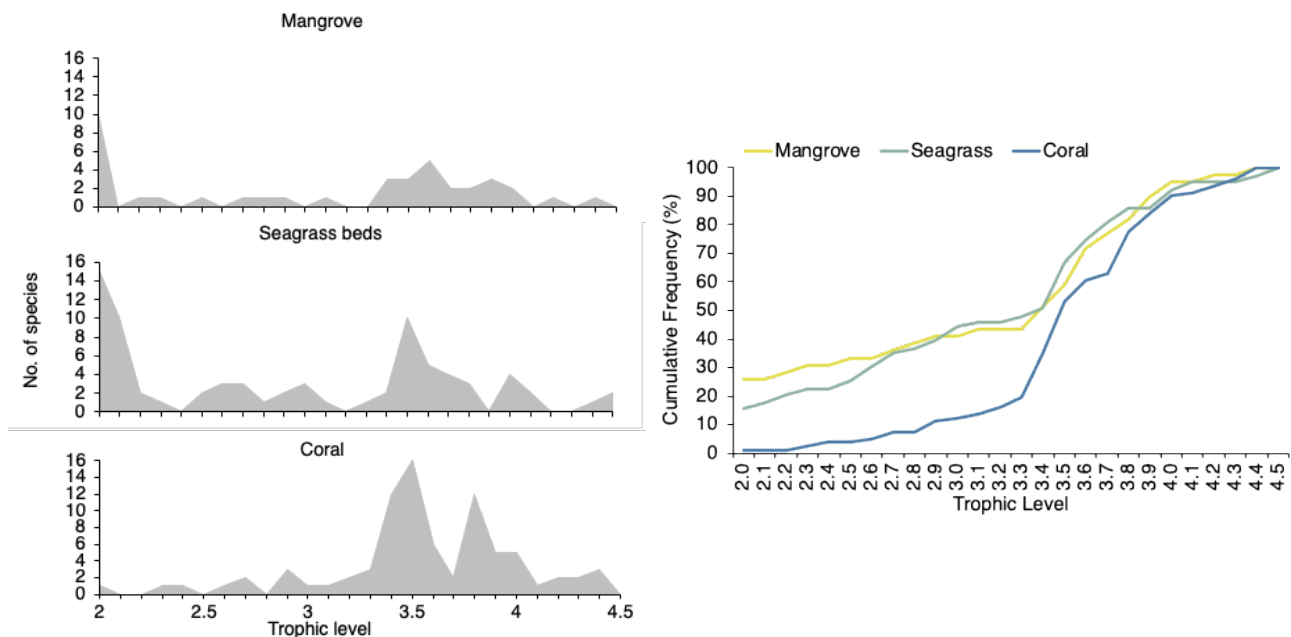


Figure 6. Trophic composition of juvenile fish assemblages in Shimoni, Kenya caught by beach seining in a mangrove-seagrass-coral continuum: (a) distribution of species richness across trophic levels (TL); (b) the cumulative trophic signatures representing the proportion of fish species relative to TL.

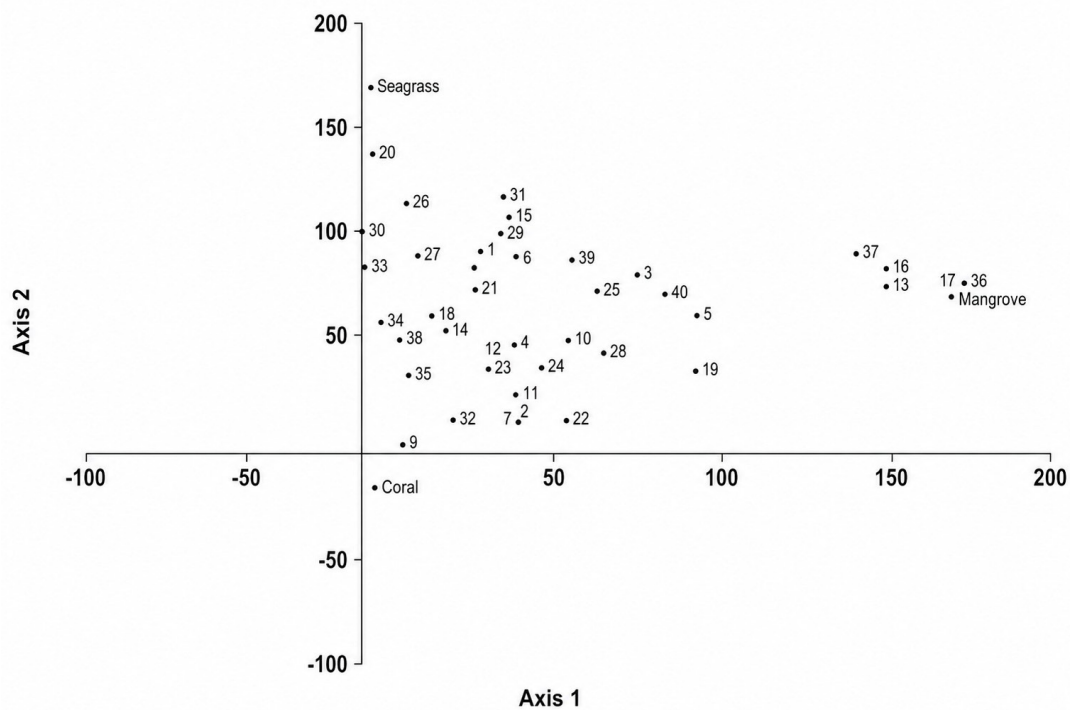


Figure 7. Detrended Correspondence Analysis (DCA) ordination bi-plot showing the associations abundant juvenile fish species across a mangrove, seagrass, and coral-associated habitat in Shimoni, Kenya. The distance between a species and habitat indicates the degree of ecological similarity, with clusters reflecting habitat-specific assemblages. 1. *S. barracuda*, 2. *C. viridis*, 3. *H. far*, 4. *G. oyena*, 5. *S. sutor*, 6. *S. lessoniana*, 7. *C. caeruleus*, 8. *S. strigiventer*, 9. *U. duvaucelii*, 10. *L. vaigiensis*, 11. *H. affinis*, 12. *Y. hyalosoma*, 13. *L. fulviflamma*, 14. *A. fragilis*, 15. *T. crocodilus*, 16. *C. nudus*, 17. *P. obtusirostris*, 18. *N. azysron*, 19. *P. gaterinus*, 20. *S. luridus*, 21. *L. microdon*, 22. *D. trimaculatus*, 23. *S. ghanam*, 24. *C. carolinus*, 25. *L. harak*, 26. *T. hebraicum*, 27. *A. vaigiensis*, 28. *C. trifasciatus*, 29. *H. nigrescens*, 30. *S. psittacus*, 31. *A. sparoides*, 32. *L. variegatus*, 33. *P. trilineatus*, 34. *C. quinquelineatus*, 35. *T. fucata*, 36. *P. mangula*, 37. *P. macronemus*, 38. *S. leiura*, 39. *F. commersonii*, 40. *S. stellatus*.

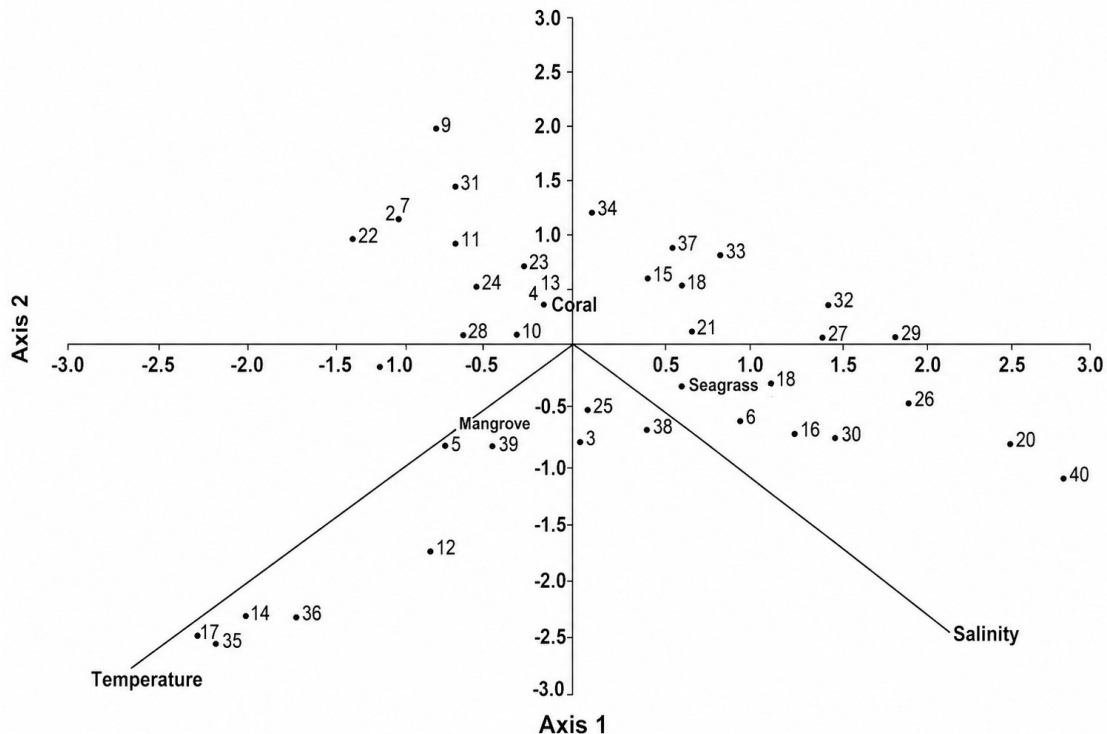


Figure 8. CCA biplot showing the relationship between physicochemical variables (salinity and temperature) and the top 40 juvenile fish species in mangrove, seagrass, and coral habitats (refer to Fig. 7 for species list).

Discussion

This study aimed to assess spatial and temporal patterns in juvenile fish assemblages along a mangrove-seagrass-coral continuum. The study revealed clear spatial differences in species composition, richness and abundance among the sites. Juvenile fish diversity and abundance was highest at the coral reef adjacent site compared to the other sites. The high diversity in reef-adjacent sites is likely driven by the structural complexity of the adjacent reef, which may provide refuge from predators (Du *et al.*, 2020; Karisa *et al.*, 2020). Although sampling was not conducted directly within each habitat, the proximity of sampling sites to these habitat types suggests that adjacent habitat structures play a key role in shaping juvenile fish assemblages along the continuum.

Several abundant species, including *Abudefduf sparoides*, *Acanthurus nigricauda*, and *Chromis viridis*, were recorded in all three sites. This indicates that some species utilize multiple habitat mosaics within the mangrove-seagrass-coral continuum. It also reflects movement across habitat boundaries for feeding, refuge, or ontogenetic shifts. These findings underscore the ecological connectivity between coral reefs, seagrass beds, and mangroves, and highlight the importance of considering the habitats as an integrated system rather than as isolated units.

The significant difference in mean diversity between the reef-adjacent and mangrove-adjacent sites reinforces the influence of habitat structure on juvenile fish assemblages. Seagrass habitats may play a transitional role by facilitating connectivity between mangroves and coral reefs, acting as corridors for ontogenetic movements (Mumby *et al.*, 2006; Du *et al.*, 2020).

The seasonal pattern in juvenile fish abundance was not distinct in this study as reported in previous studies which observed higher abundances during the Northeast Monsoon (NEM) for fish (Okemwa *et al.*, 2019) and larvae (Mwaluma *et al.*, 2021, 2022; Tarimo *et al.*, 2022). It is hypothesized that the dynamic nature of the mangrove-seagrass-coral continuum may buffer seasonal signals, particularly where juvenile fishes are mobile and can continuously redistribute across adjacent habitats. Another hypothesis is that the sampling method using a beach seine may have had an influence.

Notably, beach seine efficiency can vary with environmental conditions such as increased turbidity during the SEM which may reduce net avoidance resulting in

higher apparent catch compared to the clearer NEM period. Tidal effects, particularly the concentration of juveniles in shallow fringe areas during low tide, may additionally contribute to variability in catches. As noted by Gell and Whittington (2002), such gear-related biases can obscure subtle temporal patterns.

With regard to the trophic structure, herbivorous juveniles were most abundant at the mangrove- and seagrass-adjacent sites. This likely reflects the greater availability of plant-based food resources and shelter (Whitfield, 2017; Kairo *et al.*, 2021; Wanjiru *et al.*, 2022). These findings highlight the role of vegetated habitats in sustaining herbivorous fish populations and demonstrates the functional interdependence of the two ecosystems.

Species-specific habitat associations were most pronounced in the mangrove adjacent site. This suggests species adaptation and preferences to the shallow, warmer conditions characteristic of mangrove fringes. In contrast, the strong species overlaps between seagrass- and reef-adjacent sites supports the role of seagrass beds as transitional habitats for species such as *Gerres oyena* during movement toward more stable, higher-salinity reef environments. The Canonical Correspondence Analysis (CCA) further demonstrated that environmental variables, particularly salinity and temperature, significantly influenced species distribution and diversity. Similar patterns have been reported in other studies within the region (Eick and Thiel, 2014; James *et al.*, 2013; Mwaluma *et al.*, 2011, 2022). These findings indicate that while juvenile fish assemblages are distributed across a connected habitat continuum, the assemblage dynamics are strongly shaped by localized environmental conditions.

In conclusion, this study demonstrates the nursery role of the mangrove-seagrass-coral continuum. Each habitat contributes uniquely to supporting juvenile fish populations. Thus, the continuum plays a critical role in shaping fish assemblage structure. These findings underscore the importance of conserving coastal habitat mosaics as integrated systems to sustain fish recruitment and population dynamics in the Western Indian Ocean. Further research incorporating more replicated sampling would help refine understanding of connectivity and habitat use in these habitat mosaics.

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Appendix I

Table AI. Relative abundance and frequency of occurrence (FO%) of juvenile fish species pooled across mangrove, seagrass, and coral reef habitats in Shimoni, Kenya.

Species ID Number	Family	Species	Number sampled	Relative abundance (%)	Frequency of occurrence (%FO)
1	Sphyraenidae	<i>Sphyraena barracuda</i>	954	11.1	5
2	Pomacentridae	<i>Chromis viridis</i>	604	7.0	5
3	Hemiramphidae	<i>Hemiramphus far</i>	468	5.5	5
4	Gerreidae	<i>Gerres oyena</i>	467	5.4	5
5	Siganidae	<i>Siganus sutor</i>	418	4.9	5
6	Loliginidae	<i>Septeuthis lessoniana</i>	344	4.0	5
7	Caesionidae	<i>Caesio caeruleus</i>	322	3.8	5
8	Labridae	<i>Stethojulis strigiventer</i>	295	3.4	5
9	Loliginidae	<i>Uroteuthis duvaucelii</i>	263	3.1	5
10	Scaridae	<i>Leptoscarus vaigiensis</i>	238	2.8	5
11	Hemiramphidae	<i>Hemiramphus affinis</i>	213	2.5	5
12	Apogonidae	<i>Yarica hyalosoma</i>	206	2.4	5
13	Lutjanidae	<i>Lutjanus fulviflamma</i>	201	2.3	5
14	Apogonidae	<i>Apogon fragilis</i>	198	2.3	5
15	Belonidae	<i>Tylosurus crocodilus</i>	166	1.9	5
16	Chirocentridae	<i>Chirocentrus nudus</i>	164	1.9	5
17	Pomacentridae	<i>Pristotis obtusirostris</i>	121	1.4	2
18	Pomacentridae	<i>Neopomacentrus azyron</i>	118	1.4	5
19	Haemulidae	<i>Plectorhinchus gaterinus</i>	98	1.1	5
20	Siganidae	<i>Siganus luridus</i>	92	1.1	5
21	Lethrinidae	<i>Lethrinus microdon</i>	88	1.0	5
22	Pomacentridae	<i>Dascyllus trimaculatus</i>	87	1.0	5
23	Nemipteridae	<i>Scolopsis ghanam</i>	83	1.0	5
24	Carangidae	<i>Calotomus carolinus</i>	79	0.9	5
25	Lethrinidae	<i>Lethrinus harak</i>	77	0.9	5
26	Labridae	<i>Thalassoma hebraicum</i>	75	0.9	2
27	Pomacentridae	<i>Abudefduf vaigiensis</i>	74	0.9	5
28	Chaetodontidae	<i>Chaetodon trifasciatus</i>	71	0.8	5
29	Labridae	<i>Halichoeres nigrescens</i>	67	0.8	2
30	Scaridae	<i>Scarus psittacus</i>	65	0.8	5
31	Pomacentridae	<i>Abudefduf sparoides</i>	64	0.7	5
32	Lethrinidae	<i>Lethrinus variegatus</i>	64	0.7	3
33	Pomacentridae	<i>Pomacentrus trilineatus</i>	63	0.7	5
34	Apogonidae	<i>Cheilodipterus quinquelineatus</i>	58	0.7	5
35	Apogonidae	<i>Taeniamia fucata</i>	58	0.7	3
36	Pempheridae	<i>Pempheris mangula</i>	57	0.7	3
37	Mullidae	<i>Parupeneus macronemus</i>	52	0.6	5
38	Belonidae	<i>Strongylura leiura</i>	47	0.5	5
39	Fistulariidae	<i>Fistularia commersonii</i>	44	0.5	5
40	Siganidae	<i>Siganus stellatus</i>	44	0.5	5
41	Belonidae	<i>Ablennes hians</i>	43	0.5	3
42	Labridae	<i>Halichoeres scapularis</i>	41	0.5	5
43	Apogonidae	<i>Cheilodipterus macrodon</i>	40	0.5	5
44	Zanclidae	<i>Zanclus cornutus</i>	35	0.4	5
45	Lethrinidae	<i>Lethrinus borbonicus</i>	31	0.4	5
46	Pomacentridae	<i>Pomacentrus azuremaculatus</i>	29	0.3	2
47	Labridae	<i>Acanthurus blochii</i>	27	0.3	5
48	Spratelloididae	<i>Spratelloides delicatulus</i>	27	0.3	2
49	Apogonidae	<i>Archamia fucata</i>	26	0.3	2

Species ID Number	Family	Species	Number sampled	Relative abundance (%)	Frequency of occurrence (%FO)
50	Pomacentridae	<i>Abudefduf sexfasciatus</i>	25	0.3	5
51	Sphyraenidae	<i>Sphyraena flavicauda</i>	25	0.3	2
52	Apogonidae	<i>Ostorhinchus cookii</i>	24	0.3	3
53	Carangidae	<i>Carangoides armatus</i>	23	0.3	5
54	Carangidae	<i>Carangoides dinema</i>	22	0.3	5
55	Labridae	<i>Cheilio inermis</i>	22	0.3	5
56	Centriscidae	<i>Aeoliscus punctulatus</i>	21	0.2	5
57	Apogonidae	<i>Apogon semiornatus</i>	21	0.2	2
58	Sphyraenidae	<i>Sphyraena obtusata</i>	21	0.2	2
59	Fistulariidae	<i>Fistularia petimba</i>	18	0.2	5
60	Labridae	<i>Thalassoma hardwicke</i>	18	0.2	2
61	Pomacentridae	<i>Abudefduf sordidus</i>	17	0.2	3
62	Carangidae	<i>Caranx melampygus</i>	17	0.2	5
63	Ephippidae	<i>Platax teira</i>	17	0.2	5
64	Scaridae	<i>Chlorurus pyrrhus</i>	16	0.2	2
65	Pomacentridae	<i>Chromis amboinensis</i>	16	0.2	3
66	Thalassoma lunare	<i>Thalassoma lunare</i>	16	0.2	3
67	Scaridae	<i>Calotomus spinidens</i>	15	0.2	3
68	Pomacentridae	<i>Plectoglyphidodon lacrymatus</i>	15	0.2	2
69	Labridae	<i>Acanthurus nigricauda</i>	14	0.2	5
70	Lethrinidae	<i>Lethrinus lentjan</i>	14	0.2	5
71	Mullidae	<i>Parupeneus rubescens</i>	14	0.2	5
72	Haemulidae	<i>Plectorhinchus chubbi</i>	14	0.2	3
73	Scaridae	<i>Scarus ghobban</i>	14	0.2	3
74	Lethrinidae	<i>Lethrinus nebulosus</i>	13	0.2	5
75	Siganidae	<i>Siganus canaliculatus</i>	13	0.2	3
76	Apogonidae	<i>Ostorhinchus nigripes</i>	24	0.3	5
77	Apogonidae	<i>Apogonichthyoides timorensis</i>	12	0.1	2
78	Tetraodontidae	<i>Arothron hispidus</i>	12	0.1	3
79	Synodontidae	<i>Saurida gracilis</i>	11	0.1	5
80	Tetraodontidae	<i>Canthigaster solandri</i>	10	0.1	3
81	Scombridae	<i>Rastrigella kanarguta</i>	10	0.1	2
82	Danionidae	<i>Rastrineobola argentea</i>	10	0.1	2
83	Carangidae	<i>Scomberoides tol</i>	10	0.1	2
84	Mullidae	<i>Upeneus tragula</i>	10	0.1	5
85	Monacanthidae	<i>Aluterus scriptus</i>	9	0.1	3
86	Labridae	<i>Labroides dimidiatus</i>	9	0.1	5
87	Ostraciidae	<i>Lactoria fornasini</i>	9	0.1	3
88	Lethrinidae	<i>Lethrinus obsoletus</i>	9	0.1	5
89	Lethrinidae	<i>Lethrinus mahsena</i>	9	0.1	5
90	Pomacentridae	<i>Neoglyphidodon oxyodon</i>	9	0.1	3
91	Mullidae	<i>Parupeneus barberinus</i>	9	0.1	5
92	Scaridae	<i>Scarus gibbus</i>	9	0.1	2
93	Labridae	<i>Acanthurus nigrofusus</i>	8	0.1	3
94	Caesionidae	<i>Caesio lunaris</i>	8	0.1	2
95	Tetraodontidae	<i>Canthigaster amboinensis</i>	8	0.1	5
96	Scaridae	<i>Chlorurus sordidus</i>	8	0.1	3
97	Carangidae	<i>Caranx heberi</i>	7	0.1	3
98	Lethrinidae	<i>Lethrinus borbonicus</i>	7	0.1	2
99	Lethrinidae	<i>Lethrinus xanthurus</i>	7	0.1	3
100	Mullidae	<i>Parupeneus cinnabarinus</i>	7	0.1	2
101	Scaridae	<i>Scarus globiceps</i>	7	0.1	2
102	Siganidae	<i>Siganus rivulatus</i>	7	0.1	5

Species ID Number	Family	Species	Number sampled	Relative abundance (%)	Frequency of occurrence (%FO)
103	Pomacentridae	<i>Abudefduf natalensis</i>	6	0.1	2
104	Pomacentridae	<i>Abudefduf septemfasciatus</i>	6	0.1	2
105	Labridae	<i>Acanthurus gahhm</i>	6	0.1	3
106	Monodactylidae	<i>Monodactylus argenteus</i>	6	0.1	3
107	Sparidae	<i>Pachymetopon blochi</i>	6	0.1	2
108	Syngnathidae	<i>Syngnathoides biaculeatus</i>	6	0.1	5
109	Labridae	<i>Acanthurus dussumieri</i>	5	0.1	2
110	Labridae	<i>Acanthurus mata</i>	5	0.1	2
111	Chaetodontidae	<i>Chaetodon melanotus</i>	5	0.1	5
112	Pomacentridae	<i>Chromis scotochiloptera</i>	5	0.1	2
114	Apogonidae	<i>Rhabdamia gracilis</i>	5	0.1	2
115	Clupeidae	<i>Sardinella gibbosa</i>	5	0.1	2
116	Siganidae	<i>Siganus argenteus</i>	5	0.1	2
117	Chaetodontidae	<i>Chaetodon xanthocephalus</i>	4	0.0	3
118	Labridae	<i>Cheilinus chlorourus</i>	4	0.0	3
119	Apogonidae	<i>Cheilodipterus artus</i>	4	0.0	2
120	Pomacentridae	<i>Chrysiptera annulata</i>	4	0.0	2
121	Dactylopteridae	<i>Dactyloptena peterseni</i>	4	0.0	5
122	Diodontidae	<i>Diodon liturosus</i>	4	0.0	3
123	Fistulariidae	<i>Fistularia petimba</i>	4	0.0	3
124	Labridae	<i>Gomphosus caeruleus</i>	4	0.0	3
125	Labridae	<i>Halichoeres hortulanus</i>	4	0.0	3
126	Scaridae	<i>Hipposcarus harid</i>	4	0.0	3
127	Scaridae	<i>Hipposcarus longiceps</i>	4	0.0	2
128	Ostraciidae	<i>Lactoria diaphana</i>	4	0.0	5
129	Lethrinidae	<i>Lethrinus erythropterus</i>	4	0.0	2
130	Haemulidae	<i>Plectorhynchus schotaf</i>	4	0.0	2
131	Caesionidae	<i>Pterocaesio tile</i>	4	0.0	2
132	Clupeidae	<i>Sardinella longiceps</i>	4	0.0	2
133	Acanthuridae	<i>Zebrasoma veliferum</i>	4	0.0	3
134	Tetraodontidae	<i>Canthigaster valentini</i>	3	0.0	2
135	Scaridae	<i>Cetoscarus bicolor</i>	3	0.0	3
136	Chaetodontidae	<i>Chaetodon auriga</i>	3	0.0	2
137	Labridae	<i>Cheilinus trilobatus</i>	3	0.0	5
138	Labridae	<i>Cheilinus undulatus</i>	3	0.0	3
139	Dactylopteridae	<i>Dactyloptena orientalis</i>	3	0.0	2
140	Labridae	<i>Hemigymnus melapterus</i>	3	0.0	3
141	Lethrinidae	<i>Lethrinus rubrioperculatus</i>	3	0.0	3
142	Acanthuridae	<i>Naso brevirostris</i>	3	0.0	2
143	Pempheridae	<i>Pempheris schwenkii</i>	3	0.0	2
144	Priacanthidae	<i>Priacanthus hamrur</i>	3	0.0	5
145	Scaridae	<i>Scarus prasiognathus</i>	3	0.0	5
146	Synodontidae	<i>Synodus englemani</i>	3	0.0	3
147	Labridae	<i>Thalassoma purpuraceum</i>	3	0.0	2
148	Labridae	<i>Acanthurus triostegus</i>	2	0.0	2
149	Carangidae	<i>Alectis ciliaris</i>	2	0.0	2
150	Pomacentridae	<i>Amphiprion allardi</i>	2	0.0	2
151	Apogonidae	<i>Apogon cyanosoma</i>	2	0.0	2
152	Tetraodontidae	<i>Arathron hispidus</i>	2	0.0	2
153	Chaetodontidae	<i>Chaetodon trifascialis</i>	2	0.0	2
154	Chaetodontidae	<i>Chaetodon ocellicaudus</i>	2	0.0	3
155	Syngnathidae	<i>Choeroichthys sculptus</i>	2	0.0	2
156	Pomacentridae	<i>Chromis opercularis</i>	2	0.0	2

Species ID Number	Family	Species	Number sampled	Relative abundance (%)	Frequency of occurrence (%FO)
157	Pomacentridae	<i>Chrysiptera biocellata</i>	2	0.0	3
158	Labridae	<i>Epibulus insidiator</i>	2	0.0	3
159	Lethrinidae	<i>Lethrinus mahsena</i>	2	0.0	2
160	Lethrinidae	<i>Lethrinus olivaceus</i>	2	0.0	3
161	Lutjanidae	<i>Lutjanus ehrenbergi</i>	2	0.0	3
162	Lutjanidae	<i>Lutjanus russellii</i>	2	0.0	2
163	Lutjanidae	<i>Macolor niger</i>	2	0.0	2
164	Monacanthidae	<i>Paraluteres prionurus</i>	2	0.0	3
165	Mullidae	<i>Parupeneus indicus</i>	2	0.0	2
166	Mullidae	<i>Parupeneus heptacanthus</i>	2	0.0	3
167	Haemulidae	<i>Plectorhinchus scholaf</i>	2	0.0	2
168	Haemulidae	<i>Plectorhinchus flavomaculatus</i>	2	0.0	3
169	Scorpaenidae	<i>Pterois miles</i>	2	0.0	2
170	Scaridae	<i>Scarus sordidus</i>	2	0.0	3
171	Nemipteridae	<i>Scolopsis bimaculata</i>	2	0.0	2
172	Carangidae	<i>Scomberoides commersonnianus</i>	2	0.0	2
173	Labridae	<i>Stethojulis balteata</i>	2	0.0	3
174	Dasyatidae	<i>Taeniura lymma</i>	2	0.0	3
175	Balistidae	<i>Abalistes stellatus</i>	1	0.0	2
176	Labridae	<i>Acanthurus lineatus</i>	1	0.0	2
177	Labridae	<i>Acanthurus xanthopterus</i>	1	0.0	2
178	Monacanthidae	<i>Aluterus monoceros</i>	1	0.0	2
179	Antennariidae	<i>Antennarius indicus</i>	1	0.0	2
180	Apogonidae	<i>Apogon timorensis</i>	1	0.0	2
181	Tetraodontidae	<i>Arothron immaculatus</i>	1	0.0	2
182	Tetraodontidae	<i>Arothron stellatus</i>	1	0.0	2
183	Bothidae	<i>Bothus pantherinus</i>	1	0.0	2
184	Monacanthidae	<i>Cantherhines pardalis</i>	1	0.0	2
185	Tetraodontidae	<i>Canthigaster bennetti</i>	1	0.0	2
186	Carangidae	<i>Caranx tille</i>	1	0.0	2
187	Chaetodontidae	<i>Chaetodon falcula</i>	1	0.0	2
188	Chaetodontidae	<i>Chaetodon lunula</i>	1	0.0	2
189	Labridae	<i>Cheilinus cheilionermis</i>	1	0.0	2
190	Pomacentridae	<i>Chromis notata</i>	1	0.0	2
191	Labridae	<i>Coris caudimacula</i>	1	0.0	2
192	Acanthuridae	<i>Ctenochaetus striatus</i>	1	0.0	2
193	Diodontidae	<i>Cyclichthys orbicularis</i>	1	0.0	2
194	Haemulidae	<i>Diagramma pictum</i>	1	0.0	2
195	Diodontidae	<i>Diodon hystrix</i>	1	0.0	2
196	Drepaneida	<i>Drepane longimana</i>	1	0.0	2
197	Blenniidae	<i>Ecsenius bicolor</i>	1	0.0	2
198	Serranidae	<i>Epinephelus caeruleopunctatus</i>	1	0.0	2
199	Labridae	<i>Halichoeres marginatus</i>	1	0.0	3
200	Labridae	<i>Halichoeres bivittatus</i>	1	0.0	2
201	Syngnathidae	<i>Hippichthys spicifer</i>	1	0.0	2
202	Ostraciidae	<i>Lactoria cornuta</i>	1	0.0	2
203	Lethrinidae	<i>Lethrinus genivittatus</i>	1	0.0	2
204	Lutjanidae	<i>Lutjanus bohar</i>	1	0.0	2
205	Lutjanidae	<i>Lutjanus lutjanus</i>	1	0.0	2
206	Lutjanidae	<i>Lutjanus stallatus</i>	1	0.0	2
207	Monodactylidae	<i>Monodactylus falciformis</i>	1	0.0	2
208	Mullidae	<i>Mulloidichthys vanicolensis</i>	1	0.0	2
209	Acanthuridae	<i>Naso annulatus</i>	1	0.0	2

Species ID Number	Family	Species	Number sampled	Relative abundance (%)	Frequency of occurrence (%FO)
210	Acanthuridae	<i>Naso fageni</i>	1	0.0	2
211	Acanthuridae	<i>Naso thynnoides</i>	1	0.0	2
212	Labridae	<i>Novaculoides macrolepidotus</i>	1	0.0	2
213	Ostraciidae	<i>Ostracion cubicum</i>	1	0.0	2
214	Scorpaenidae	<i>Parascorpaena mossambica</i>	1	0.0	2
215	Plotosidae	<i>Plotosus nkunga</i>	1	0.0	2
216	Pomacentridae	<i>Pomacentrus indicus</i>	1	0.0	2
217	Labridae	<i>Pteragogus flagellifera</i>	1	0.0	2
218	Clupeidae	<i>Sardinella neglecta</i>	1	0.0	2
219	Scorpaenidae	<i>Sebastapistes mauritiana</i>	1	0.0	2
220	Scorpaenidae	<i>Sebastapistes strongia</i>	1	0.0	2
221	Solenostomidae	<i>Solenostomus cyanopterus</i>	1	0.0	2
222	Sphyraenidae	<i>Sphyraena putnamae</i>	1	0.0	2
223	Pomacentridae	<i>Stegastes partitus</i>	1	0.0	2
224	Engraulidae	<i>Stolephorus waitei</i>	1	0.0	2
225	Syngnathidae	<i>Syngnathus acus</i>	1	0.0	2
226	Labridae	<i>Thalassoma lunare</i>	1	0.0	2
227	Labridae	<i>Thalassoma lutescens</i>	1	0.0	2
228	Zanclidae	<i>Zanclus canescens</i>	1	0.0	2
			8,575	100.0	

Appendix II

Table AII. Presence (+) and absence (-) of juvenile fish species sampled in 60 beach seine hauls across mangrove-seagrass-coral continuum in Shimoni, Kenya. Gray shading indicates juveniles of the species were present in all three habitats.

Species	Mangrove	Seagrass	Coral	Combination
<i>Abalistes stellatus</i>	-	+	-	S
<i>Ablennes hians</i>	-	+	+	S, C
<i>Abudefduf natalensis</i>	-	-	+	C
<i>Abudefduf septemfasciatus</i>	-	-	+	C
<i>Abudefduf sordidus</i>	-	+	+	S, C
<i>Abudefduf sparoides</i>	+	+	+	M, S, C
<i>Abudefduf vaigiensis</i>	+	+	+	M, S, C
<i>Abudefduf sexfasciatus</i>	+	+	+	M, S, C
<i>Acanthurus blochii</i>	+	+	+	M, S, C
<i>Acanthurus dussumieri</i>	-	-	+	C
<i>Acanthurus gahhm</i>	+	-	+	M, C
<i>Acanthurus lineatus</i>	-	-	+	C
<i>Acanthurus mata</i>	-	+	-	S
<i>Acanthurus nigrofusus</i>	+	-	+	M, C
<i>Acanthurus triostegus</i>	-	+	-	S
<i>Acanthurus xanthopterus</i>	-	-	+	C
<i>Acanthurus nigricauda</i>	+	+	+	M, S, C
<i>Aeoliscus punctulatus</i>	+	+	+	M, S, C
<i>Alectis ciliaris</i>	-	-	+	C
<i>Aluterus monoceros</i>	-	+	-	S
<i>Aluterus scriptus</i>	-	+	+	S, C
<i>Amphiprion allardi</i>	-	-	+	C
<i>Antennarius indicus</i>	+	-	-	M
<i>Apogon cyanosoma</i>	+	-	-	M
<i>Apogon fragilis</i>	+	+	+	M, S, C
<i>Apogon semiornatus</i>	-	+	-	S
<i>Apogon timorensis</i>	-	-	+	C
<i>Apogonichthyoides timorensis</i>	+	-	-	M
<i>Arathron hispidus</i>	-	-	+	C
<i>Archamia fucata</i>	-	-	+	C
<i>Arothron hispidus</i>	-	+	+	S, C
<i>Arothron immaculatus</i>	-	-	+	C
<i>Arothron stellatus</i>	-	+	-	S
<i>Bothus pantherinus</i>	-	-	+	C
<i>Caesio caeruleus</i>	+	+	+	M, S, C
<i>Caesio lunaris</i>	-	-	+	C
<i>Calotomus spinidens</i>	-	+	+	S, C
<i>Calotomus carolinus</i>	+	+	+	M, S, C
<i>Cantherhines pardalis</i>	+	-	-	M
<i>Canthigaster amboinensis</i>	+	+	+	M, S, C
<i>Canthigaster bennetti</i>	-	+	-	S
<i>Canthigaster solandri</i>	+	+	-	M, S
<i>Canthigaster valentini</i>	-	-	+	C

Species	Mangrove	Seagrass	Coral	Combination
<i>Carangoides armatus</i>	+	+	+	M, S, C
<i>Carangoides dinema</i>	+	+	+	M, S, C
<i>Caranx heberi</i>	+	-	+	M, C
<i>Caranx melampygus</i>	+	+	+	M, S, C
<i>Caranx tille</i>	+	-	-	M
<i>Cetoscarus bicolor</i>	-	+	+	S, C
<i>Chaetodon auriga</i>	-	-	+	C
<i>Chaetodon falcula</i>	-	-	+	C
<i>Chaetodon lunula</i>	-	+	-	S
<i>Chaetodon melannotus</i>	+	+	+	M, S, C
<i>Chaetodon trifascialis</i>	-	-	+	C
<i>Chaetodon trifasciatus</i>	+	+	+	M, S, C
<i>Chaetodon xanthocephalus</i>	-	+	+	S, C
<i>Chaetodon ocellicaudus</i>	+	-	+	M, C
<i>Cheilinus cheilionermis</i>	-	-	+	C
<i>Cheilinus chlorourus</i>	+	-	+	M, C
<i>Cheilinus trilobatus</i>	+	+	+	M, S, C
<i>Cheilinus undulatus</i>	-	+	+	S, C
<i>Cheilio inermis</i>	+	+	+	M, S, C
<i>Cheilodipterus artus</i>	+	-	-	M
<i>Cheilodipterus macrodon</i>	+	+	+	M, S, C
<i>Cheilodipterus quinquelineatus</i>	+	+	+	M, S, C
<i>Chirocentrus nudus</i>	+	+	+	M, S, C
<i>Chlorurus pyrrhus</i>	-	-	+	C
<i>Chlorurus sordidus</i>	-	+	+	S, C
<i>Choeroichthys sculptus</i>	-	-	+	C
<i>Chromis amboinensis</i>	+	+	-	M, S
<i>Chromis notata</i>	-	-	+	C
<i>Chromis opercularis</i>	-	+	-	S
<i>Chromis scotochiloptera</i>	-	-	+	C
<i>Chromis viridis</i>	+	+	+	M, S, C
<i>Chrysiptera annulata</i>	+	-	-	M
<i>Chrysiptera biocellata</i>	+	-	+	M, C
<i>Coris caudimacula</i>	-	-	+	C
<i>Ctenochaetus striatus</i>	-	+	-	S
<i>Cyclichthys orbicularis</i>	-	+	-	S
<i>Dactyloptena orientalis</i>	-	-	+	C
<i>Dactyloptena peterseni</i>	+	+	+	M, S, C
<i>Dascyllus trimaculatus</i>	+	+	+	M, S, C
<i>Diagramma pictum</i>	-	+	-	S
<i>Diodon hystrix</i>	-	-	+	C
<i>Diodon liturosus</i>	-	+	+	S, C
<i>Drepane longimana</i>	-	-	+	C
<i>Ecsenius bicolor</i>	-	-	+	C
<i>Epibulus insidiator</i>	-	+	+	S, C
<i>Epinephelus caeruleopunctatus</i>	+	-	-	M

Species	Mangrove	Seagrass	Coral	Combination
<i>Fistularia petimba</i>	+	+	+	M, S, C
<i>Fistularia commersonii</i>	+	+	+	M, S, C
<i>Fistularia petimba</i>	-	+	+	S, C
<i>Gerres oyena</i>	+	+	+	M, S, C
<i>Gomphosus caeruleus</i>	-	+	+	S, C
<i>Halichoeres nigrescens</i>	-	+	+	S, C
<i>Halichoeres hortulanus</i>	+	-	+	M, C
<i>Halichoeres marginatus</i>	-	+	-	S
<i>Halichoeres scapularis</i>	+	+	+	M, S, C
<i>Halichoeres bivittatus</i>	-	-	+	C
<i>Hemigymnus melapterus</i>	+	-	+	M, C
<i>Hemiramphus affinis</i>	+	+	+	M, S, C
<i>Hemiramphus far</i>	+	+	+	M, S, C
<i>Hippichthys spicifer</i>	-	-	+	C
<i>Hipposcarus harid</i>	+	-	+	M, C
<i>Hipposcarus longiceps</i>	-	-	+	C
<i>Labroides dimidiatus</i>	+	+	+	M, S, C
<i>Lactoria cornuta</i>	-	+	-	S
<i>Lactoria fornasini</i>	-	+	+	S, C
<i>Lactoria diaphana</i>	+	+	+	M, S, C
<i>Leptoscarus vaigiensis</i>	+	+	+	M, S, C
<i>Lethrinus borbonicus</i>	-	-	+	C
<i>Lethrinus crythropterus</i>	-	+	-	S
<i>Lethrinus genivittatus</i>	-	-	+	C
<i>Lethrinus harak</i>	+	+	+	M, S, C
<i>Lethrinus lentjan</i>	+	+	+	M, S, C
<i>Lethrinus mahsena</i>	-	+	-	S
<i>Lethrinus microdon</i>	+	+	+	M, S, C
<i>Lethrinus obsoletus</i>	+	+	+	M, S, C
<i>Lethrinus olivaceus</i>	-	+	+	S, C
<i>Lethrinus rubrioperculatus</i>	+	+	-	M, S
<i>Lethrinus variegatus</i>	-	+	+	S, C
<i>Lethrinus xanthochilus</i>	+	-	+	M, C
<i>Lethrinus borbonicus</i>	+	+	+	M, S, C
<i>Lethrinus mahsena</i>	+	+	+	M, S, C
<i>Lethrinus nebulosus</i>	+	+	+	M, S, C
<i>Lutjanus bohar</i>	+	-	-	M
<i>Lutjanus ehrenbergi</i>	-	+	+	S, C
<i>Lutjanus fulviflamma</i>	+	+	+	M, S, C
<i>Lutjanus lutjanus</i>	+	-	-	M
<i>Lutjanus russellii</i>	-	-	+	C
<i>Lutjanus stallatus</i>	-	-	+	C
<i>Macolor niger</i>	-	-	+	C
<i>Monodactylus argenteus</i>	-	+	+	S, C
<i>Monodactylus falciformis</i>	+	-	-	M
<i>Mulloidichthys vanicolensis</i>	-	-	+	C

Species	Mangrove	Seagrass	Coral	Combination
<i>Naso annulatus</i>	-	-	+	C
<i>Naso brevirostris</i>	-	-	+	C
<i>Naso fageni</i>	-	-	+	C
<i>Naso thynnoides</i>	-	-	+	C
<i>Neoglyphidodon oxyodon</i>	-	+	+	S, C
<i>Neopomacentrus azysron</i>	+	+	+	M, S, C
<i>Novaculoides macrolepidotus</i>	-	+	-	S
<i>Ostorhinchus nigripes</i>	+	+	+	M, S, C
<i>Ostorhinchus cookii</i>	+	+	-	M, S
<i>Ostracion cubicum</i>	-	-	+	C
<i>Pachymetopon blochi</i>	-	-	+	C
<i>Paraluteres prionurus</i>	+	-	+	M, C
<i>Parascorpaena mossambica</i>	+	-	-	M
<i>Parupeneus barberinus</i>	+	+	+	M, S, C
<i>Parupeneus cinnabarinus</i>	-	-	+	C
<i>Parupeneus indicus</i>	+	-	-	M
<i>Parupeneus rubescens</i>	+	+	+	M, S, C
<i>Parupeneus heptacanthus</i>	+	-	+	M, C
<i>Parupeneus macronemus</i>	+	+	+	M, S, C
<i>Pempheris mangula</i>	+	+	-	M, S
<i>Pempheris schwenkii</i>	+	-	-	M
<i>Platax teira</i>	+	+	+	M, S, C
<i>Plectoglyphidodon lacrymatus</i>	-	+	-	S
<i>Plectorhinchus scholaf</i>	-	-	+	C
<i>Plectorhinchus chubbi</i>	+	-	+	M, C
<i>Plectorhinchus flavomaculatus</i>	+	+	-	M, S
<i>Plectorhinchus gaterinus</i>	+	+	+	M, S, C
<i>Plectorhinchus schotaf</i>	+	-	-	M
<i>Plotosus nkunga</i>	-	-	+	C
<i>Pomacentrus azuremaculatus</i>	-	-	+	C
<i>Pomacentrus indicus</i>	+	-	-	M
<i>Pomacentrus trilineatus</i>	+	+	+	M, S, C
<i>Priacanthus hamrur</i>	+	+	+	M, S, C
<i>Pristotis obtusirostris</i>	+	-	-	M
<i>Pteragogus flagellifera</i>	-	-	+	C
<i>Pterocaesio tile</i>	-	-	+	C
<i>Pterois miles</i>	+	-	-	M
<i>Rastrigeller kanarguta</i>	-	+	-	S
<i>Rastrineobola argentea</i>	-	+	-	S
<i>Rhabdamia gracilis</i>	+	-	-	M
<i>Sardinella gibbosa</i>	-	-	+	C
<i>Sardinella longiceps</i>	+	-	-	M
<i>Sardinella neglecta</i>	-	-	+	C
<i>Saurida gracilis</i>	+	+	+	M, S, C
<i>Scarus ghobban</i>	-	+	+	S, C
<i>Scarus gibbus</i>	-	+	-	S

Species	Mangrove	Seagrass	Coral	Combination
<i>Scarus globiceps</i>	-	-	+	C
<i>Scarus prasiognathus</i>	+	+	+	M, S, C
<i>Scarus psittacus</i>	+	+	+	M, S, C
<i>Scarus sordidus</i>	+	+	-	M, S
<i>Scolopsis bimaculata</i>	-	-	+	C
<i>Scolopsis ghanam</i>	+	+	+	M, S, C
<i>Scomberoides commersonnianus</i>	-	-	+	C
<i>Scomberoides tol</i>	+	-	-	M
<i>Sebastapistes mauritiana</i>	-	-	+	C
<i>Sebastapistes strongia</i>	-	+	-	S
<i>Sepioteuthis lessoniana</i>	+	+	+	M, S, C
<i>Siganus argenteus</i>	+	-	-	M
<i>Siganus canaliculatus</i>	-	+	+	S, C
<i>Siganus luridus</i>	+	+	+	M, S, C
<i>Siganus rivulatus</i>	+	+	+	M, S, C
<i>Siganus stellatus</i>	+	+	+	M, S, C
<i>Siganus sutor</i>	+	+	+	M, S, C
<i>Solenostomus cyanopterus</i>	+	-	-	M
<i>Sphyaena barracuda</i>	+	+	+	M, S, C
<i>Sphyaena flavicauda</i>	-	-	+	C
<i>Sphyaena obtusata</i>	-	+	-	S
<i>Sphyaena putnamae</i>	-	+	-	S
<i>Spratelloides delicatulus</i>	+	-	-	M
<i>Stegastes partitus</i>	-	+	-	S
<i>Stethojulis strigiventer</i>	+	+	+	M, S, C
<i>Stethojulis balteata</i>	+	-	+	M, C
<i>Stolephorus waitei</i>	-	-	+	C
<i>Strongylura leiura</i>	+	+	+	M, S, C
<i>Syngnathoides biaculeatus</i>	+	+	+	M, S, C
<i>Syngnathus acus</i>	-	+	-	S
<i>Synodus englemani</i>	+	+	-	M, S
<i>Taeniamia fucata</i>	+	-	+	M, C
<i>Taeniura lymma</i>	-	+	+	S, C
<i>Thalassoma hardwicke</i>	+	+	+	M, S, C
<i>Thalassoma hebraicum</i>	+	+	+	M, S, C
<i>Thalassoma lunare</i>	-	+	+	S, C
<i>Thalassoma purpureum</i>	-	-	+	C
<i>Thalassoma lunare</i>	-	-	+	C
<i>Thalassoma lutescens</i>	-	+	-	S
<i>Tylosurus crocodilus</i>	+	+	+	M, S, C
<i>Upeneus tragula</i>	+	+	+	M, S, C
<i>Uroteuthis duvaucelii</i>	+	+	+	M, S, C
<i>Yarica hyalosoma</i>	+	+	+	M, S, C
<i>Zanclus canescens</i>	-	-	+	C
<i>Zanclus cornutus</i>	+	+	+	M, S, C
<i>Zebrasoma veliferum</i>	-	+	+	S, C

Appendix III

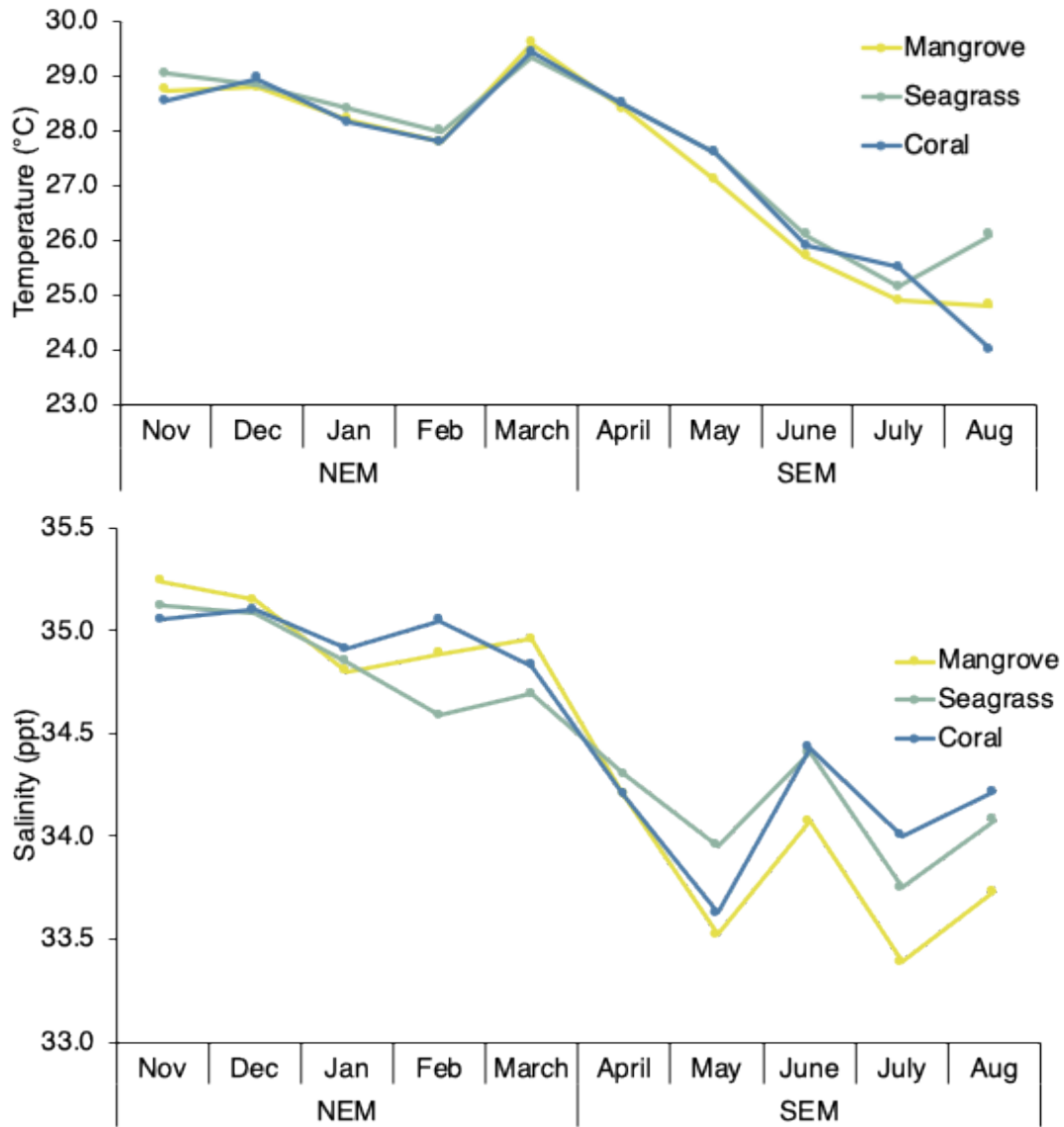


Figure AIII. Monthly trends in mean temperature (°C) and salinity (PSU) across a mangrove-seagrass-coral reef continuum in Shimoni, Kenya, between November 2021 and August 2022.