

Seasonal variation, habitat complexity, and trophic structure of fish assemblages in the Irrawaddy Delta, Myanmar

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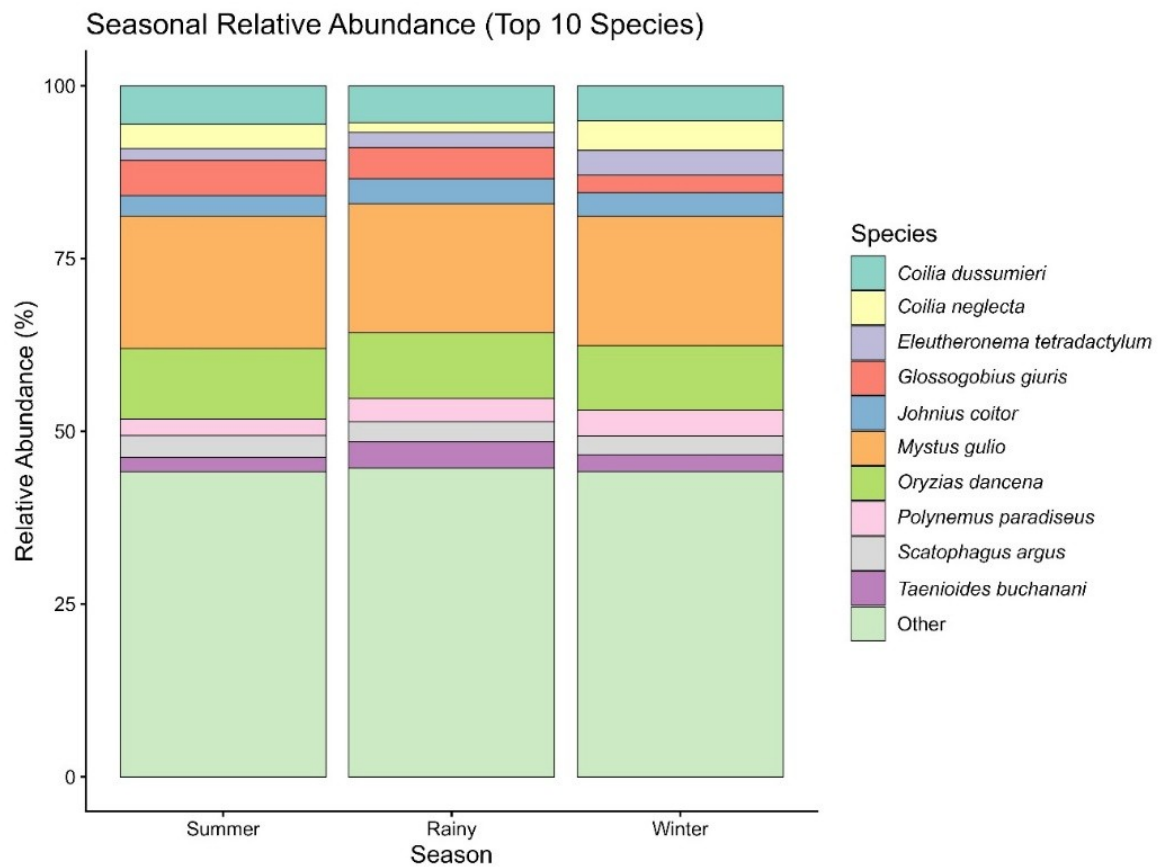


FIGURE S1 Seasonal Relative Abundance in Bogale and Pyapon townships.

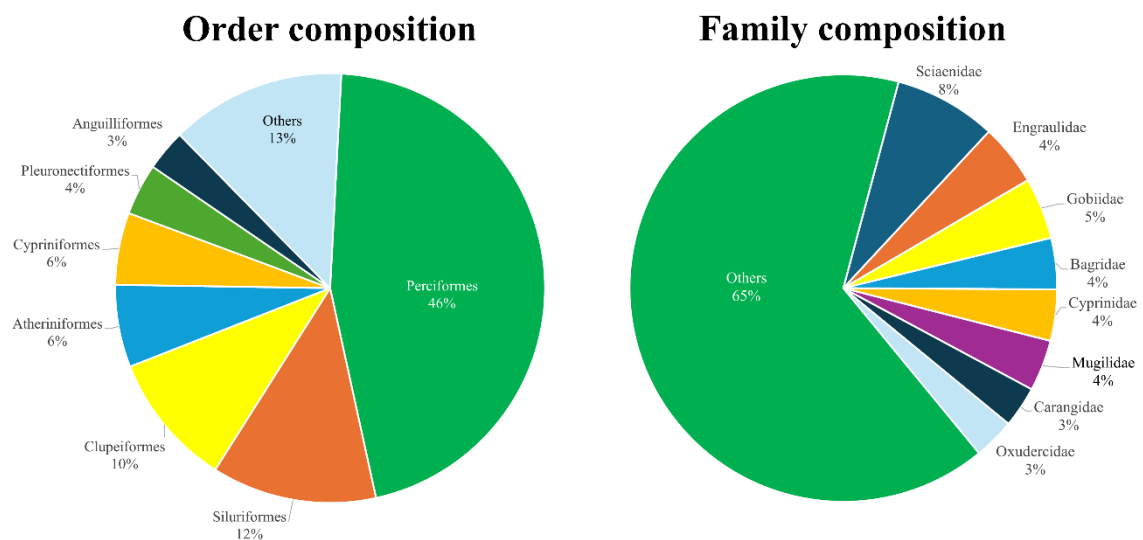


FIGURE S2 Order and family composition of fish species in study area.

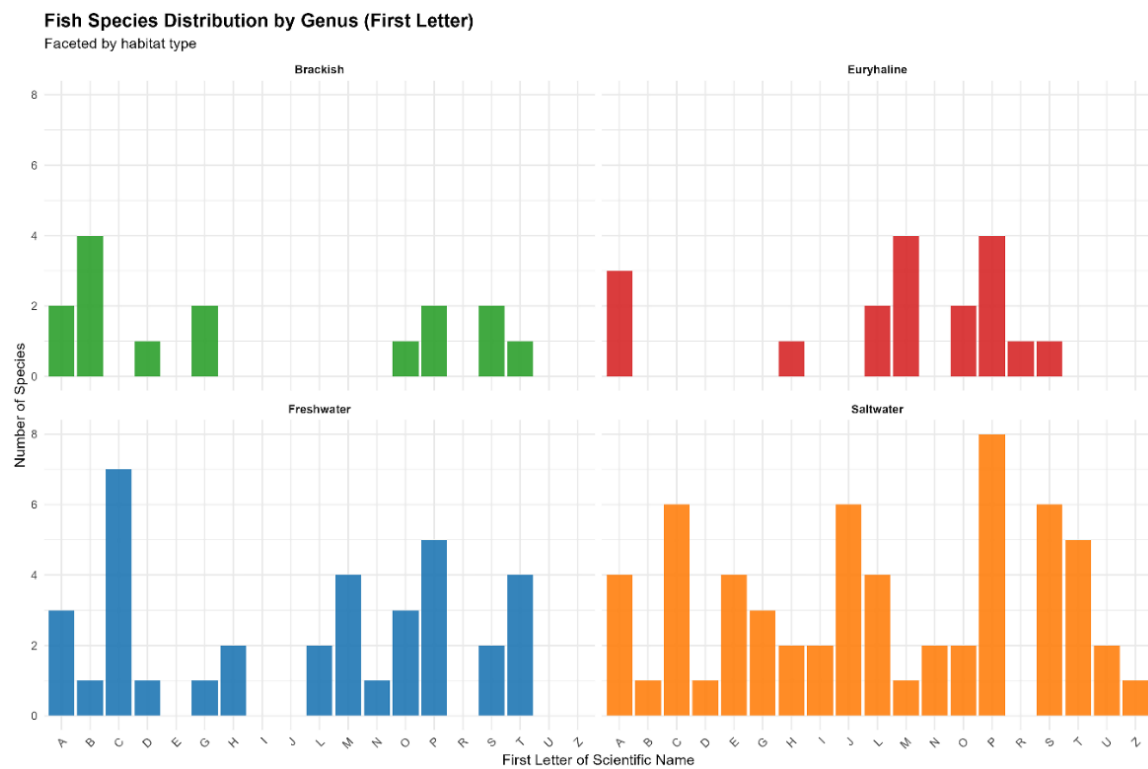


FIGURE S3 Species Distribution Faceted by habitat types in the study area.

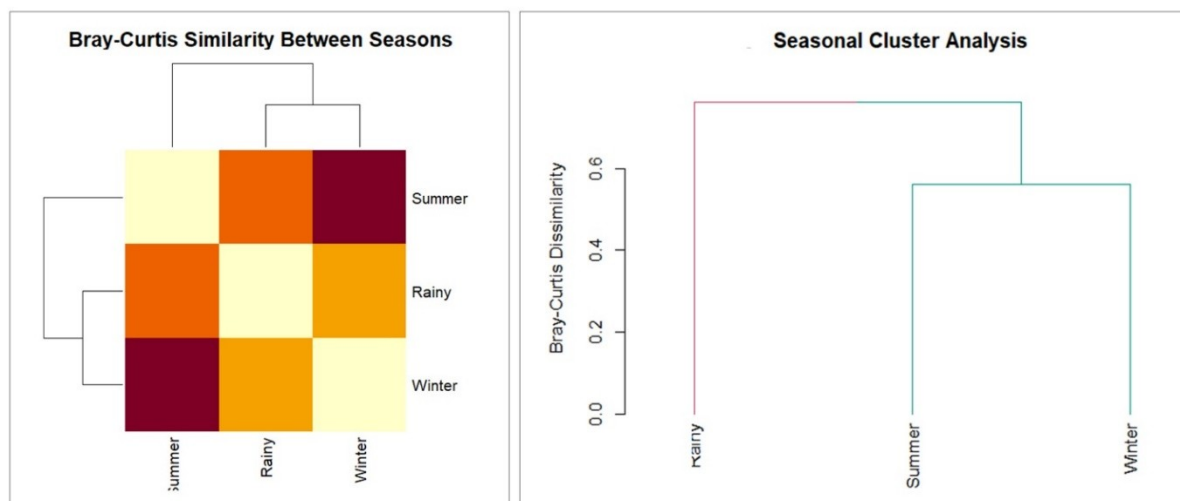


FIGURE S4 Heatmap of Bray-Curtis Similarity and Dendrogram of Cluster Analysis between seasons.

TABLE S1 Seasonal occurrence of fish species in study area.

No.	Order	Family	Scientific name	Summer	Rainy	Winter	IUCN Red List Categories
1	Torpediniformes	Narcinidae	<i>Narcine timlei</i>	-	+	-	Vulnerable (VU)
2	Myliobatiformes	Dasyatidae	<i>Brevitrygon walga</i>	+	-	-	Near Threatened (NT)
3	Osteoglossiformes	Notopteridae	<i>Notopterus notopterus</i>	+	+	+	Least Concern (LC)
4	Elopiformes	Megalopidae	<i>Megalops cyprinoides</i>	-	-	+	Data Deficient (DD)
5	Anguilliformes	Anguillidae	<i>Anguilla bicolor</i>	-	-	+	Least Concern (LC)
6	Anguilliformes	Congridae	<i>Uroconger lepturus</i>	+	+	+	Least Concern (LC)
7	Anguilliformes	Muraenidae	<i>Gymnothorax tile</i>	+	+	+	Least Concern (LC)
8	Anguilliformes	Ophichthidae	<i>Pisodonophis boro</i>	+	+	+	Least Concern (LC)
9	Clupeiformes	Dorosomatidae	<i>Escualosa thoracata</i>	+	+	+	Least Concern (LC)
10	Clupeiformes	Dorosomatidae	<i>Tenualosa toli</i>	+	+	+	Vulnerable (VU)
11	Clupeiformes	Dorosomatidae	<i>Tenualosa ilisha</i>	+	+	+	Least Concern (LC)
12	Clupeiformes	Ehiravidae	<i>Corica soborna</i>	-	+	-	Least Concern (LC)
13	Clupeiformes	Ehiravidae	<i>Clupeichthys aesarnensis</i>	-	-	+	Least Concern (LC)
14	Clupeiformes	Engraulidae	<i>Coilia dussumieri</i>	+	+	+	Least Concern (LC)
15	Clupeiformes	Engraulidae	<i>Coilia neglecta</i>	-	+	+	Least Concern (LC)
16	Clupeiformes	Engraulidae	<i>Stolephorus andhraensis</i>	+	+	+	Least Concern (LC)
17	Clupeiformes	Engraulidae	<i>Stolephorus waitei</i>	+	-	+	Data Deficient (DD)
18	Clupeiformes	Engraulidae	<i>Thryssa hamiltonii</i>	+	+	+	Least Concern (LC)
19	Clupeiformes	Engraulidae	<i>Thryssa kammalensis</i>	-	-	-	Data Deficient (DD)
20	Clupeiformes	Pristigasteridae	<i>Ilisha elongata</i>	-	-	+	Least Concern (LC)
21	Clupeiformes	Pristigasteridae	<i>Ilisha kampeni</i>	+	+	+	Least Concern (LC)
22	Cypriniformes	Cyprinidae	<i>Barbonymus gonionotus</i>	-	+	-	Least Concern (LC)
23	Cypriniformes	Cyprinidae	<i>Labeo catla</i>	-	-	+	Least Concern (LC)
24	Cypriniformes	Cyprinidae	<i>Labeo gonius</i>	-	+	+	Least Concern (LC)
25	Cypriniformes	Cyprinidae	<i>Osteobrama belangeri</i>	+	+	+	Near Threatened (NT)
26	Cypriniformes	Cyprinidae	<i>Puntius sophore</i>	+	+	+	Least Concern (LC)
27	Cypriniformes	Danionidae	<i>Salmophasia sardinella</i>	+	+	+	Least Concern (LC)
28	Cypriniformes	Danionidae	<i>Salmostoma phulo</i>	+	-	-	Least Concern (LC)
29	Siluriformes	Ariidae	<i>Arius arius</i>	+	-	-	Least Concern (LC)
30	Siluriformes	Bagridae	<i>Hemibagrus microphthalmus</i>	-	-	+	Least Concern (LC)
31	Siluriformes	Bagridae	<i>Mystus gulio</i>	+	+	+	Least Concern (LC)
32	Siluriformes	Bagridae	<i>Mystus ngasep</i>	-	+	+	Least Concern (LC)
33	Siluriformes	Bagridae	<i>Mystus vittatus</i>	-	-	+	Least Concern (LC)
34	Siluriformes	Bagridae	<i>Sperata aor</i>	+	+	+	Least Concern (LC)
35	Siluriformes	Clariidae	<i>Clarias batrachus</i>	+	+	+	Least Concern (LC)
36	Siluriformes	Heteropneustidae	<i>Heteropneustes fossilis</i>	+	+	+	Least Concern (LC)
37	Siluriformes	Loricariidae	<i>Hypostomus plecostomus</i>	-	+	+	Least Concern (LC)
38	Siluriformes	Pangasiidae	<i>Pangasius myanmar</i>	-	-	+	Least Concern (LC)
39	Siluriformes	Pangasiidae	<i>Pangasius pangasius</i>	-	-	+	Least Concern (LC)
40	Siluriformes	Plotosidae	<i>Plotosus canius</i>	+	+	+	Least Concern (LC)
41	Siluriformes	Plotosidae	<i>Plotosus lineatus</i>	-	+	-	Least Concern (LC)

No.	Order	Family	Scientific name	Summer	Rainy	Winter	IUCN Red List Categories
42	Siluriformes	Schilbeidae	<i>Clupisoma garua</i>	-	+	+	Least Concern (LC)
43	Siluriformes	Schilbeidae	<i>Proeutropiichthys macrophthalmos</i>	-	-	+	Least Concern (LC)
44	Siluriformes	Sisoridae	<i>Gagata melanopterus</i>	-	+	-	Least Concern (LC)
45	Aulopiformes	Synodontidae	<i>Harpadon nehereus</i>	-	+	+	Near Threatened (NT)
46	Batrachoidiformes	Batrachoididae	<i>Allenbatrachus grunniens</i>	+	+	+	Not Evaluated
47	Atheriniformes	Atherinidae	<i>Hypoatherina valenciennei</i>	+	-	-	Not Evaluated
48	Atheriniformes	Atherinidae	<i>Doboatherina duodecimalis</i>	+	-	-	Not Evaluated
49	Atheriniformes	Mugilidae	<i>Planiliza planiceps</i>	+	+	+	Least Concern (LC)
50	Atheriniformes	Mugilidae	<i>Osteomugil cunnesius</i>	+	+	+	Not Evaluated
51	Atheriniformes	Mugilidae	<i>Planiliza subviridis</i>	+	+	+	Least Concern (LC)
52	Atheriniformes	Mugilidae	<i>Planiliza tade</i>	+	+	+	Data Deficient (DD)
53	Atheriniformes	Mugilidae	<i>Rhinomugil corsula</i>	-	-	+	Least Concern (LC)
54	Atheriniformes	Mullidae	<i>Upeneus sulphureus</i>	+	-	-	Least Concern (LC)
55	Cyprinodontiformes	Aplocheilidae	<i>Aplocheilus panchax</i>	+	-	-	Least Concern (LC)
56	Beloniformes	Adrianichthyidae	<i>Oryzias uwai</i>	+	-	+	Data Deficient (DD)
57	Beloniformes	Adrianichthyidae	<i>Oryzias dancena</i>	+	+	+	Least Concern (LC)
58	Beloniformes	Zenarchopteridae	<i>Dermogenys burmanica</i>	+	+	+	Least Concern (LC)
59	Syngnathiformes	Syngnathidae	<i>Microphis dunckeri</i>	-	-	+	Data Deficient (DD)
60	Synbranchiformes	Mastacembelidae	<i>Macrognathus dorsiocellatus</i>	+	+	+	Data Deficient (DD)
61	Synbranchiformes	Mastacembelidae	<i>Macrognathus zebrinus</i>	-	+	+	Least Concern (LC)
62	Synbranchiformes	Synbranchidae	<i>Monopterus albus</i>	+	-	+	Least Concern (LC)
63	Scorpaeniformes	Platycephalidae	<i>Platycephalus indicus</i>	+	+	+	Data Deficient (DD)
64	Perciformes	Ambassidae	<i>Ambassis dussumieri</i>	-	-	+	Least Concern (LC)
65	Perciformes	Ambassidae	<i>Ambassis nalua</i>	+	-	-	Least Concern (LC)
66	Perciformes	Ambassidae	<i>Parambassis ranga</i>	+	+	-	Least Concern (LC)
67	Perciformes	Anabantidae	<i>Anabas testudineus</i>	+	+	+	Least Concern (LC)
68	Perciformes	Butidae	<i>Butis humeralis</i>	-	-	+	Least Concern (LC)
69	Perciformes	Butidae	<i>Butis koilomatodon</i>	+	+	-	Least Concern (LC)
70	Perciformes	Butidae	<i>Butis butis</i>	+	+	+	Least Concern (LC)
71	Perciformes	Carangidae	<i>Caranx ignobilis</i>	-	-	+	Least Concern (LC)
72	Perciformes	Carangidae	<i>Megalaspis cordyla</i>	+	-	-	Least Concern (LC)
73	Perciformes	Carangidae	<i>Scomberoides commersonnianus</i>	+	-	-	Least Concern (LC)
74	Perciformes	Carangidae	<i>Atropus atropus</i>	+	+	+	Least Concern (LC)
75	Perciformes	Channidae	<i>Channa gachua</i>	-	-	+	Least Concern (LC)
76	Perciformes	Channidae	<i>Channa panaw</i>	+	+	+	Least Concern (LC)
77	Perciformes	Channidae	<i>Channa striata</i>	+	+	+	Least Concern (LC)
78	Perciformes	Cichlidae	<i>Oreochromis niloticus</i>	+	+	+	Least Concern (LC)
79	Perciformes	Danioideidae	<i>Danioides polota</i>	-	+	-	Least Concern (LC)
80	Perciformes	Echeneidae	<i>Echeneis naucrates</i>	+	-	-	Least Concern (LC)
81	Perciformes	Gerreidae	<i>Gerres erythrourus</i>	+	+	-	Least Concern (LC)
82	Perciformes	Gerreidae	<i>Gerres filamentosus</i>	-	-	+	Least Concern (LC)
83	Perciformes	Gobiidae	<i>Acentrogobius viridipunctatus</i>	+	-	-	Least Concern (LC)
84	Perciformes	Gobiidae	<i>Glossogobius giuris</i>	+	+	+	Least Concern (LC)

No.	Order	Family	Scientific name	Summer	Rainy	Winter	IUCN Red List Categories
85	Perciformes	Gobiidae	<i>Gobiopsis macrostoma</i>	+	-	-	Least Concern (LC)
86	Perciformes	Gobiidae	<i>Odontamblyopus rubicundus</i>	-	+	+	Least Concern (LC)
87	Perciformes	Gobiidae	<i>Stigmatogobius sadanundio</i>	-	+	+	Least Concern (LC)
88	Perciformes	Gobiidae	<i>Taenioides buchanani</i>	+	+	+	Least Concern (LC)
89	Perciformes	Haemulidae	<i>Pomadasys argyreus</i>	+	-	+	Least Concern (LC)
90	Perciformes	Haemulidae	<i>Pomadasys kaakan</i>	-	-	+	Least Concern (LC)
91	Perciformes	Haemulidae	<i>Pomadasys maculatus</i>	+	-	+	Least Concern (LC)
92	Perciformes	Latidae	<i>Lates calcarifer</i>	+	+	+	Least Concern (LC)
93	Perciformes	Leiognathidae	<i>Leiognathus equulus</i>	+	+	+	Least Concern (LC)
94	Perciformes	Lutjanidae	<i>Lutjanus johnii</i>	+	-	-	Least Concern (LC)
95	Perciformes	Lutjanidae	<i>Lutjanus argentimaculatus</i>	+	+	+	Least Concern (LC)
96	Perciformes	Osphronemidae	<i>Trichogaster lalius</i>	+	+	+	Least Concern (LC)
97	Perciformes	Osphronemidae	<i>Trichopodus pectoralis</i>	-	-	-	Least Concern (LC)
98	Perciformes	Oxudercidae	<i>Apocryptes bato</i>	+	-	-	Least Concern (LC)
99	Perciformes	Oxudercidae	<i>Boleophthalmus boddarti</i>	+	+	+	Least Concern (LC)
100	Perciformes	Oxudercidae	<i>Parapocryptes serperaster</i>	+	+	+	Least Concern (LC)
101	Perciformes	Oxudercidae	<i>Pseudapocryptes elongatus</i>	+	+	+	Least Concern (LC)
102	Perciformes	Polynemidae	<i>Eleutheronema tetradactylum</i>	+	+	+	Endangered (EN)
103	Perciformes	Polynemidae	<i>Leptomelosoma indicum</i>	-	+	-	Not Evaluated
104	Perciformes	Polynemidae	<i>Polynemus paradiseus</i>	+	+	+	Least Concern (LC)
105	Perciformes	Scatophagidae	<i>Scatophagus argus</i>	+	+	+	Least Concern (LC)
106	Perciformes	Sciaenidae	<i>Johnius macrorhynchus</i>	-	+	+	Endangered (EN)
107	Perciformes	Sciaenidae	<i>Johnius belangerii</i>	+	-	+	Least Concern (LC)
108	Perciformes	Sciaenidae	<i>Johnius borneensis</i>	+	-	-	Least Concern (LC)
109	Perciformes	Sciaenidae	<i>Johnius coitor</i>	+	+	+	Least Concern (LC)
110	Perciformes	Sciaenidae	<i>Johnius dussumieri</i>	+	+	+	Least Concern (LC)
111	Perciformes	Sciaenidae	<i>Johnius spp.</i>	+	-	+	Not Evaluated
112	Perciformes	Sciaenidae	<i>Nibea soldado</i>	+	+	+	Least Concern (LC)
113	Perciformes	Sciaenidae	<i>Otolithes ruber</i>	-	-	+	Least Concern (LC)
114	Perciformes	Sciaenidae	<i>Otolithoides pama</i>	-	+	-	Data Deficient (DD)
115	Perciformes	Sciaenidae	<i>Arius maculatus</i>	+	+	+	Data Deficient (DD)
116	Perciformes	Serranidae	<i>Epinephelus coioides</i>	+	-	+	Least Concern (LC)
117	Perciformes	Sillaginidae	<i>Sillaginopsis panijus</i>	+	+	+	Not Evaluated
118	Perciformes	Sillaginidae	<i>Sillago sihama</i>	-	+	-	Least Concern (LC)
119	Perciformes	Sphyraenidae	<i>Sphyraena obtusata</i>	+	-	-	Least Concern (LC)
120	Perciformes	Terapontidae	<i>Terapon jarbua</i>	+	+	+	Least Concern (LC)
121	Perciformes	Toxotidae	<i>Toxotes chatareus</i>	+	+	+	Not Evaluated
122	Perciformes	Trichiuridae	<i>Lepturacanthus savala</i>	+	+	+	Not Evaluated
123	Pleuronectiformes	Cynoglossidae	<i>Cynoglossus cynoglossus</i>	-	+	+	Least Concern (LC)
124	Pleuronectiformes	Cynoglossidae	<i>Cynoglossus puncticeps</i>	+	+	+	Least Concern (LC)
125	Pleuronectiformes	Paralichthyidae	<i>Pseudorhombus elevatus</i>	+	-	-	Least Concern (LC)
126	Pleuronectiformes	Soleidae	<i>Aseraggodes cf. cyaneus</i>	-	-	+	Data Deficient (DD)

No.	Order	Family	Scientific name	Summer	Rainy	Winter	IUCN Red List Categories
127	Pleuronectiformes	Soleidae	<i>Zebrias altipinnis</i>	-	-	+	Least Concern (LC)
128	Tetraodontiformes	Tetraodontidae	<i>Chonerhinos naritus</i>	-	+	+	Least Concern (LC)
129	Tetraodontiformes	Tetraodontidae	<i>Tetraodon fluviatilis</i>	+	+	+	Least Concern (LC)

TABLE S2 *t*-test comparison of mangrove and non-mangrove sites.

Parameter	Mean (Mangrove)	Mean (Non-mangrove)	t-statistic	p-value
Salinity (ppt)	19.8	12.1	7.56	< 0.0001
DO (mg/l)	6.16	5.69	5.84	< 0.0001
Water Temp (°C)	27.2	28.9	-4.46	0.0005
pH	8.23	7.66	5.46	< 0.0001
Conductivity (ms)	30.9	24.9	5.59	0.0001
Species Composition	23	18.2	6.7	< 0.0001