Fish diversity in sub-Saharan African estuaries – a preliminary analysis

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A preliminary biogeographic grouping of sub-Saharan African estuaries, based primarily on available coastal and estuarine water temperatures, was undertaken. Four broad categories were recognised for the purposes of this assessment; namely tropical, subtropical, warm-temperate and cool-temperate regions. The only cool-temperate estuarine region was that in southwestern Africa between 25^{o}S and 35^{o}S. There were two warm-temperate regions, one in southern Africa between 32^{o}S and 35^{o}S, the other on the southwestern coast between 20^{o}S and 25^{o}S. This latter region has no estuaries and the coastal interior comprises the Namib Desert. There are two sub-Saharan subtropical regions, one located on the southwestern coastline between 10^{o} and 20^{o}S, the other in the southeastern region extending from 25^{o} to 32^{o}S. Whilst the former region is associated with a mainly arid interior and contains few estuaries, the latter contains numerous estuarine systems, ranging in size from <1 ha to >30 km^{2}. The eastern and western African tropical regions are also well endowed with a wide variety of estuaries and are bounded by latitudes 15^{o}N-25^{o}S on the east coast to 15^{o}N-10^{o}S on the west coast.

Indigenous fish species lists from each biogeographic region were compiled from both published and unpublished data. Comparisons are made at the species and family level between the fish assemblages recorded in the different biogeographic regions. These results showed that both species and family diversity declined between tropical and temperate sub-Saharan estuaries (Figure 1). Eastern and western tropical estuaries have similar numbers of species and families. The ratio of species to families increased as one moves from temperate to tropical systems. In terms of the top three most diverse families, Mugilidae and Gobiidae featured in all biogeographic regions (Table 1).

Comparisons in both species and family composition between the different biogeographic regions were undertaken using the Bray-Curtis (BC) similarity coefficient. Results indicated that although family similarities between the different biogeographic regions were generally high, this was often not the case at the species level, e.g. family similarities between the tropical east and west coasts of Africa were considerable but species composition between the two regions were very different (Table 2). Temperate regions along the southern and southwestern coast of Africa probably prevent mixing of east and west coast tropical fish species, thus causing the low species similarities between the ichthyofauna in the two regions.

Fish species sampled in cool temperate, warm temperate, subtropical and tropical African estuaries were divided into guilds based upon their life histories and degree of association with estuarine environments (Table 3). For some of the species there is detailed life-history information available and placing them in a particular guild was relatively easy. However, there were also a large number of species whose allocated guild may change once further biological and ecological information on those taxa becomes available. Preliminary results show that marine taxa (marine immigrants and marine stragglers) provided between 67% and 75% of the fish species diversity recorded in sub-Saharan estuaries. Estuarine taxa (estuarine residents and estuarine migrants) accounted for between 10% and 30% of the fish species recorded. Freshwater taxa (freshwater immigrants and freshwater stragglers) comprised <7% of fish diversity on the east and south coasts of Africa compared to 20% in the west.

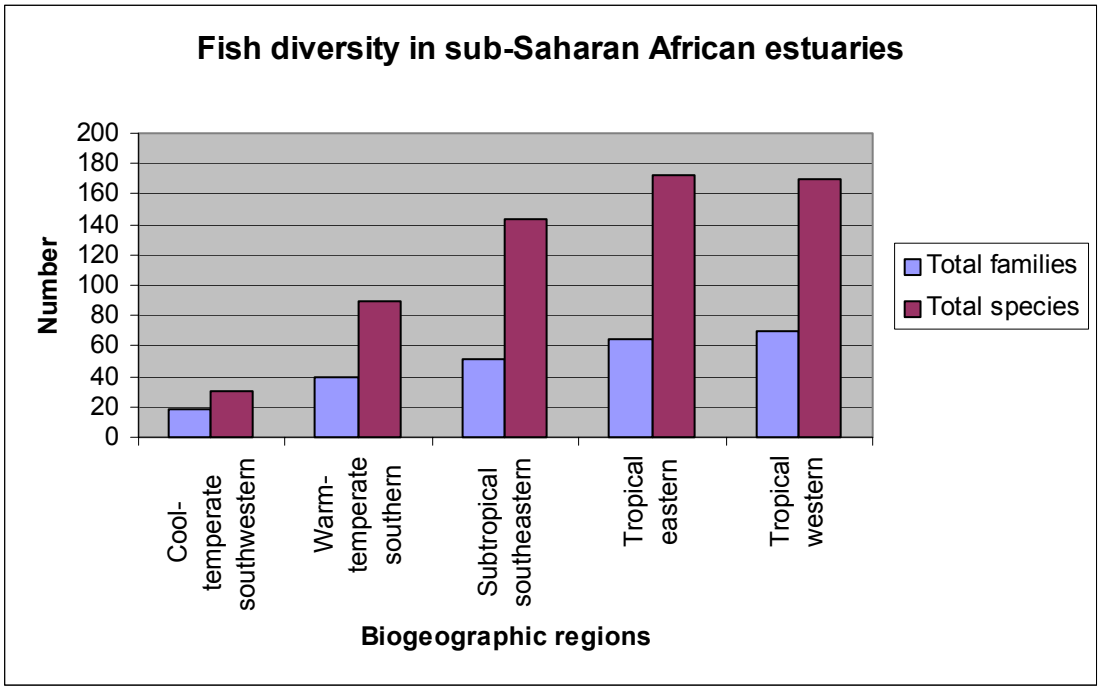

Figure 1. Total numbers of fish families and species recorded in estuaries in the different sub-Saharan biogeographic regions.

Table 1. The five most diverse families in each of the African biogeographic regions (numbers in brackets refer to the number of species in each of the families).

Southwestern cool-temperate	**Southeastern warm-temperate**	**Southeastern subtropical**	**Eastern tropical**	**Western tropical**
Sparidae (6)	Mugilidae (11)	Gobiidae (21)	Gobiidae (21)	Carangidae (13)
Mugilidae (4)	Sparidae (10)	Mugilidae (13)	Mugilidae (12)	Mugilidae (7)
Gobiidae (3)	Gobiidae (8)	Sparidae (10)	Carangidae (8)	Gobiidae (7)
Clinidae (2)	Carangidae (5)	Carangidae (8)	Syngnathidae (8)	Sciaenidae (7)
Soleidae (2)	Syngnathidae (4)	Gerreidae (5)	Haemulidae (7)	Cichlidae (7)

Table 2. Bray-Curtis similarity coefficients between estuarine fish assemblages (family figures above diagonal line; species figures below diagonal line) based on presence/absence data from the different biogeographic regions of sub-Saharan Africa.

Family / Species	Southwestern cool-temperate	Southeastern warm-temperate	Southeastern subtropical	Eastern tropical	Western tropical
Southwestern cool-temperate		0.59	0.41	0.31	0.34
Southeastern warm-temperate	0.45		0.73	0.65	0.55
Southeastern subtropical	0.23	0.59		0.81	0.66
Eastern tropical	0.05	0.34	0.71		0.70
Western tropical	0.03	0.02	0.06	0.05	

Table 3. Categorization of the major fish groups (guilds) utilizing sub-Saharan African estuaries.

Categories	Description of categories
Marine immigrants	Marine fish species that usually breed at sea with the juveniles and/or adults making extensive use of the estuarine environment. The juveniles of many of these species show varying degrees of dependence on estuaries as nursery areas.
Marine stragglers	Marine fish species that breed at sea with only a small proportion of the overall population ever entering or making use of estuaries. Most marine stragglers are confined to the lower estuarine reaches where they occur in low numbers.
Estuarine residents	Fish species, usually of marine origin, that breed and are able to conduct their entire life cycle within the estuarine environment. Some estuarine species may also have marine or freshwater breeding populations.
Estuarine migrants	Fish species, usually of marine origin, that breed in estuaries but have a marine or freshwater aspect to their life cycle. Estuarine migrants often have marine or freshwater breeding populations.
Freshwater immigrants	Freshwater fish species that are often recorded in estuaries, retreating into catchment rivers when conditions become unfavourable. Some of these species may also breed in estuaries when conditions are suitable.

Freshwater stragglers	Freshwater fish species that sometimes enter estuaries when conditions are favourable. Freshwater stragglers are usually confined to the upper estuarine reaches where they occur in low numbers.
Catadromous migrants	Species that spawn at sea but use freshwater catchment areas during the juvenile and subadult life stages. Semi-catadromous migrants are those taxa that can successfully occupy estuaries during these life stages when riverine areas are inaccessible.