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Species Composition of Fish Community in Kundu Estuary (Antalya-Turkey) and their Length-weight Relationships

[1]Deniz Innal and [2]Filiz Ozdemir
[1]Department of Biology, Mehmet Akif Ersoy University, 15100, Burdur, Turkey
[2]Department of Biology, Hacettepe University, 06532, Ankara, Turkey

Corresponding Author: Deniz Innal, Department of Biology, Mehmet Akif Ersoy University, 15100, Burdur, Turkey

ABSTRACT

This study describes the fish species composition and their length-weight relationships from Kundu Estuary (Antalya-Turkey). A total of 679 individuals (catch of 116.2 kg) representing 14 marine, freshwater and migratory fish species were caught by different nets from March, 2008 to February, 2009. Marine fish species represent the highest abundance (69.66%) and biomass (55.93%). *Liza aurata* was the most frequently captured species (38.9%), followed by *Mugil cephalus* (14.7%) and *Dicentrarchus labrax* (10.8%). The length-weight relationships displayed that six species grew positively allometric and four of them grew negatively allometric.

Key words: Length-weight relationships, fish species, abundance, biomass, Kundu Estuary

INTRODUCTION

Estuaries are dynamic and unpredictable systems, consisting of a wide diversity of shallow water habitats, which undergo strong seasonal changes in many parts of the world. Estuaries and coastal lagoons are used by large numbers of fish as nursery sites, migration routes, feeding and/or breeding areas (Malavasi *et al*., 2004). Fish assemblages in estuaries can include larvae, juveniles and adults of species of both marine and freshwater origin, with migratory or sedentary behaviour (Chicharo *et al*., 2006). Many researchers have also shown that fish assemblages in estuaries exhibit strong short and long-term variability, due to environmental fluctuations (Koutrakis *et al*., 2000; Garcia *et al*., 2003; Matic-Skoko *et al*., 2005). Fluctuations in water temperature, dissolved oxygen, salinity, turbidity and nutrient input can directly influence fish abundance, distribution patterns, and species composition in estuarine fish communities (Elliott and Hemingway, 2002).

Estuaries are also closely linked with human activity and have been altered significantly as a result of urban and industrial development. Throughout the world, estuaries are among the most modified and threatened environments (Blaber *et al*., 2000). The Kundu Estuary has been affected by large-scale anthropogenic influences, mainly the substantial development of Tourism activities and the increasing population in the catchment. Fish assemblage composition (species numbers, ecological guilds, abundance and biomass), length-weight relationships of species of Kundu Estuary are still poorly understood. In Mediterranean estuaries of Turkey, information about the fish assemblage composition is rare with the exception of studies in Koycegiz Lagoon Estuary (Akin *et al*., 2005) and the Goksu River Estuary (Kucuk *et al*., 2007). So the specific objectives of this study were, (1) to describe the fish assemblages in terms of species numbers, ecological guilds, abundance and biomass and (2) to determine length-weight relationships of fish species.

MATERIALS AND METHODS

The study was carried out in estuary zones of Kundu Creek (Kundu Village-Acysu, 36°51'14.65" N 30°53'42.37" E-36°54'20.66" N 30°53'17.89" E) flowing into the Antalya Gulf (Mediterranean Sea- Turkey). It can be classified as temporarily open and shallow with a maximum depth of about 4 m. The total length of the main channel is approximately 8 km. Field studies were conducted in the period of March 2008-February 2009. Temperature (C), salinity and oxygen concentration were determined by using WTW 340*i*. Water temperature, ranged from 14-26.5°C. Dissolved oxygen concentration varied from a minimum of 6.8 mg L^{-1} to a maximum of 8.0 mg L^{-1}. Salinity values ranged from 0.2-21.9. The highest and lowest mean salinity values were measured for summer and winter months, respectively. Salinity showed a spatial gradient along the length of estuary. Decreasing progressively from the mouths to the upstream sites. This decrease was statistically significant ($p<0.05$).

The ichthyofauna was sampled using various fishing gear (fyke-net, gill nets and fish traps). Fish specimens were collected and identified to species level according to Aksiray (1987), Geldiay and Balik (1988), The fish community were characterized using either the species richness S (total number of species obtained at each sampling) and the Shannon-Wiener diversity index H' (Sisli, 1999). The species were weighed for biomass determination. Fish species in Kundu Estuary were categorized according to salinity preference and migratory behaviour into marine, migratory, estuarine and freshwater (Araujo *et al.*, 1999). Exotic or native taxa were identified by reference to Innal and Erkakan (2006). Specimens were measured to the nearest 0.1 cm total length (L) and weighed to the nearest 0.01 (g) total weight, (W). Length-weight relationships were described for ten fish species (The species whose number of individuals were less than 20 were not taken into estimation). Length-weight relationship was calculated using the equation (Ricker, 1973):

$$W = aL^b$$

The parameters, a and b were estimated by linear regression on the transformed equation:

$$\log (w) = \log (a) + b \log (L)$$

When the b value in length-weight relationship was equal to or did not show statistically significant deviation from 3, the growth was isometric, whereas the positive or negative allometric growth occurred when the b value deviated significantly from 3. The significance of the b value for each species was tested by t-test.

RESULTS

Fish assemblage composition (species numbers, ecological guilds, abundance and biomass) in Kundu Estuary is given in Table 1. Temporal variation in species richness (number of species sampled) and diversity (Shannon-Wiener diversity index; H') of fish is given in Fig. 1.

A total of 679 individuals (116.2 kg total biomass) from 14 fish species (Table 1) was caught throughout the study. Fish species distributed among 14 genera and 7 families were identified. Cyprinidae was the family most represented in terms of number of species. Cyprinidae was followed in species number by Mugilidae (three species). In contrast, the remaining families (Moronidae, Clariidae, Anguillidae, Sparidae, Poeciliidae) were all represented by one species. Number of species (Fig. 1) varied from 12 (May 2008) to 4 (February 2009) in

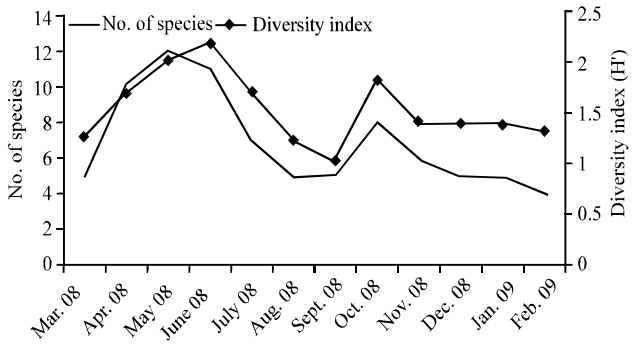

Fig. 1: Temporal variation in species richness (No. of species sampled) and diversity (Shannon-Wiener diversity index; H') of fish caught in Kundu Estuary

Table 1: Fish assemblage composition (species No. ecological guilds, abundance, biomass) of Kundu Estuary

Species	Families	Status	Salinity preference	N	Abundance (%)	Biomass (g)	Biomass (%)
Liza aurata	Mugilidae	Native	Marine	264	38.88	34039.1	29.30
Mugil cephalus	Mugilidae	Native	Marine	100	14.73	7710.6	6.64
Dicentrarchus labrax	Moronidae	Native	Marine	73	10.75	18630.2	16.04
Carassius gibelio	Cyprinidae	Alien	Freshwater	41	6.04	7760.0	6.68
Cyprinus carpio	Cyprinidae	Native	Freshwater	33	4.86	6216.4	5.35
Capoeta antalyensis	Cyprinidae	Native	Freshwater	32	4.71	6257.4	5.39
Clarias gariepinus	Clariidae	Native	Freshwater	27	3.98	14366.1	12.37
Anguilla anguilla	Anguillidae	Native	Migrant	24	3.53	14252.0	12.27
Chelon labrosus	Mugilidae	Native	Marine	23	3.39	3615.7	3.11
Vimba vimba	Cyprinidae	Native	Freshwater	22	3.24	2116.1	1.82
Pseudorasbora parva	Cyprinidae	Alien	Freshwater	15	2.21	160.2	0.14
Sparus aurata	Sparidae	Native	Marine	13	1.91	991.2	0.85
Gambusia affinis	Poeciliidae	Alien	Freshwater	9	1.33	1.0	0.00
Pseudophoxinus alii	Cyprinidae	Native	Freshwater	3	0.44	67.0	0.06
Total				679	100.00	116183.1	100.00

N: Total number of individuals

Kundu Estuary. Monthly values of diversity index differed significantly ($p<0.05$). In general, species richness was higher during spring-summer months than winter months.

Mugilidae was the most abundant family in terms of specimens number. Mugilidae species comprised 387 (57.0%) of 679 specimens. *Liza aurata* was the most frequently captured species (38.9%), followed by *Mugil cephalus* (14.7%) and *Dicentrarchus labrax* (10.8%). From the 14 species caught, four species (*L. aurata*, *D. labrax*, *Clarias gariepinus* and *Anguilla anguilla*) accumulated more than 69% of the total biomass.

Fishes in the Kundu Estuary have been categorized as marine, freshwater and migratory species. The marine species, with five species, represented the highest abundance (69.66%) and biomass (55.93%). The freshwater species, with eight species, represented 26.81% of abundance and 31.80% of biomass. The migrant species, with a single species, represented 3.53% of abundance and 12.27% of biomass. Alien species comprised 21.43% of the catches in terms of number of species. Three alien species distributed among two families (Cyprinidae, Poeciliidae) were recorded.

The length-weight relationships of 10 fish species belonging to 5 families were calculated. Length-weight relationships parameters of species is given in Table 2. The species named

Table 2: The species, sample size, size range (total length and total weight), length–weight parameters (a and b) and the correlation coefficient (R^2)

								Length				Weight			
Species	No.	a	b	SE (b)	CI (95%)	Growth type	R^2	Min.	Max.	Mean	SE	Min.	Max.	Mean	SE
C. labrosus	23	0.0037	3.2987	0.00515	3.2863-3.3082	PAG	0.9754	20.8	32.3	24.60	0.81889	78.8	338	157.20	17.4350
C. gariepinus	27	0.0086	2.9788	0.00065	2.9781-2.9808	NAG	0.9996	26.3	55.0	39.32	1.37261	147.0	1310	532.08	62.1316
A. anguilla	24	0.0143	2.5711	0.00741	2.5275-2.6468	NAG	0.4015	58.0	69.5	62.20	0.61206	438.0	789	593.83	21.3888
C. gibelio	41	0.0080	3.2874	0.00913	3.2684-3.3058	PAG	0.8278	15.5	27.2	20.88	0.40200	58.0	702	189.27	17.0125
C. antalyensis	32	0.0148	2.9296	0.00231	2.8714-2.9461	NAG	0.9963	15.3	32.1	24.58	0.87976	45.2	393	196.47	18.7161
C. carpio	33	0.0072	3.2707	0.00210	3.2430-3.3120	PAG	0.9936	15.1	25.0	20.50	0.46100	57.9	283.7	150.20	10.7380
V. vimba	22	0.0059	3.1707	0.00697	3.1549-3.1846	PAG	0.9867	9.5	24.5	20.54	0.88790	8.1	150	96.186	8.33464
D. labrax	73	0.0082	3.1071	0.00202	3.1018-3.1099	PAG	0.9837	17.1	33.5	27.47	0.42028	59.8	486	255.21	10.1432
L. aurata	264	0.0093	2.9362	0.00109	2.9336-2.9379	NAG	0.9955	11.7	36.8	24.27	0.38150	12.9	361.2	128.94	5.34401
M. cephalus	100	0.0090	3.0119	0.00120	3.0099-3.0147	PAG	0.9977	9.5	29.7	19.31	0.41808	8.4	252.4	77.106	5.16946

PAG: Positive allometric growth, NAG: Negative allometric growth

Sparus aurata, *Gambusia affinis*, *Pseudorasbora parva*, *Pseudophoxinus alii* were left out of consideration due to the insufficient number of individuals. The sample sizes varied from 22 fish for *Vimba vimba* (Cyprinidae) to 264 fish for *L. aurata* (Mugilidae). of all the fish species in Table 2, *A. anguilla* recorded the highest maximum length of 69.5 cm followed by *C. gariepinus* (55.0 cm), *L. aurata* (36.8 cm) and *D. labrax* (33.5 cm). *C. gariepinus* recorded the highest maximum weight of 1310 g followed by *A. anguilla* (789 g), *Carassius gibelio* (702 g) and *D. labrax* (486 g).

The parameter b of the fishes captured in Kundu Estuary ranged from a minimum of 2.5711 (95% CI = 2.5275-2.6468) for *Anguilla anguilla* to a maximum of 3.2987 (95% CI = 3.243-3.312) for *Cyprinus carpio* with a mean value equal to 3.0562.

The R^2 values of the fishes captured in Kundu Estuary ranged from a minimum of 0.4015 for *Anguilla anguilla* to a maximum of 0.9996 for *Clarias gariepinus* with a mean value equal to 0.9100 (95% CI = 0.7766-1.0432).

DISCUSSION

According to this study, 14 species permanently or temporarily occupy in the study area. Number of fish species of Kundu Estuary is fewer than the most studies such as Richmond River Estuary (Australia, 64 species) and Clarence River Estuary (Australia, 66 species) (West and Walford, 2000); Strymon River Estuary (Greece, 43 species) and Rihios River Estuary (Greece, 29 species) (Koutrakis *et al*., 2000); Kakanui River Estuary (New Zealand, 20 species) (Jellyman *et al*., 1997); Solway River Estuary (England, 22 species) (Elliott and Dewailly 1995). The present study showed similar number of species values with that reported by Jellyman *et al*. (1997) for Waitaki River Estuary (New Zealand, 16 species), Clutha River Estuary (New Zealand, 14 species), Waiau River Estuary (New Zealand, 14 species) and Mohaka River Estuary (New Zealand, 13 species). Occurrence, distribution and movement of fishes in estuary systems are certainly determined by a complex combination of both biotic and abiotic factors (Martino and Able, 2003; Jaureguizar *et al*., 2006; Sosa-Lopez *et al*., 2007). The highest abundance of marine species entering Kundu Estuary early in life or adults demonstrates its importance to marine species.

The relationship between body length and weight is of great importance in fishery biology (Frota *et al*., 2004). Length-weight relationships for fish have been used extensively to provide

information on the condition of fish, their isometric or allometric growth, in the analysis of ontogenic changes, to compare life histories of fish species between regions as well as other aspects of fish population dynamics (Verdiell-Cubedo *et al*., 2006). Length-weight relationships have been reported for Turkish marine (Akyol *et al*., 2007; Kalayci *et al*., 2007; Bayhan *et al*., 2008; Torcu Koc *et al*., 2008; Turker Cakir *et al*., 2008; Ak *et al*., 2009) and freshwater (Alp and Kara, 2004; Arslan *et al*., 2004; Tarkan *et al*., 2006; Ozcan, 2008; Unver and Yildirim, 2011) species but data for estuarine fish are inadequate. The length-weight relationship in fish may vary according to species, age and sexes. Geographic location and associated environmental conditions, such as seasonality (date and time of capture), stomach fullness, disease and parasite loads, can also affect the value of b (Bagenal and Tesch, 1978; Le Cren, 1951).

The parameter b of the fishes were significantly different ($p<0.001$) from 3. Fish species of Kundu Estuary grows allometric (Weight increased allometrically with length). Six species (*C. labrosus*, *M. cephalus*, *D. labrax*, *V. vimba*, *C. carpio* and *C. gibelio*) showed positive allometric growth ($b>3$): four species (*L. aurata*, *A. anguilla*, *C. gariepinus*, *C. antalyensis*) showed negative allometric growth ($b<3$).

Studies about length weight relationships of similar species also showed very variable b value. Differences in b-values can be attributed to the combination of one or more of the following factors: (1) differences in the number of specimen examined, (2) area/season effect and (3) differences in the observed length ranges of the specimen caught (Moutopoulos and Stergiou, 2002; Sani *et al*., 2010).

Kundu estuary is a suitable habitat for a variety of species, especially fish of both conservation and commercial importance. Two (*C. antalyensis* and *P. alii*) of them are very rare and previously unstudied. The present study showed the first data about length weight relationships of *C. antalyensis*. However, due to anthropogenic pressures such as tourism, fisheries, water sports and other maritime activities, it is necessary to effectively protect and monitor this important fish habitat.

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