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Diversity of Fish Fauna in Gediz Estuary Lagoons (Izmir Bay/Aegean Sea)

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Abstract: In order to establish the present fish fauna in Gediz estuary lagoons, sampling was conducted in the 4 stations, one inside Gediz river mouth and 3 in the lagoons during 2004. In the first station, a commercial trawling with 44 mm codend mesh size to determine fish fauna was used and sub marine observations or beach seine of 1 mm mesh size employed to establish fish fauna in the lagoons, Kırdeniz, Homa and Çilazmak, which are relatively shallow. In addition some physicochemical parameters such as temperature, salinity, dissolved oxygen, pH and chlorophyl-a which all play significant roles were measured for each stations monthly. As the result of the research, 56 fish species of 24 families were found from the 4 stations. According to a Bray-Curtis similarity index and multi dimensional scaling analysis in relation to the lagoons, 2 groups are formed based on diversity of fish fauna; Kırdeniz, Homa and Çilazmak are similar to one another in diversity of species, with the first station being different from them.

Key words: Fauna, fish, lagoon, gediz estuary, Izmir bay, Aegean Sea

INTRODUCTION

Estuarine environments are vital habitats for many species of fish, crustaceans and molluscs, serving as spawning grounds, nurseries, feeding grounds and important for early growth and/or physiological preparation of migration. Estuaries are also of great importance in biodiversity and it is important to note that most species found there attract attention both in direct and indirect commercial interests (Élie, 1997).

The largest river into Izmir bay, Gediz has a great influence on marine ecosystem of the bay itself, whose water has long been contaminated by increasingly growing industrialization, air pollution, human settlements and agricultural processes and running into the inner bay to affect the marine ecosystem since 1980's (Sunlu *et al*., 2002; Tatlıdil, 2002). In addition to adversities caused by the pollutants, sediments carried away by the river gradually fill the north part over years. Increased shallowness and high temparature in summer allows salinity to elevate, threatening organisms in the estuary. Recent droughts and overconsumption of water from the river in farming in Aegean basin has caused the river to flow to greatly decrease during summer months in particular. Therefore, reedy areas and marshlands are exposed to the danger of evaporation/dehydration.

The lagoons between land and sea are under the influence of both marine and territoral factors, constituting a transition process from sea to fresh water. Because of their mobility and impact at various trophic levels, fish play an important biological part in the functionality of an estuary. Fish occupy estuarine areas at different phases of their life cycle, either using these habitats temporarily for reproduction, as transition zones or occasionally for feeding or on a more permanent basis (Vicente, 1997). Estuaries are unique areas not only because of their landscape value but also due to the fact that they are of fundamental importance as feeding and spawning grounds and as nurseries for juveniles of many marine species. In addition, estuaries often are part of the local traditional fishing grounds (Vieira *et al*., 2002). That's why lagoons are of great ecological value as shallow waters.

Previous studies made in the lagoons of Gediz estuary are mainly related to fish fauna in Homa lagoon (Alpbaz and Kınacıgil, 1988; Korkut and Gamsız, 1995; Akyol, 1999; Kaya *et al*., 2000; Akyol and Kınacıgil, 2001; Acarlı, 2006; Bayhan and Acarlı, 2006; Ilkyaz *et al*., 2006). However, there are no studies conducted involving fish diversity and similarity index of Kırdeniz and Çilazmak lagoons in the estuary. This research established fish fauna in the lagoons of Gediz estuary, interpretted and compared their lagoonal distributions with some physicochemical parameters.

MATERIALS AND METHODS

The river Gediz is the second biggest river after Büyük Menderes flowing to Aegean Sea from western Anatolia, with a length of 401 km and a water reservoir of

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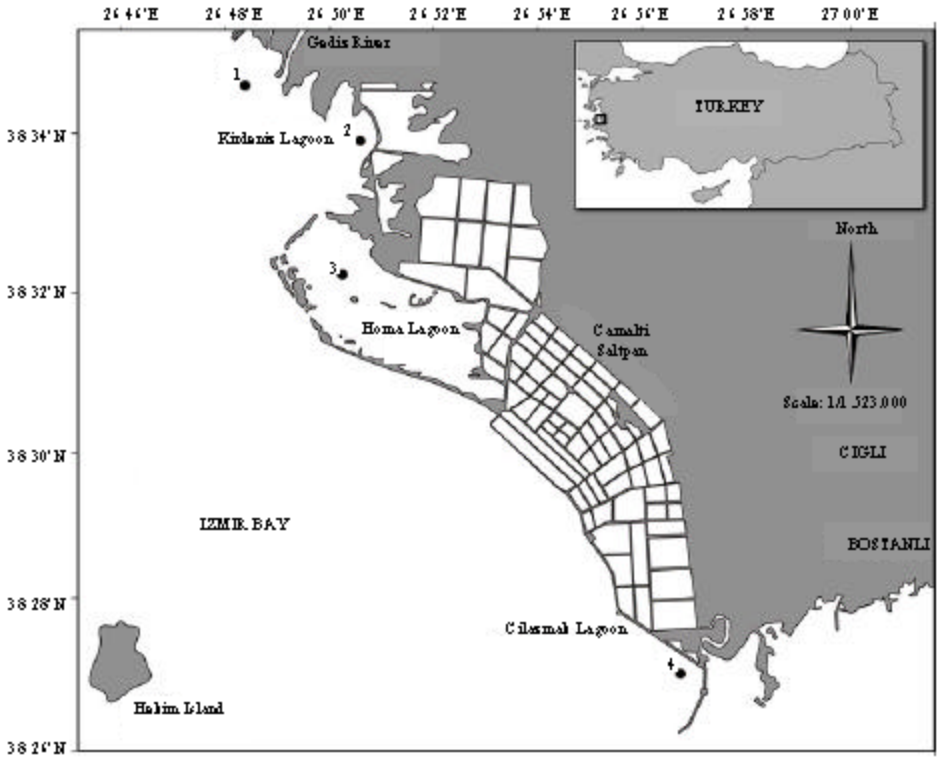

Fig. 1: Map of the study area (Izmir Bay/Aegean Sea)

17.500 km^2. It forms an estuary of some 40.000 ha. This study aimed at identifying fish species inhabiting in Gediz estuary conducted samplings in the 4 stations: Gediz river mouth, Kırdeniz, Homa and Çilazmak lagoons (Fig. 1).

The first station located in river mouth was chosen to compare it with the lagoons in fish fauna, with a 10-15 m depth and muddy ground. In 2004, 4 trawls were set and hauled for 30 min with the catch being sorted into fish species. The commercial trawl netting hauled had a 44 mm codend mesh size. Being very shallow, the other stations conducted submarine observations and beach seine of 1 mm mesh size was used to identify fish species.

Similarity relationships of the species to in the lagoons were established by Bray-Curtis and multi dimensional scaling, with Biodiversity professional ver.2 and Istatistica ver.7 programs being employed for this purpose.

Some physicochemical parameters such as temperature, salinity, dissolved oxygen, pH and Chlorophyl-a which all play significant roles were measured for each stations monthly. Water temperature plus pH, dissolved oxygen (DO) and salinity (%S) were measured by Hanna Instruments HI 8314, Winkler and Mohr-Knudsen methods respectively. Turner Designs 10-AU Flurometre established chlorophyl-a (Chl-a).

RESULTS AND DISCUSSION

Fish established in the lagoons in and around Gediz river into sea consist of best known species in Aegean Sea fish fauna (Bilecenoglu *et al*., 2002). A total of 56 fish species of 24 families were identified in the four stations where the study was conducted. Considering the distribution of the species captured in the lagoonal area by the stations, that richest in number of species was the station 2 with 45 followed by station 1 with 30, 4 with 25 and 3 with 22 (Table 1). The lagoons quite shallow in depth have great number of species established, the very reason for which is that there is no definitive border between the sea and the lagoons. It is difficult to definitely establish the border of all the lagoons with the sea but Homa. The lagoon Çilazmak the third rich in species is out of service due to shallowness, negligence and deficiency in commercial fisheries.

Multi dimentional scaling and Bray-Curtis analysis established 2 different results to explain the similarity relationships of the fish species in the stations with 2, 3 and 4 similar to one another and 1 different from them (Fig. 2 and 3).

Chlorophyl-a to affect productivity of the lagoons and therefore indicate primary productivity was

Table 1: Distribution of fish species by the stations

Fish species	Stations: Gediz river	Kırdeniz lagoon	Homa lagoon	Çilazmak lagoon
Scyliorhanidae				
Scyliorhinus canicula	+	-	-	-
Rajidae				
Raja clavata	+	-	-	-
Clupeidae				
Sardina pilchardus	+	+	+	-
Sardinella aurita	+	+		-
Engraulidae				
Engraulis encrasicolus	+	+	+	+
Belonidae				
Belone belone	+	+	+	-
Cyprinodontidae				
Aphanius fasciatus	-	+	+	+
Syngnathidae				
Hippocampus hippocampus	-	+	+	-
Syngnathus acus	-	+	+	+
Serranidae				
Serranus cabrilla	-	-	-	+
Serranus hepatus	+	+	-	-
Serranus scriba	-	+	-	+
Moronidae				
Dicentrarchus labrax	+	+	+	+
Carangidae				
Trachurus mediterraneus	+	-	-	-
Trachurus trachurus	+	-	-	+
Sparidae				
Boops boops	+	+	-	+
Diplodus vulgaris	+	+	-	-
Diplodus annularis	+	+	+	+
Diplodus puntazzo	+	+	-	-
Diplodus sargus	+	+	-	-
Sarpa salpa	-	+	-	-
Sparus aurata	+	+	+	+
Lithognathus mormyrus	+	+	+	-
Pagellus acarne	+	-	-	-
Pagellus erythrinus	+	-	-	-
Centracanthidae				
Spicara smaris	+	-	-	-
Spicara maena	+	+	-	+
Labridae				
Coris julis	-	+	-	-
Symphodus cinereus	-	+	-	+
Symphodus mediterraneus	-	+	-	-
Symphodus ocellatus	-	+	-	-
Symphodus roissali	-	+	-	-
Symphodus rostratus	-	+	-	-
Symphodus tinca	-	+	-	+
Uranoscopidae				
Uranoscopus scaber	+	-	-	-
Scombridae				
Scomber japonicus	+	+	-	-
Gobiidae				
Gobius bucchichi	-	+	-	-
Gobius niger	+	+	+	+
Pomatoschistus sp.	-	+	+	+
Zosterisessor ophiocephalus	-	+	+	+
Blenniidae				
Blennius sanguinolentus	-	+	-	+
Parablennius tentacularis	-	+	-	+
Lipophrys pavo	-	+	+	+
Mugilidae				
Chelon labrosus	-	+	+	-
Liza aurata	-	+	+	-
Liza ramada	-	+	+	+
Liza saliens	-	+	+	-
Mugil cephalus	-	+	+	-
Atherinidae				
Atherina boyeri	+	+	+	+

Table 1: Continued

Fish species	Stations: Gediz river	Kırdeniz lagoon	Homa lagoon	Çilazmak lagoon
Scorpaenidae				
Scorpaena porcus	-		-	+
Scorpaena scrofa	-	+	-	-
Triglidae				
Lepidotrigla cavillone	+	-	-	-
Citharidae				
Citharis linguatula	+	+	-	-
Bothidae				
Arnoglossus laterna	+	+	-	+
Buglossidium luteum	+	+	+	+
Soleidae				
Solea solea	+	+	+	+

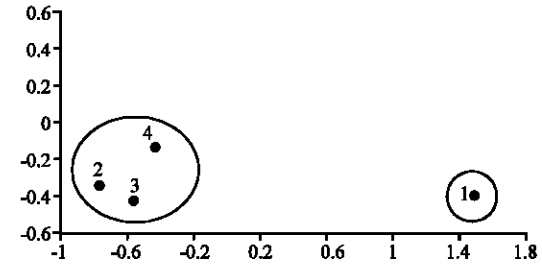

Fig. 2: A multi dimensional scaling (MDS) analysis to represent the correlations in the stations (1-Gediz river 2-Kırdeniz lagoon 3-Homa lagoon 4-Çilazmak lagoon)

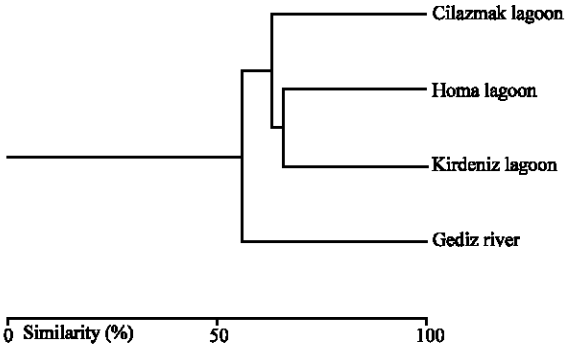

Fig. 3: Dendrogram of similarity between the stations based on the fish species

established to be of highest value followed by Homa and Çilazmak lagoons (Fig. 4), which also resembles list of species diversity in a full consistence. Therefore, amount of chlorophyl-a found in the lagoons can be said to have an effect to increase species diversity.

The highest value in annual dissolved oxygen (DOD) distributions was found in Çilazmak lagoon in march 2004 (17.0 mg L^{-1}) (Fig. 4). All the others but Çilazmak are similar in yearly mean DOD values. However, all the lagoons showed no significant difference in terms of annual mean water temperature and pH (Table 2).

Table 2: Minimum, maximum and mean values of some physicochemical param`eters according to the stations

Physicochemical parameters	Stations											
	Gediz river			Kırdeniz lagoon			Homa lagoon			Çilazmak lagoon		
	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
Chlorophyl-a (μg L^{-1})	0.74	3.32	1.71	0.64	9.94	2.53	0.04	6.85	2.10	0.45	2.84	1.19
Temperature (°C)	9	28	19.92	10	33	19.33	9	29	19.04	10	32	21.75
Salinity (%)	0.29	35.97	17.04	24.57	38.95	33.02	24.96	52.60	36.07	28.37	38.99	34.70
Dissolved oxygen (mg L^{-1})	4.8	10	6.18	0	10.8	7.12	4.8	12.4	7.61	6.8	27.6	12.53
PH	7.56	8.53	7.98	7.43	8.72	8.09	7.85	8.27	8.10	7.92	8.59	8.25

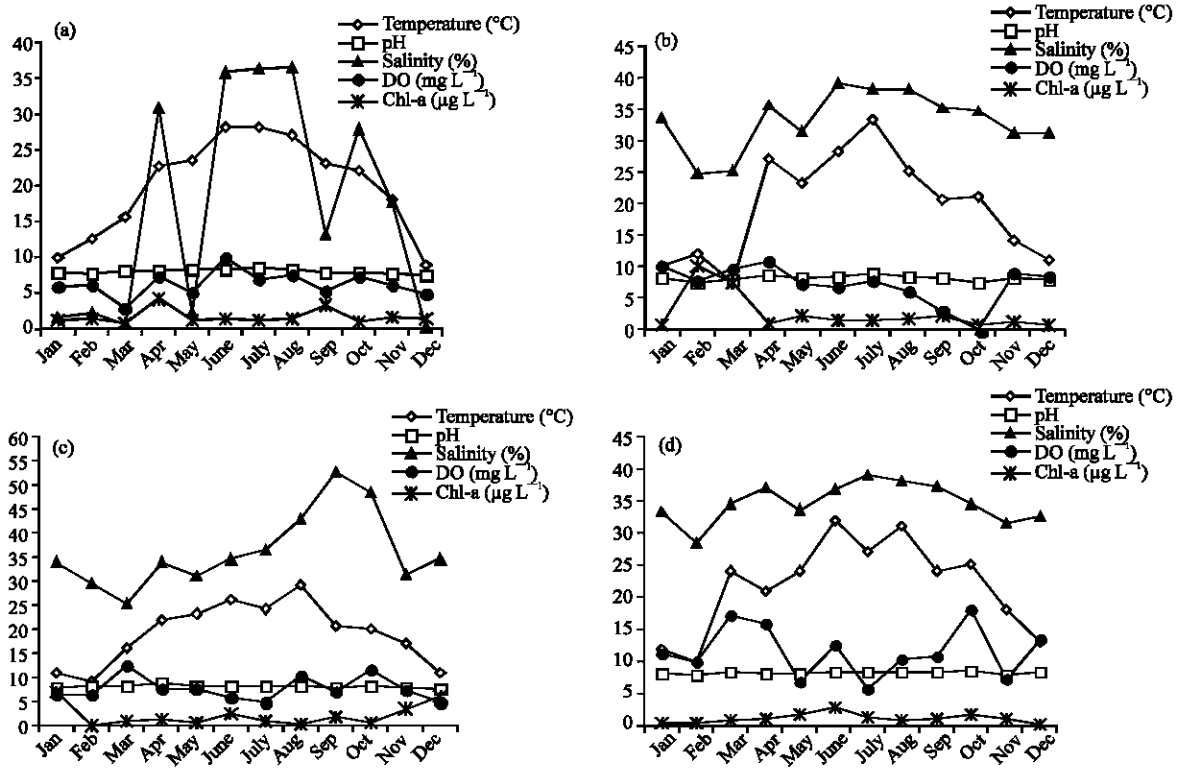

Fig. 4: Monthly variations of some physicochemical parameters by the stations (1-Gediz River 2-Kırdeniz lagoon 3-Homa lagoon 4-Çilazmak lagoon)

With the lagoons in salinity elevation during summer months compared, 3 was highest followed by 2 and 4 stations (Fig. 4). Low salinity seen in station 1 in December, January, February and March was accounted for by increased flow in the river due to precipitation. A typical example of salinity increase in summer is Homa lagoon, where highest salinity value was established to be 52.6% in September by the study concerned. Because of such a high salinity to affect species distribution in the lagoons, Homa remains down in the list in species diversity as compared to the others. In addition shallowness and salinity increase caused by hot weather in summer creates fluctuations in the number of the species rich in value of commercial fisheries (Fig. 5) (Acarli, 2006).

Such commercially valuable fish species as *Dicentrarchus labrax*, *Lithognathus mormyrus*, *Sparus aurata*, *Liza aurata*, *Liza ramada*, *Liza saliens*, *Chelon labrosus*, *Mugil cephalus* and *Solea solea* caught in and around lagoonal site of Gediz river by the fishermen contribute greatly to the local livelihood. In addition pelagic species such as *Sardina pilchardus*, *Sardinella aurita*, *Engraulis encrasicholus* and *Atherina boyeri* found there constitute basic nutrient source of many native and immigrant birds in the lagoons and Birds Paradise in Çamaltı saltpan. Especially migrating species feed on such natural sources there (Sıkı, 1988).

Because marshland and farming areas have been lost to settlements caused by the increased demand for

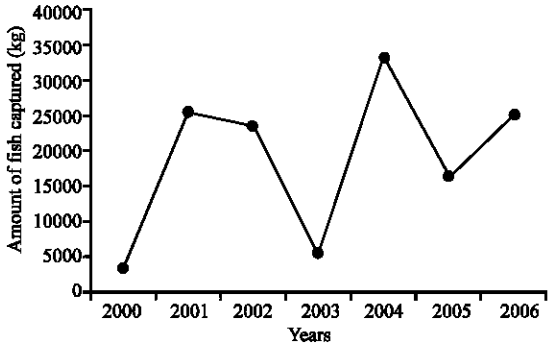

Fig. 5: Amount of fish captured from Homa lagoon between 2000-2006

housing purposes constructions in and around Bostanlı and Cigli within reach of the lagoonal area, people are gradually interested in the site, which implies that the lagoonal location not previously exposed to human activities undergoes pressures from industries and settlements. Organic, inorganic and agricultural pesticides particularly contaminate the water of river Gediz to flow into sea through the territories on which farms and facilities are established, affecting the lagoons and Izmir Bay (Anonymous, 1999), which is typically examplified by a hermaphrodite individual encountered in lagoon Homa (Bayhan and Acarli, 2006).

Finally, in order to protect natural fish reserves without disturbing delicate ecosystem balances in the lagoonal area of great importance both for fisheries and migrating species in the tributary of Gediz, it seems necessary to control construction of settlement around the lagoons, take some measures to protect shallowness and over salinity, prevent fishermen from over exploiting and avoid all sorts of pollutant risks.

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