Asian Journal of Water, Environment and Pollution, Vol. 6, No. 4, pp. 37-43.

Fisheries of Golden Horn following the Improvements in Water Quality

Nurtac Ogleni*, Ramazan Gokdas and Omer Ogleni

Sakarya University, Environmental Engineering Department, Esentepe Campus, 54187 Sakarya, Turkey
✉ nuroz@sakarya.edu.tr

Received September 12, 2008; revised and accepted April 27, 2009

Abstract: The aim of the study was to determine the returning of current and former species in their native lands, the Galata Bridge and the Ataturk (Unkapani) Bridge, at Golden Horn during the periods from October 2005 to May 2006—stations on which established fisheries were determined and inland distances where these fisheries were viewed and observed. At the end of the observations, thirty-four species were determined at Golden Horn. Fifteen species, *Hippocampus hippocampus, Solea vulgaris, Atherina boyeri, Thrachurus trachurus, Maena smaris, Psetta maxima, Diplodus vulgaris, Gobius batrachocephalus, Boops boops, Boops salpa, Merlangius euxinus, Lithognathus mormyrus, Alosa fallax nilotica, Trachinus draco,* and *Belone belone gracilis* were observed for the first time differently from the previous studies (Yuksek et al., 2006). Economically important species like *Mullus surmuletus, Mugil cephalus, Sarda sarda, Pomatomus saltator, Psetta maxima, Engraulis encrasicolus, Trigla lucerna, Belone belone, Trachurus trachurus, Solea vulgaris, Diplodus vulgaris, Lithognathus mormyrus,* and *Merlangius euxinus* were frequently determined. Furthermore the length sizes of the same species that were observed at the selected stations were compared statistically (P>0.05). Consequently, positive influence of rehabilitation studies started in 1995 on the increasing of the species and the amounts was researched.

Key words: Fish, the length difference, significant statistically, rehabilitation, Golden Horn.

Introduction

The Golden Horn Estuary is close to the Bosphorus–Marmara Sea junction, extending in northwest–southeast direction (28° 97' E longitude, 41° 02' N latitude) with approximately 7.5 km length and 700 m width and 25×10^6 m^2 area. The maximum depth is 40 m at the lower estuary and the depth decreases towards the upper part. Although the two small streams carry freshwater to the estuary, the amount of the flow decreased remarkably by the end of 1990s to 3×10^5 m^3 year^{-1} (Ozturk et al., 1998). Therefore, the main source of the freshwater flowing into the Golden Horn was rainfall (Sur et al., 2002).

By the end of 1990s, the Golden Horn Improvement Project was initiated. According to this project, all of the surface discharges were controlled, the 4×10^6 m^3 anoxic sediment at the upper part was removed and the bridge floating on pontoons was partially opened (Tas et al., 2006).

Severe pollution limited aquatic life to the surroundings of Galata Bridge, while more upper parts were almost lifeless. Although high mobility of fish limited the usage in pollution monitoring, the group is included in monitoring studies. As a result of the commercial and public interest, Guvengiris et al. (1977) described the historic Golden Horn as a rich ecosystem, where valuable fish such as *Sarda sarda, Thunnus thynnus,* and *Pomatomus saltatrix* were caught. Even the creeks feeding the estuary were rich in *Leuciscus cephalus* and *Scardinius erythrophthalmus*. Unfortunately, in 1996, fish distribution was limited to the lowermost region (around Galata Bridge) and only fish such as mackerel, sprat and mullet were caught (Okus et al., 1996).

*Corresponding Author

It has come across that fourteen species of fish were caught by angling around The Galata Bridge during 1999-2000. In May 2000, following the release of water from Alibey Creek, many dead *S. erythrophthalmus* were seen in the uppermost parts, indicating persistence of these species in the dam reservoir. Existence of 35 species in the Golden Horn was detected in 2002, for feeding and/or reproduction purposes. Among these 35 species, egg and/or larvae belonging to 32 were determined (Yuksek et al., 2006).

In this study, it has been searched that the kind of fisheries which are lost in process of pollution in Golden Horn return in native land as a result of the rehabilitation work. The Galata Bridge and The Ataturk (Unkapani) Bridge were chosen as stations. The length sizes of fishes caught at these two stations were compared. On being measured, it has been investigated that differences are significant statistically.

Materials and Methods

Study Area

This study enclosed the period of October to December in 2005 and January to April, in 2006. The two stations chosen for the studying are the Galata Bridge and the Ataturk (Unkapani) Bridge on the Golden Horn. These stations have been shown on the map of the Golden Horn in Figure 1. The Galata Bridge has been fixed as first station and the Ataturk (Unkapani) Bridge has been fixed as second station.

Our first station, the Galata Bridge, is on the entrance part of Golden Horn at the nearest point of the Bosphorus. It is approximately 500 m in length and it connects the Eminonu area with the Karakoy area.

The second station, the Ataturk (Unkapani) Bridge, is approximately 450 m in length and connects the Unkapani with the Beyoglu.

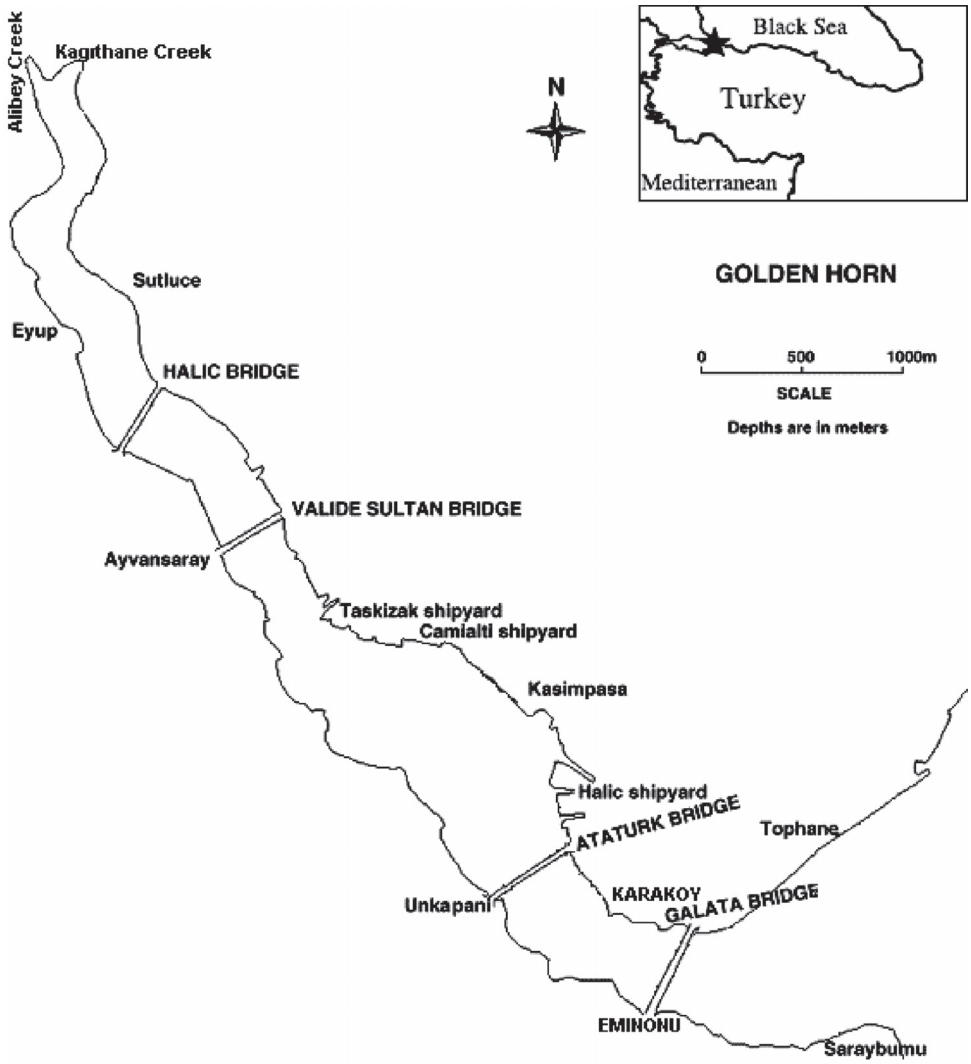

Figure 1: The study area and sampling stations (Yuksek et al., 2001; Tuncer et al., 2001).

Water Quality

Following the onset of rehabilitation studies, the surface dissolved oxygen (DO) concentrations have raised significantly throughout the estuary. Minimum values were ~3 mg l^{-1} in 1998 at Galata Bridge and rose to ~ 5 mg l^{-1} in 2000. Total suspended sediment (TSS) values decreased from 80 mg l^{-1} to 10 mg l^{-1} in 2000 at the mid-estuary, but remained around 25 mg l^{-1} in more upper parts due to high phytoplankton densities and influxes, particularly those originating from rainfall. The highest surface inorganic phosphate (PO_4) value was 10.36 µM in 1998 at the entrance of the estuary and decreased to 1.12 µM in 2001. Silicate (SiO_2) concentrations decreased ~10 folds at the outer part, while the inner part concentration decreased ~16 folds at the first sampling following the semi-opening of the bridge. Nitrate (NO_2) displayed slight decrease compared to phosphate and silicate. A remarkable decrease was monitored at uppermost regions when compared to 1998, despite weak circulation and ongoing inputs from the Alibey and Kagithane Creeks. Although seasonal fluctuations were detected, $NO_3 + NO_2$ concentrations increased two folds after May 2000 at the entire estuary. High bacterial counts of 1998 approaching 10^7 CFU 100 ml^{-1} gradually decreased during the rehabilitation studies. Bacteriological values decreased to 10^3 CFU 100 ml^{-1} by the end of 2001 (Yuksek et al., 2006).

Sampling

Samples have been taken by angling because of forbidden hunting of fisheries of all species except by angling the Alibey and the Kagithane to the New Galata Bridge in the Golden Horn (Sarikaya, 1980; Kucuk and Ikiz, 2004; KKGM, 2004). The two stations where we got the examples for our study are the points that have been made angling as an intensive around Golden Horn, as well. Our examples have been taken from both sides of both ends and the origin of the bridges. The length of fishes as an extent between the nose of fish and the last point of caudal fin has been measured in sensibility of mm. The fishes sampled on both the stations were registered carefully.

Statistical Analysis

The difference of the lengths of fish at both the stations has been searched. Thus it has been investigated that the environmental factors do affect the lengths of the fishes. Arithmetic average of the length of the same type of fishes has been compared (Geldiay and Balik, 1996). The Significant Test of Difference between Two Averages was used which is optimal method for our study. From the methods used in science of statistics, it could be understood whether appeared difference is statistically significant (Sumbuloglu and Sumbuloglu, 1998). The test has been ignored for some types of very low sample number or just appeared types.

Sample numbers are fit for necessary minimum sample number (n = 30) as the tests are applied for significant difference between two averages. Sample numbers of compared two groups get a term of being equal or near equal to each other. Probability of failure of hypothesis in parametric tests increases while sample numbers are getting decreased (generally it is less than 30) (Sumbuloglu and Sumbuloglu, 1998).

Results and Discussion

It has been seen as good influences to increasing number of fish species and increasing amount of angled fisheries of rehabilitation study started in 1995 at observations during the period from October 2005 to May 2006 in Golden Horn.

As a result of the study, thirty-four species were totally determined at Golden Horn. Fifteen species (*Hippocampus hippocampus, Solea vulgaris, Atherina boyeri, Thrachurus trachurus, Maena smaris, Psetta maxima, Diplodus vulgaris, Gobius batrachocephalus, Boops boops, Boops salpa, Merlangius euxinus, Lithognathus mormyrus, Alosa fallax nilotica, Trachinus draco,* and *Belone belone gracilis*) were observed for the first time differently from the previous studies (Yuksek et al., 2006).

It has been determined that fisheries such as sword fish (*Xiphias gladius*), erytrinus (*Pagellus erythrinus*), thunny (*Thunnus thynnus*), carp (*Cyprinus carpio*), and chub mackerel *(Scomber japonicus*) are known to live in Golden Horn in earlier years but presently not seen i.e. did not return to native lands.

The food, warmth, DO, pollution, flow etc. effects of environmental factors are huge on growth of fishes. It has been made a statistical study in order to understand that characters of the environment and average length differences for same species are better in which station. The average length differences for same species were calculated by making length measurement of angled fish species in the Galata and the Ataturk (Unkapani) Bridges. Generally it has not been a significant difference in this statistical study. However, significant differences seen on just two species take root from the fact that these species are being stationed in better conditions than at other station as a matter of getting own living places and suitable environment to leave eggs.

Consequently it has been understood that there is not very much difference between these two stations without making any measurement. Anyhow averages of length measurements for same period and same species are not different. So it betrays that conditions of a food, warmth, DO, pollution, salinity, flow etc. do not show an exchange enough to make a difference on growth of fishes in both stations.

It has been decided not to go back for native land fish species like sword fish, erytrinus, thunny, mackarel, carp, and chub mackerel that they were stated to live in Golden Horn in earlier years but not seen at the present when the detected species in this study and the detected kinds in previous investigations are being evaluated. Table 1 shows which species on were seen in which months.. It has been thought to take root from obstructive effects of bridge underpinnings and getting very low kinds as sword fish, thunny, erytrinus and mackerel.

In length measurement done with statistical purpose, it has seen a difference as a rule between average lengths of angled fishes in the Unkapani and average lengths of that in the Galata Bridge when compared valuations at two points of same species (Table 2). It has appeared that lengths of angled fishes in the Galata are longer. The difference has been getting statistically significant for only some species but usually not for other species (Table 2). It has been supposedly taking root for reason that little individuals tend for shelter at the Ataturk

Table 1: Periods (in months) fisheries are caught and seen on the Galata and the Ataturk (Unkapani) Bridges

Species	*October 2005*	*November 2005*	*December 2005*	*January 2006*	*February 2006*	*March 2006*	*April 2006*
Mugil (liza) auratus, Riss., 1810				• ▪	• ▪	• ▪	• ▪
Mullus barbatus, Linn., 1758			• ▪	• ▪	• ▪	• ▪	
Sprattus sprattus, Linn., 1758	• ▪						• ▪
Hippocampus hippocampus, Linn., 1758					• ▪	• ▪	
Solea vulgaris, Quen., 1806					▪		
Scianea umbra Linn., 1758							▪
Gaidropsarus mediterraneus, Linn., 1758	▪	▪					
Atherina boyeri, Riss., 1810						• ▪	• ▪
Engraulis encrasicolus, Linn., 1758	• ▪	• ▪					
Serranus hepatus, Linn., 1758	•						▪ •
Mugil cephalus, Linn., 1758				• ▪	• ▪	• ▪	• ▪
Scorpeana porcus Linn., 1758							• ▪
Trachurus mediterraneus Std., 1868				• ▪	• ▪	• ▪	• ▪
Thrachurus trachurus, L Linn., 1758				• ▪	• ▪	• ▪	• ▪
Spicara maenas, Linn., 1758	• ▪	• ▪				• ▪	• ▪
Maena smaris, Linn., 1758	• ▪	• ▪	• ▪	• ▪	• ▪	• ▪	• ▪
Psetta maxima, Linn., 1758					• ▪		• ▪
Diplodus vulgaris, Hill., 1817	• ▪						
Gobius niger, Linn., 1758						• ▪	• ▪
Gobius batrachocephalus Pall., 1811						• ▪	• ▪
Trigla lucerna, Linn., 1758					• ▪	• ▪	
Boops boops, Linn., 1758							•
Sarpa salpa, Linn., 1758	▪					▪	
Dicentrarchus labrax, Linn., 1758					• ▪	• ▪	• ▪
Pomatomus saltator, Linn., 1766	• ▪	• ▪	• ▪	• ▪	• ▪	• ▪	
Merlangius merlangus euxinus, Nord., 1840						• ▪	• ▪
Lithognathus mormyrus, Linn., 1758				• ▪	• ▪	• ▪	• ▪
Sarda sadra, Bloch., 1793	• ▪	• ▪	• ▪				
Sardina pilchardus, Walb., 1792	▪ •						▪
Mugil (chelon) labrousus, Riss., 1826				• ▪	• ▪	• ▪	• ▪
Mullus surmuletus, Linn., 1758					• ▪	• ▪	
Alosa fallax nilotica, Geof., 1808					• ▪	• ▪	• ▪
Trachinus draco, Linn., 1758	• ▪						
Belone belone gracilis, Lowe., 1839			• ▪	• ▪	• ▪	• ▪	

(• the months being angle on the Ataturk (Unkapani) Bridge, ▪ the months being angle, seen on the Galata Bridge)

Table 2: Statistical results comparing average lengths of same species

Species	*Subject number (n)*		*Length (cm) (min-max)*		*Arithmetic average (X)*		*Standard deviation (S)*		*Variance (S^2)*		*Test of significance (t)*
	GB	*AB*	*GB*	*AB*	*GB*	*AB*	*GB*	*AB*	*GB*	*AB*	
Mugil (liza) auratus	44	42	15-37	16.3-39	21.36 ± 0.73	23.99 ± 1.06	4.87	6.9	23.71	47.61	t=2.05, p<0.05 fish length differences between two points are found statistically significant
Pomatomus saltator	34	34	11.8-34	11-27	18.11 ±0.96	16.25 ±0.74	5.62	4.35	31.58	18.92	t=1.53, p>0.05 fish length differences between two points are not found statistically significant
Mugil cephalus	43	49	16.5-41	16.5-39.5	20.86± 0.74	22.32± 0.77	4.87	5.45	23.71	29.7	t= 1.36, p>0.05 difference between fish lengths on two points is not statistically significant
Trachurus mediterraneus	48	48	8.6-18.6	8.5-15.8	10,88± 0.24	10.76± 0.18	1.67	1.27	2.78	1.61	t=0.4, p>0.05 difference between fish lengths on two points is not statistically significant
Thrachurus trachurus	40	43	8.2-21	8.2-19.1	11.22 ± 0.4	11.43 ± 0.3	2.55	2.03	6.55	4.12	t=0.84, p>0.05 difference between fish lengths on two points is not statistically significant
Mugil (chelo) labrosus	36	36	16.3-36	17-38.5	24.63 ± 0.85	27.46 ± 1.14	5.13	6.89	26.32	47.47	t=1.99 p>0.05 fish length differences between two points are found statistically significant
Mullus surmuletus	30	30	11-19.2	10.4-18.9	14.33 ± 0.33	14.78 ± 0.44	1.82	2.46	3.31	6.05	t=0.81 p>0.05 fish length differences between two points are found statistically significant
Belone belone	35	35	32.5-49.5	31.7-43	39.9 ±0.77	37.3 ± 0.49	4.56	2.89	20.79	8.35	t=4.3 p<0.05 fish length differences between two points are found statistically significant

GB: Galata Bridge, AB: Ataturk (Unkapani) Bridge

(Unkapani) Bridge because the vicinity of the Ataturk (Unkapani) Bridge is more shoal. From the Bosphorus chased, followed fish species squeeze each other, especially little individuals, to more interior sides where noise of intensive sea and land traffic around the Galata Bridge bothers little individuals more. In nourishment of primary production, the conditions as phytoplankton and zooplankton are better for little individuals in this area and is more suitable for some species in leaving egg, after progress phase of larvae on first periods of their livings are on.

Conclusions

Even though Golden Horn was an abundant region in fisheries area until 1960s, most of the existing fish species were lost in process of intensive pollution all these years. Increase in fish species is one of the positive results of rehabilitation study which started in 1995 and also increasing progressively during following years.

Species and quantitative increase in fisheries form positive results of physical and chemical rehabilitation made in The Golden Horn and marks out a future on point of reaching their fertility comparing with previous years. Biological state of water environment and living ecology in fisheries have a direct relationship with other inhabitants of the environment and water quality. Station of nutrition, sheltering, reproduction and other activities of fisheries are under the influence of these factors as well. Quantitative increase in fisheries relates to physical and chemical conditions of the environment.

Increase in variety produced a distribution to more interior parts of the Golden Horn and is not as much as at the Galata and the Ataturk (Unkapani) stations which shows that changing in water quality on around here needs a reconsideration.

Today in effect for growing fishing environment of the Galata and the Ataturk (Unkapani) stations are not different in general and needs getting same position for other inside parts. Current underpinning buildings of the Ataturk (Unkapani) and the Sultana Bridges need to change urgently in order that water circulation reaches inside parts. Time period is a restrictive factor for our study evaluations and more large in new investigations. Making a search by different methods and tools in fisheries, a heavy metal analyses on trolled species, following water quality at constant stations for many years, investigating the Marmara Sea as well and comparing of species variety and growing percentages give more detailed information on potential new investigations. Also magnitude of fisheries population, doing self-renewal, searching percentage of sucking, length-weight relationships, length-age composition factors need a searching.

Preventing of fisheries made by boats at a particular time in the Golden Horn is a necessary condition for a biological cycle here. Biological fertility of the Alibey and the Kagithane Creeks with the Marmara Sea influences the Golden Horn directly. For this reason biological fertility around here has to be protected by correction.

Protecting the Golden Horn cleaned with extremely high-cost to eliminate waste of restaurants increasing fast, social buildings and traffic of ships involves an important task.

References

Geldiay, R. and S. Balik (1996). Turkey the Fresh Water Fishes. The Issue of Ege University, Izmir, pp. 90-164.

Guvengiris, A.Z. (1977). Marine pollution and the attitude of authorities. *The Periodical of Fish and Fishery*, **5:** 4-7 (in Turkish).

KKGM (2004). The Circular Relating to 2004-2006. The Catching Period which Manages Commercial Catching Water Products in the Sea of Ours and Inland. 36/1 No., The Ministry of Agriculture and Rural Affairs, Ankara.

Kucuk, F. and R. Ikiz (2004). Fish Fauna of Spilled Streams to Antalya Gulf. E.U. *The Periodical of Water Products*, **21(3-4):** 287-294.

Okus, E., Uysal, A., Yüksek, A., Altiok, H. and S. Tas (1996). Biological aspects of the rehabilitation of Golden Horn. Submitted to: Istanbul Water and Sewage Administration, Istanbul University, Institute of Marine Sciences and Management, Istanbul (in Turkish).

Ozturk, M., Basturk, A., Ozturk, I., Kinaci, C., Topacik, D. and M.F. Sevimli (1998). The Project of The Golden Horn Rehabilitation Work in Application. A Symposium of Management Waste Water in Metropole and Control of Pollution of Sea. General Directorate of Istanbul Water and Sewerage Administration, pp. 233-242.

Sarikaya, S. (1980). Hunting of Water Products and Hunting Technology. The Ministry of Nourishment, Agriculture and Livestock, Ankara, pp. 48-51.

Sumbuloglu, K. and V. Sumbuloglu (1998). Biostatistics. The Printing 8, Ankara, pp. 48-271.

Sur, H.I., Okus, E., Sarikaya, H.Z., Altiok, H., Eroglu, V. and I. Ozturk (2002). Rehabilitation and water quality monitoring in the Golden Horn. *Water Science and Technology*, **46:** 29-36.

Tas, S., Okus, E. and A. Aslan-Yilmaz (2006). The blooms of a Cyanobacterium, Microcystis cf. aeruginosa in a severely polluted estuary, the Golden Horn, Turkey. *Estuarine Coastal and Shelf Science*, **68:** 593-599.

Tuncer, G., Tuncel, G. and T. I. Balkas (2001). Evolution of Metal Pollution in the Golden Horn (Turkey) Sediments between 1912 and 1987. *Marine Pollution Bulletin*, **42(5):** 350-360.

Yuksek, A., Okus, E., Uysal, A. and N. Yilmaz (2001). The Variety of Fish on the Process of The Golden Horn Rehabilitation. The Golden Horn Symposium. *ISKI issue*, **37:** 180-186.

Yuksek, A., Okus, E., Yilmaz, I. N., Aslan-Yilmaz, Asli and S. Tas (2006). Changes in biodiversity of the extremely polluted Golden Horn Estuary following the improvements in water quality. *Marine Pollution Bulletin*, **52(10):** 1209-1218.

Asian Journal of Water, Environment and Pollution
Volume 6 Number 1 **January –March, 2009**

Contents