Bioecology of the Otter (*Lutra lutra*) in Kızılırmak River in Kırıkkale Province*

Kırıkkale Kızılırmak'taki Su Samuru'nun (*Lutra lutra*) Biyoekolojisi

Research Article

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ABSTRACT

This study was carried out between September 2000 and June 2002, and based on the assessment of feeding and habitat features of otter which lives in two localities with the borders of Kırıkkale provinces. The sheltering places and footprints of otter were determined and spraints collected from its territory were analyzed. Sixtyfour plant species were identified, representing the common vegetation cover in the area. Nine fish species, used as food by otter, were identified from Kızılırmak River. Observations for two years revealed that the otter live in respectively unpolluted stretches of the river whereas in the stretches from the point of refinery effluent onward.

Key Words
Otter, *Lutra lutra*, bioecology, Kızılırmak, Kırıkkale, Turkey.

ÖZET

Bu araştırma Eylül 2000 ile Haziran 2002 tarihleri arasında Kırıkkale ilinde Kızılırmak Nehri'ndeki iki lokalitedeki su samurlarının habitat ve beslenme özelliklerinin belirlenmesine dayanmaktadır. Su samurunun yaşam alanı içindeki yuvaları ve ayak izleri tespit edilmiş, bıraktıkları dışkılar toplanarak analiz edilmiş ve bölgenin hakim bitki örtüsünü oluşturan 64 tür bitki teşhis edilmiştir. Kızılırmak'ta su samurunun besinini oluşturan 9 balık türü saptanmıştır. İki yılda yapılan gözlemler su samurunun nispeten kirlenmemiş ırmak suyunda yaşadığını, rafineri atıklarının kirlettiği kısımlarda hiç yaşamadığını ortaya koymuştur.

Anahtar Kelimeler
Su samuru, *Lutra lutra*, biyoekoloji, Kızılırmak, Kırıkkale, Türkiye.

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INTRODUCTION

There has been no thorough taxonomical, ecological and biological study of otter in Turkey until today. Some researchers noted the information about the spreading of otter in Anatolia as a prey animal without basing the research on samples [1-6]. Among these, the only records that were based on samples were from Rize, Artvin, Muğla, Antalya, and Mersin.

Today, the elements of the wildlife that are also the indicators of the human life are striving to carry on their existence. The mammals are the most vulnerable animal species among the wildlife to the environmental changes. Having a fur of high quality and being at the upper level of the food chain, the otters are among the endangered species due to the over hunting and environmental deformation. A member of the family Mustelidae (one of the carnivorous species), the otter lives in creeks, streams, brooks and rivers. Its aliment is comprised of mice, birds, frogs, testaceans, angleworms and water skaters living in aquatic environment. A nocturnal animal, the otter is a good swimmer and has a strong sense of smelling and hearing as well. Reproduction season begins with the spring, and breeds 2-4 annually in average. Living solitary except the copulation period, the otter noted to be living up to 20 years [7].

It is possible to classify the factors that threaten the habitat of the otter under two groups. First is the pollution; the second is the change that is not conspicuous and created by the human activities like housing, agriculture, and deformation of the vegetation.

This study aims at a detailed analyze of the habitat features, the aliment preferences, population, and the possible contaminators of the habitat of the otters. This study also seeks to both identify the protection measurements of the otters in Kızılırmak River and to contribute to the bio-ecology of the otters in Turkey.

MATERIALS AND METHODS

The observations, which were carried out in all seasons between September 2000 and June 2002, were fulfilled in two specific otter habitats along the Kızılırmak River in Kırıkkale. The excrement samples of the otters, on the rocks, stones, or reeds that were in or around the water, were collected and brought to the laboratory. The samples, loosened by (in) the warm (hot) water, were analyzed [8,9]. The fish, frogs, crabs, tortoise, and the bird species that comprise the aliment of the otter, and the dominant species that form the flora were defined as well. The diagnosis of the fish at the excrement analysis was based on the fishbone that had been taken from the Kızılırmak River earlier. The residues of the excrements at the end of the analysis were diagnosed as species or other taxa. The photos of the otter`s habitat, its excrements and tracks were taken. The diagnosis of several species was made by the experts.

The Location of the Research Area

The two-kilometer research area is located along the Kızılırmak, in between the Kırıkkale Kapulukaya Dam and the drainage point of the Tüpraş Central Anatolia Refinery (Figure 1).

The Flora of the Research Area

The plant samples that were collected from the riverside were comprised of annual or perennial wild forms and fruit trees. The plants that were picked up from the research area were represented by 64 species belonging to 30 families.

The dominant forms on the area were the members of *Salix, Rhododendron, Polygunum*, and *Rubus* species.

The Collecting Activity of the River Invertebrate Samples

The Selection of the Stations

The samples were picked up from the areas located before and after the point of the drainage of the Tüpraş Central Anatolia Refinery. Two different stations located before the drainage area (Stations I and II), and one station (Station III) located after the drainage area were selected. Station I was located just after the water outlets of the Kapulukaya Dam. Station II was close to the point that the otters known to have nested. The samples were evaluated comparatively. It was carefully followed that the riverbed has

similar substrate structure while taking the samples [10].

The Measurements of the Area and Collecting the Samples

Before collecting the invertebrate samples from the stations, the oxygen of the river, the percentage oxygen saturation, pH, conductivity, total decomposed substance, and velocity of flow were noted. Surber type sample device was used in the collection of the invertebrate samples. The different substrate samples, which were picked up from the 1-1.5 mm^2 area in front of the device that was placed upstream on the sediment, were washed [11]. After this application, which took 15-20 minutes, the samples that were piled in the net sack of the device (aperture size 250 μM) collected in a bucket on the land. The small rocks, stones, and the wild plants were taken out from the bucket. The samples were placed one on top of the other and filtered in a screen with 250 and 500 μM aperture sizes. The invertebrate samples that were caught on the screen were tagged and taken to the laboratory alive, in the sample bottles. The samples were collected in a concave tray. With the help of an overhead light they became more visible since they were moving, and were simply picked up with a pipette. They were stored in the sample bottles after adding 70% ethanol. The diagnosis of the samples was made under binocular microscope according to [12].

The Use of the River Invertebrate Samples in Defining the Quality of the Water

Variety Indexes

In order to define the differences between the macro-invertebrate populations collected from the stations, "Simpson Variety Index" and "Shannon Wiener Index" were used in the study [13]. The individuals were assumed as the families in the evaluations.

Simpson Variety Index (D), which gave result focusing on the common species, was used according to the following equation [13]. P_i is the ratio of the number of the total individuals in one taxon, to the number of the total individuals in all of the taxa.

$$D=1/\Sigma P_i^2 \quad (1)$$

Shannon Wiener Index (H), which gave result additionally focusing on the rare species, was used according to the following equation [13]. P_i is the ratio of the number of total individuals in one taxon, to the total number of individuals.

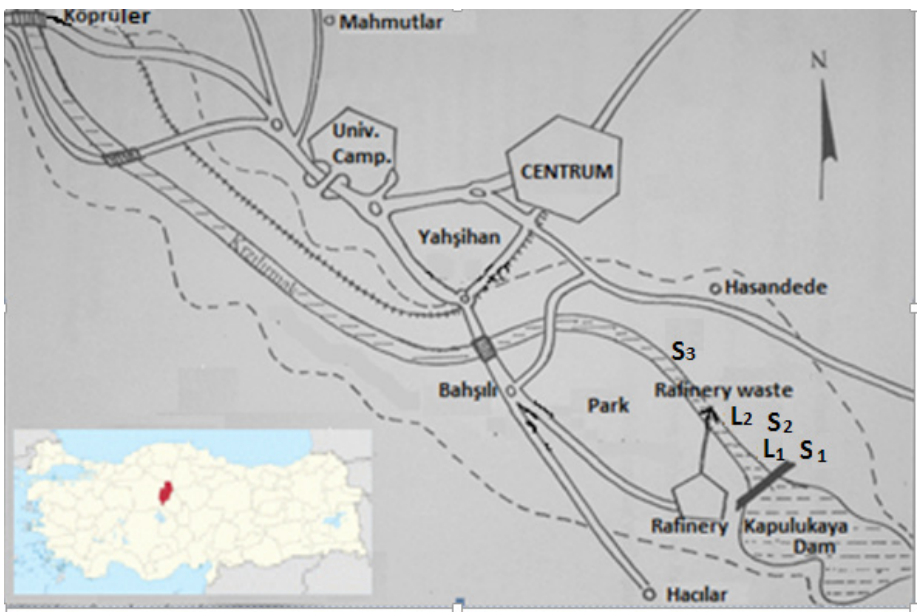


Figure 1. The map of the research area (Locations where the otters were found: L_1 and L_2 and Stations where the water and invertebrate samples were taken: S_1, S_2 and S_3).

$$H=\Sigma^{s}_{i=1} P_i \log P_i \quad (2)$$

Biotic Index

In order to measure the quality of the river habitat, Biological Monitoring Working Party (BMWP) Index was used in this study [10, 14]. Table 1 that was used in the measurement shows the points of each family. The score of the BMWP was obtained with the addition of the points of each family determined in the study area. The meaning of the total points regarding the quality of the river water quality is given in the Table 2 [1, 15].

RESULTS

One of the otter habitats was found on a side of a river pocket that had been formed by a backward curve of the streamline. It was observed that the otter was swimming by the break of day. Excrement samples were collected from the surfaces of the stones on the riverside. It was observed that the animals felt uneasy about the burning of the bushes around this area. The other habitat was located 1 km away from the first habitat. The otters were observed resting

Table 1. Biologic Monitoring Working Party (BMWP) Scores.

	Families	Scores
May Bugs	Siphlonuridae, Heptageniidae, Leptophlebiidae, Ephemerellidae, Potamanthidae, Ephemeridae	10
Stone Flies	Taeniopterygidae, Leuctridae, Capniidae, Perlodidae, Perlidae, Chloroperlidae	
River Bedbugs	Aphelocheiridae	
Caddice Flies	Phryganeidae, Molannidae, Beraeidae, Odontoceridae, Leptoceridae, Goeridae, Lepidostotidae, Brachycentridae, Sericostomatidae	10
Lobsters	Astacidae	8
Odonatas	Lestidae, Agriidae, Gomphidae, Cordulegasteridae, Aeshinidea, Corduliidae, Libellulidae	
Caddice Flies	Psychomyidae, Philopotamiidae	
May Bugs	Caenidae	7
Stone Flies	Nemouridae	
Caddice Flies	Rhyacophilidae, Polycentropidae, Limnephilidae	
Snails	Neritidae, Viviparidae, Anyclidae	6
Caddice Flies	Hydroptilidae	
Mussels	Unionidae	
Shrimps	Corophiidae, Gammaridae	
Odonatas	Platycnemididae, Coenagriidae	
Water Bedbugs	Mesoveliidae, Hydrometridae, Gerridae, Nepidae, Naucoridae, Notonectidae, Pleidae, Corixidae	5
Water Coleopterous	Haliplidae, Hygrobiidae, Dytiscidae, Gyrinidae, Hydrophilidae, Clambidae, Helodidae, Dryopidae, Elminthidae, Chrysomelidae, Curculionidae	
Caddice Flies	Hydropsychidae	
Meadow Mosquitos	Tipulidae	
Common Flies	Simuliidae	
Flat Angleworms	Planariidae, Dendrocoelidae	5
May Bugs	Baetidae	4
Mud Flies	Sialidae	
Bloodsuckers	Piscicolidae	
Snails	Valvatidae, Hydrobiidae, Lymnaeidae, Physidae, Planorbidae	3
Heart Mussel	Sphaeriidae	
Bloodsuckers	Glossiphoniidae, Hirudidae, Erpobdellidae	
Animal Louses	Asellidae	
Herd Mosquitos	Chironomidae	2
Angleworms	Oligochaeta (All species)	1

Table 2. The Water Quality Intervals that BMWP Scores (Which were Calculated According to Macro-Invertebrate Family Points) Indicate.

Classification	Quality	Score	Explanation
I	Good	101-200	Very clean water quality
II	Acceptable	61-100	Very low levels of contamination
III	Uncertain	36-60	Contaminated (changed) system
IV	Critical	16-35	Very contaminated (quite changed) system
V	Very Critical	< 15	Alarmingly contaminated system

at times on the stones and leaving excrements. Additionally a photo, showing the footmark of the otter, was taken.

Nutrition Preference

Nine species of fish were determined in the Kızılırmak River regarding the elements of the fauna of study area.

A. Family: Cyprinidae
   1. Species : *Capoeta tinca* (Seblefish)
   2. Species : *Chondrostoma nasus*
   3. Species : *Leyciscus cephalus* (European chub) (Inoculated)
   4. Species : *Barbus plebejus*
   5. Species : *Tinca tinca* (Tench) Inoculated

B. Family: Esociade
   6. Species: *Esox lucius* (European Barracuda)

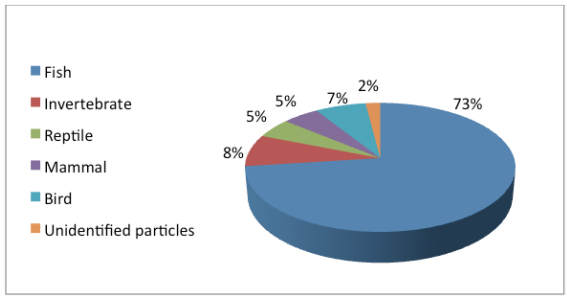
C. Family : Salmonide
   7. Species: *Salmo trutta* (Salmon Trout) (Inoculated)

D. Family : Siluridae
   8. Species : *Silurus glanis* (Catfish) (Inoculated)

E. Family : Percidae
   9. Species : *Sander lucioperca*

Rana sp. as a member of amphibian, and *Mauremys caspica* (turtle) as a member of reptiles live in the study area. Among the invertebrate, *Potamus edulis* and *Helix pomato* were found in the study area.

Figure 2. The proportions of the aliments in the excrement



Excrement Analyses

At the end of the excrement analyses it was found that Cyprinidae family fish constituted most of its aliment. Additionally, Motacilla alba feathers, particles of snail and crab, spoils of reptiles and mammals were found in small quantities. Some particles could not be identified. The proportions of the aliments in the excrement were: Fish 73%, Invertebrate 8%, Reptile 5%, Mammal 5%, Bird 7%, unidentified particles 2% (Figure 2).

The Determination of the Quality of the River Habitat

The individual numbers of the macro-invertebrate families that were obtained from the selected stations on the study area, and the variety of the species are presented on Table 3.

In the area that was beyond the point of the drainage of the Refinery (station III), were found only the members of Oligochaeta family. The number of the families that were detected in the Station I and II was relatively more. Gammaridae and Sphaeriidae families in these stations were detected having high numbers of individuals. The number of the Chironomidae family was also relatively high. The variety index rates of Simpson and Shannon were recorded highest in the Station II. Similar but fewer rates were detected in the Station I. The rates of Simpson and Shannon variety index were notably lower in the Station III.

The BMWP rates of the families differed similarly in different stations. These rates were highest in the Station II which was 44, while they were 21 in Station I. As for Station III, it was 2, which was significantly lowest (Table 3).

Table 3. The numbers of the individuals that were detected in the selected stations on the river. Simpson variety index. Shannon Wiener variety index. and BMWP scores.

	Individual Numbers			Family tolerance score		
	Station I	Station II	Station III	Station I	Station II	Station III
Gammaridae	24	36	-	6	6	-
Hydropsychidae	2	5	-	5	5	-
Baetidae	-	1	-	-	4	-
Tipulidae	-	1	-	-	5	-
Chironomidae	10	18	-	2	2	-
Sphaeriidae	26	23	-	3	3	-
Glossiphonidae	-	3	-	-	3	-
Planorbidae	-	2	-	-	3	-
Planaridae	3	5	-	5	5	-
Agriidae	-	1	-	-	8	-
Tubificidae	-	-	69	-	-	1
Lumbriculidae	-	-	4	-	-	1
Total	65	95	73			
Simpson variety index	3.095	4.074	1.115			
Shannon variety index	0.55	0.725	0.092			
BMWP score				21	44	2

DISCUSSION

Otters need a flora on the land which is enough for roaming and reproduction. The destruction of the flora due to fire, lumbering, erosion, flooding, and excessive grazing is a significant problem for the otters. Moreover, the contamination of the river due to the mining, refinery, and plant drainage damages the otters that are living in those areas [16]. In Shetland Islands of Scotland, otters had to leave their habitat due to an oil contamination after an oil tanker ran aground in between 1988-1993. Moreover, the population of otters in the nearby islands was increased [17]. Our studies are supporting this argument. No otter excrement was found beyond the drainage point of the Tüpraş Central Anatolia Refinery.

Otters are nocturnal and shy creatures. Accordingly, it is difficult to track them directly in the nature. However, it is possible to prove the existence of these animals by means of their excrements, footprints, and some other indications [18]. When the excrements in the south-west coasts of Portuguese were analyzed, it was understood that the snakefish and amphibian were the typical aliment of the otters [19]. When the otter excrements around the Killarney Lake were analyzed, it was understood that the initial aliments of the otters were snakefish and salmonids, while the secondary aliments were frogs and birds [20].

According to the excrement analyses of the otters from two different sites of National Navy Park in Spain, the aliments were consisted of 94% fish, and the rest were insects and amphibian. Additionally, the seasonal changes of aliment differed [21].

Otters were detected in 41 areas out of 42 in Yugoslavia's Drina Basin, after the excrement analyses. Although the fish were their basic aliment, the otters were living on crablike animals in stagnant waters as often as they do on fish [22].

The excrement analyses of the otters living in the Central Anatolia showed that they live on 67% fish, 13% invertebrate, 6% amphibian, 6% mammal, 5% unidentified materials and 3% birds [23].

In this study, it was detected that the otters are living on 73% fish, 8% invertebrate, 7% birds,5% reptiles, 5% mammal, and 2% unidentified materials.

The otter activities were found more frequently in the habitats with better vegetation rather than treeless rivers or the rivers that have adjusted riversides [24]. The riverside *Rhododendron, Polygunum, Rubus,* and very thick *Salix bushes* are preferred as shelters [25].

There is good vegetation in the riverside of the study area, and most of these are members *Rhododendron, Polygunum, Rubus*, and *Salix* species. It was observed that nesting, aliment and reproduction area of otters was beginning from the water outlets of Kapulukaya Dam, continuing along the water flow direction of the Kızılırmak River for about 1000 m. These observations are supported with the excrement samples and footprint evidences picked from the same area. However, these excrement samples and indications regarding the otters could not be found in the riverside beyond the drainage point of the Tüpraş Central Anatolia Refinery. This fact shows up the possibility that the drainage waters can still have a contaminative effect. The analysis of the drainage waters and the river water regarding the heavy metal and hydrocarbon compounds was not carried out. However, regarding the quality of the river, it is preferred to observe the invertebrate population since it is more reliable and able to manifest the lasting effects of contamination [26]. In defining the quality of the river, to analyze, measure, and evaluate on the invertebrate population in terms of biologic measurements, is an obligation according to the European Community Water Framework Code [27]. It was detected that the river invertebrate populations in the area that was beyond the drainage point of the Refinery, significantly differ from the area that was before this point. Only Tubificidae family was observed in the area that was beyond the drainage point. Classifying the river quality, the category of the area is "alarmingly contaminated system," (Table 2 and 3). It was announced by different researchers that the members of the Tubificidae family are durable against contamination and that they can become dominant as monocultures with 10^6 m^{-2} density [10, 28]. It was discovered that this family can survive up to 4 weeks even in the low oxygen concentrations; moreover, they managed to maintain aliment, reproduction, and excretion functions normally [28]. In our studies, that the oxygen concentration was lowest in the station beyond the drainage point comparing to the other stations (Table 4), explains that the family Tubificidae is dominant. There is no evidence in that station about the existence of Chironomidae family, although it has a wide tolerance for contamination. It may be due to the fact that Chironomid species are not durable against oxygen-less environments as much as Tubificidae members are [29].

In this study, variety indexes were used in addition to biotic indexes, in order to determine the water quality of the river. Because it is known that biologic indexes are able to be used reliably in defining organic contamination, while they may mislead in defining different types of contamination [10]. For example, some stone fly species may be quite tolerating towards some metals, while they are being quite sensitive about the low oxygen concentration. The usage of the variety indexes in this study aimed at minimizing the possible misleading explained above and supporting the findings. In this study, the findings derived from the variety indexes and biotic indexes gave similar results regarding the comparisons between the stations before and beyond the refinery drainage point.

Table 4. The measured rates regarding the environmental parameters in the selected stations on the river.

	Station I	Station II	Station III
Water Temperature (°C)	15.50	20.10	20.10
Oxygen (mg /L)	13.75	12.15	7.65
Oxygen Saturation (%)	154.00	131.00	84.00
pH	7.90	7.50	5.90
Salinity (mg/l)	0.80	0.80	1.30
Total Solute (↔s)	1126.00	785.00	2151.00
River Water Flow Rate	12.00	18.00	10.00

It is known that the river water and the drainage disposals poured into the river may vary in quantity in different times of the year. Additionally, it is also known that the possible drainage disposals poured into the river, may result differently regarding the velocity of the flow and flow rate in different seasons of the year. Because of that, it may be misleading to derive results by taking samples while the chemical disposal level is low. On the other hand, we consider that, it is more reliable to derive results from the samples of invertebrate population that is nested in the riverbed and that is highly sensible towards the contaminators and habitat destruction. Depending on this fact, it is an obligation to analyze and take necessary measurements in order to sanitize the drainage disposals poured into the river.

Despite the fact that the area beyond the drainage point is highly contaminated and hazardous for living beings, it is also proved that the water quality of the area that is before the drainage point is not in an acceptable level, which is indicated by biotic and variety indexes of that area (Table 3). This result may be due to human activities (i.e. agriculture, watering, fishing, and human settlements etc.) in the vicinities rather than the drainage disposals. Because these activities causes the annihilation of the natural riparian territories on the river basin [30], and eventually causes physical and biologic changes on the river [31-34]. It was proved by numerous scholars that the dams built on the rivers have different negative effects on the quality of the river water and habitat [35-37].

The area that the otters live is consisted of the river and the area in its basin (Riparian territory). It is important that this natural area be away from the reach of human intervention in order for otters to stay overnight, take care its nestling, and aliment.

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