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DISTRIBUTION AND ECOLOGY OF *LUTRA LUTRA* (LINNAEUS, 1758) IN KIZILIRMAK RIVER (TURKEY)

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ABSTRACT

This study was conducted in an about 130-km section of Kızılırmak River located between Hirfanlı Dam and border of Kalecik district between February 2005 and August 2009. Footprints and feces of otter were identified and direct observations were made in order to determine its activity areas (including 7 localities). As a result of analysis of 233 fecal samples of otter, preys in its diet were divided into 5 categories as invertebrates, fish, bird, mammal, and unidentified pieces. It was determined that 69.91% of the diet were fish, 18.80% were invertebrate, 4.39% were bird, 4.39% were mammal, and 2.51% were unidentified remains. Habitat characteristics were recorded and habitat quality was calculated for *Lutra lutra*. Behaviors of Eurasian otter individuals determined as a result of the direct observation were recorded and photos were taken.

Keywords: Otter, *Lutra lutra*, Distribution, Kızılırmak River, Kırıkkale Province, Turkey.

INTRODUCTION

While the Lutrinae subfamily of the Mustelidae family in the Carnivora order of class Mammalia is represented by 6 genera and 13 species all over the world (Wilson and Reeder 2005), it is represented by the one species, *Lutra lutra*, in Turkey (Kurtonur *et al.* 1996; Albayrak *et al.* 1997). Eurasian otter (*Lutra lutra*) which is a semi-aquatic animal is the species having the widest distribution among other otter species and distributed in Palearctic zone including Europe, Asia, and Northern Africa (Miller 1912; Ellerman and Morrison-Scott 1951; Corbet 1978; Harrison and Bates 1991; Mitchell-Jones *et al.* 1999; Wilson and Reeder 2005; Kruuk 2006).

Generally, pollution and destruction of habitats are the primary factors that negatively influence otters (Macdonald and Mason 1983; Delibes *et al.* 1991; Laws 1993; Mason and Wren 2001; Ross *et al.* 2001). Rapid urbanization depending on increasing population, pollution of waters by wastes occurring as a result of industrial activities, and restriction of areas around rivers have negatively influenced the distribution of otter populations recently.

According to IUCN criteria, otter was evaluated as low risk or least concern species in 1996 (Baillie and Groombridge 1996; Ruiz-Olmo *et al.* 2008), vulnerable species in 2000 (Hilton-Taylor 2000; Ruiz-Olmo *et al.* 2008), and near threatened species in 2004 and 2008 (Ruiz-Olmo *et al.* 2008) around the world. Various studies on distribution, habitat characteristics, and food preference of otter in Turkey have been conducted in the last 20 years (Eroğlu 1994; Albayrak 1995, 2000, 2002; Albayrak *et al.* 1997; Yerli and Güven 1998; Güven 2000; Özdemir and Barlas 2002; Pamukoğlu 2002; Özen 2002, 2008; Tüzün and Albayrak 2005; Albayrak and Toyran 2008; Toyran and Albayrak 2012; Özen and Gündüz 2015; Turan *et al.* 2015; Toyran and Albayrak 2016). In addition, it became possible to compile and collect every kind of information about the species by organizing four symposiums on "Status of Otter in Turkey" between 1999 and 2015 in Turkey. Taxonomical, biological, ecological, and molecular characteristics of otter in Turkey have not been exactly revealed, yet.

The aim of this study is to detect the distribution areas of otter, an endangered species, in Kızılırmak River located in the province of Kırıkkale and to determine some of its biological and ecological characteristics.

MATERIALS AND METHODS

This study was conducted in the section of Kızılırmak River located from Hirfanlı Dam in the province of Kırşehir and the border of Kalecik district (Ankara Province), between February 2005 and August 2009.

The study area was examined as follows; the section of Kızılırmak River between Hirfanlı Dam (Kırşehir) and Kesikköprü Dam was the first locality, the section between Kesikköprü Dam and Kapulukaya Dam was the second zone, and the section between Kapulukaya Dam and the border of Kalecik (Ankara) district was the third zone (Fig. 1.).

Field studies were carried out at least twice every month in such a way to include all seasons in the study field. Field studies were performed along both

banks of Kızılırmak River. Locations where feces and footprints of otter were found were recorded and their photos were taken. Otter was observed in both day and night in some regions where it was detected, photos of otter were taken, and its behavioral characteristics were recorded. GPS coordinates of localities where otter inhabited were given.

Fecal analysis of otter was carried out as stated by Webb (1976) and Conroy *et al.* (1993). For reliability of fecal analyses, *Tinca tinca*, *Capoeta tinca*, *Esox lucius*, *Sander lucioperca*, and *Cyprinus carpio,* which were the fish species caught from Kızılırmak river, were boiled in water and their body skeletons were obtained by cleaning with water on a wire sieve with 0.5 mm mesh, and were used as comparison material for identification of fish remains obtained as a result of fecal analysis.

Fecal samples, which were dried in the oven for making food analysis, were again dried in the oven for 24 hours to remove moisture from them, were loosened in petri dishes using hot water, and then were washed with water on the wire sieve with 0.5 mm mesh. The obtained food particles were examined under binocular microscope after they were dried at room temperature. As a result of analysis, preys being involved in the diet of otter were divided into 5 categories as invertebrate, fish, bird, mammal, and unidentified pieces. Frequency of occurrence for each prey group was calculated with ratio of number of occurrences of that group obtained after fecal analysis to the sum of occurrences of all prey groups (Conroy *et al.* 2005).

$$RFO\% = \frac{\text{Number of occurrences of a prey group X 100}}{\text{Sum of occurrences of all prey groups}}$$

An otter skull found in the study area was cleaned and some measurements of cranial character were taken (Thomas 1905; Miller 1912; Harrison and Bates 1991).

RESULTS

Fecal activity and dietary characteristics: During this study, a total of 233 fecal samples were collected from the study area. Among these samples, 41 were collected in the winter, 63 in the spring, 96 in the summer, and 33 in the fall. Accordingly, lower number of fecal samples was encountered in fall and winter seasons.

As a result of the analysis, otter's diet was determined to consist of fish (69.91%), invertebrates (18.80%), bird (4.39%), mammal (4.39%), and unidentified remains (2.51%). The fish mostly consumed by otter were *Cyprinus carpio* (carp) (37.22%), *Tinca tinca* (tench) (21.53%), and *Esox lucius* (pike) (7.62%), respectively. The remaining 33.63% were not identified. The otter's second preference was mostly freshwater crab from invertebrates. Remains of garden snail, a terrestrial animal, were also found. Except for the ones belonging to pigeon, other species could not be identified from bird remains obtained in fecal analysis. All of the mammal pieces in the feces were detected to belong to rodents.

It was observed that invertebrates (23.21% in the winter; 20.68% in the spring; 16.67% in the summer; 15.90% in the fall) and fish (71.42% in the winter; 67.81% in the spring; 70.45% in the summer; 70.45% in the fall) from prey categories involved in the diet of otter were consumed at similar rates in all seasons. Rates of bird remains were close to each other in the spring (4.59%) and summer (4.54%) seasons, but this rate increased in the fall (6.81%). Rates of mammal remains were close to each other in the spring (4.59%) and fall (4.54%) seasons and this rate increased in the summer (6.06%). In addition, mammal remains were never found in feces collected in the winter.

Habitat: Otter, inhabiting in rivers, streams, lakes, ponds, and wetlands, was detected to inhabit in sheltering regions, where vegetation was dense and generally river water subsided, in Kızılırmak River, in the province of Kırıkkale. Bushes of *Rubus* sp. (blackberry) and *Salix* sp. (willow), reed fields, dam sluices and then artificial rocky places built around downstreams were determined to be used as den by otter.

Holt types of otter: Otters were determined to prefer reed fields, the places between rocks built after dam barriers, and regions where the tree root systems developed, and to generally build their holts in the bank facing stream bed. In this study, three types of holts for otter were detected; between rocks, in a tree root system, and in the soil tunnel (Fig. 2.). Moreover, intense smell of urine was determined in regions around the den.

Behavior: Otter, a nocturnal animal is active out of the den from dusk to dawn. Being generally solitary, otter was observed to be shy. It was observed that otter, known to be a good swimmer, was swimming by holding its whole body under water and waging its tail up and down. It was determined that when otter did not completely dive under water, it kept its head up by leaving nostrils and eyes on the surface of water and stayed for 2-3 minutes under the water during submersion. Walking and posture of otter on land resemble a beech marten.

Otters were determined to become couples in observations made in April and May during monthly field studies. A couple having a distance of 9-10 meters between each other on the rocks after the downstream of Hirfanlı dam was observed to be in mutual communication. Also, they were making sounds like long screams. When these observations were taken into consideration, it was concluded that otters were active in terms of reproduction in this period (April-May period).

Fur color: One of two otters observed on the rocks after the downstream of Hirfanlı Dam had brown tinged somewhat grayish on dorsal and the other one had dark brown on dorsal. Ventral color of both was off-white

tinged and slightly yellowish. However, general fur color of the otter had a darker tone when it came out of water.

Cranial measurements: Cranial measurements of an adult individual obtained from the study area were recorded (Table 1).

Determined localities: As a result of the study, it was determined that otter had distribution in seven localities in the study area (Table 2).

Factors threatening the species in the study area: Otters usually use dens, caves, and spaces between tree roots, rock pieces, and rubbles poured in the river bank as holt. Otters also need a dense vegetation such as bushes and reeds. Habitat of otter in the study area was destroyed due to various reasons. Burning or cutting of the riparian vegetation to enlarge agricultural lands are among important factors of habitat destruction. Facilities taking sand from the river also negatively affect and damage the otter habitat.

Even though two dams built on the river are considered to create a wide activity area for otter, passages are prevented by dam. River bed is exposed to substantial physical changes and habitat is negatively influenced during the construction of the dam. River bed dries out as a result of retaining river water in dams and not releasing the water for a long time. As a result, the fish being a considerable amount of otter's diet have decreased gradually. Otter, which has been regarded as a game animal for years due to its valuable fur, has been illegally hunted in Kızılırmak River for its fur.

Otter has been negatively influenced because of hand-line and net fishing in Kızılırmak River. Otters caught by fishing nets in the river get drowned or are killed (Fig. 3.). Fishing nets left in the water cause pollution and are always pose a threat for otter.

Extension of settlements due to increasing population, enterprises, agricultural lands, and roads built for transportation have encircled the rivers. Accordingly, vehicle traffic has also increased. It was determined that an otter died as a result of crashing by the shuttle vehicle transporting the dam's personnel on Kapulukaya Dam in September 2008 (Fig. 4.).

Vegetation on bank of Kızılırmak River did not remain natural and has disappeared in the picnic sites. Trashes in places visited by humans intensively have caused water pollution and threatened both otter and its food sources. Consequently, dam, habitat reduction, traffic accident, fishing activities, recreation areas, and land and water pollution in Kızılırmak River were determined to be the most important factors threatening the otter.

Table 1. Cranial measurements of an adult individual (mm); number of samples (n), range (r), mean (m).

Measurements	n	r	m
Greatest skull length	1	111.8-111.8	111.8
Condylobasal length	1	113.6-113.6	113.6
Zygomatic breadth	1	68.0-68.0	68.0
Mastoid breadth	1	61.6-61.6	61.6
Interorbital constriction	1	20.6-20.6	20.6
Postorbital breadth	1	13.5-13.5	13.5
Braincase breadth	1	47.6-47.6	47.6
Braincase length	1	63.8-63.8	63.8
Palatal breadth	1	33.9-33.9	33.9
Palatal length	1	48.1-48.1	48.1
Basilar length	1	104.1-104.1	104.1
Bullae length	1	22.6-22.6	22.6
Skull height	1	38.0-38.0	38.0
Maxillary toothrow length	1	41.1-41.1	41.1
Mandibulary toothrow length	1	44.9-44.9	44.9
Coronoid height	1	32.5-32.5	32.5
Mandible length	1	71.4-71.4	71.4

Table 2. Determined localities.

No	Coordinate	Detecting method	Habitat property
1	39°16'21,76"N 33°31'29,04"E	Feces	This locality has a great number of willows, thorn-bushes, and reed fields in its vegetation.
2	39°16'37,19"N 33°31'05,35"E	Feces and direct observation	This locality which is about 9 km long is observed by using security cameras for 24 hours and was protected by security guards because of its strategic importance. As well as poplar and willow trees, the locality had thorn-bushes. Rocky areas built artificially in the river bank after dam also became a significant shelter for otter.
3	39°23'50,92"N 33°25'19,33"E	Feces	This locality is poor in terms of vegetation and there are few poplar trees and thorn-bushes on the river bank.
4	39°43'59,10"N 33°29'01,16"E	Feces and direct observation	The locality has a good vegetation in the river bank and has had a dense vegetation with poplar and willow trees planted between reeds and blackberry bushes.
5	39°46'24,84"N 33°28'46,69"E	Footprints	This locality has dense reed fields.
6	39°48'57,91"N 33°28'48,47"E	Feces	A great part of the locality is covered by reeds along with willow and eleagnus trees.
7	39°55'23,98"N 33°25'37,71"E	Skeleton, footprints and feces	This locality is about 15 km long and reed fields are present in the locality along with prevailing willow and eleagnus trees.

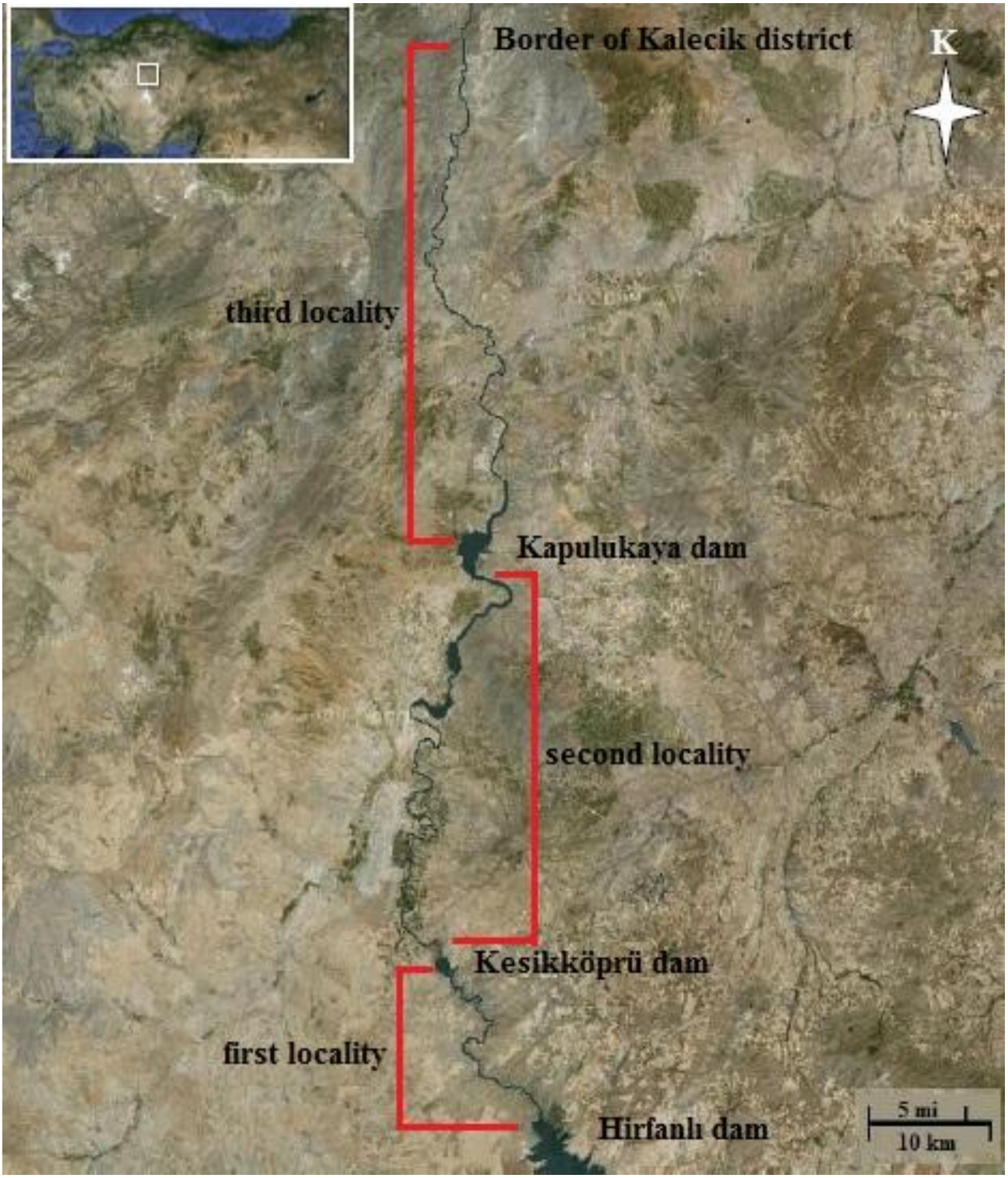

Fig. 1. Kızılırmak River in Kırıkkale where the study was conducted

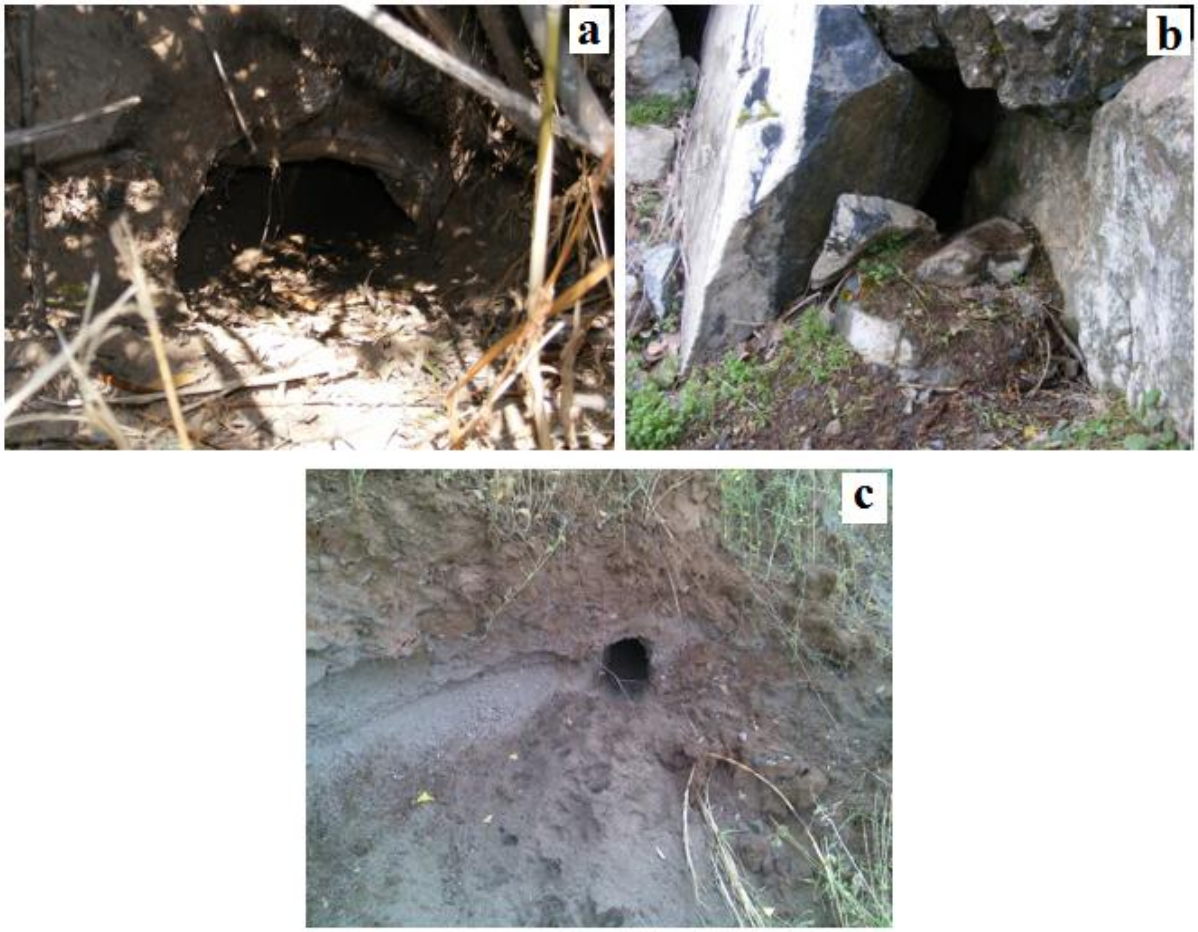

Fig. 2. Holt types of otter (a: in the tree root system, b: between rocks, c: a tunnel on the shore)

Fig. 3. Skeleton residue of an otter

Fig. 4. Otter died as a result of crushing by service vehicle

DISCUSSION

Otter is a nocturnal species (Green *et al.* 1984). It is also hard to observe other under natural conditions because it is a quite shy animal.

In this study, the presence of otter was determined through identification of footprints and fecal samples and then also recorded via direct observation. Otter was directly observed in three of seven localities determined. In addition, fur residues of an otter were detected in one of the localities and its skeleton pieces were found in another locality.

There is a significant relationship between otter activities and habitat (Mason 1995). Otter has high activity around reeds in irrigation canals and in areas with vegetation including willow and thorn-bushes in the river bank (Macdonald and Mason 1985). Particularly bushes of *Rhododendron*, *Polygonum*, *Rubus* and *Salix* in the riverside are used as shelter by otters (Macdonald and Mason 1985).

In this study, otter was observed to have distribution in sheltered areas with rich vegetation. In addition to bushes including plant species of *Polygonum*, *Rhododendron*, *Rubus* and *Salix*, rocky areas artificially built after dam barriers were also found to be used as shelter by otters. Any sign of otter was not observed in areas which have a poor vegetation or are completely bare in the river bank.

Human activities such as agriculture, irrigation, fishing, and settlement cause to destroy riparian vegetation in the river basin (Gregory *et al.* 1991; Ruiz-Olmo 2006) and as a result, biological and physical changes occur in the river (Karr and Schlosser 1978; Cross and Moss 1987; Smith *et al.* 1991; Bisson *et al.* 1992). In addition, destruction occurring as a result of fire, lumbering, erosion, floods, and excessive grazing causes a significant trouble for otter (Albayrak 2000).

In addition to habitat characteristics; protection of the area and the effect of pressure caused by human activities are also important for distribution of otter across river bed (Dubinin 2002). Structuring in river banks, construction of dam, releasing wastewater and sewages into river beds, destruction of vegetation, and various recreation activities conducted in the riversides negatively affect otters (Wilson *et al.* 1996; Reuther and Hilton-Taylor 2004). Dams constructed on the rivers both cause considerable changes in the river bed and adversely affect qualities of habitat and river water (Petts 1984; Ward and Stanford 1987; Armitage and Blackburn 1990).

Habitat of otters living in a certain area in Kızılırmak River has reduced as a result of human activities such as dam construction, pollution caused by refinery wastes, fishing, and settlement (Tüzün and Albayrak 2005).

In the study area, agricultural activities in the riparian area and enterprises established in the river bank such as sand pit were observed to cause reduction of riparian area in the river basin. The fact that the trees in the river bank are cut and as a result, erosion accelerates leads riparian area to be destructed.

In this study, human activities were observed to negatively influence habitat of otter. However, it was determined that areas, where otters had distribution, in

specially protected zones were also protected so that otter inhabited in these areas without any disturbance. The dams constructed on the river have caused both changes in the river bed and irregularities in river regimen because they hold water. Holding water completely and not releasing water for a long time particularly in dry periods were determined to lead extinction of fish species and other aquatic species inhabiting in the river. Thus, it was observed that a significant part of otter's diet consists of fish and therefore this caused otters to be localized rather in downstream of dams.

The present study revealed that dams on the river also had some positive effects on otters as well as negative effects. Dams which are strategically important areas and a certain zone around them are continuously observed by using cameras for security and protected by guards. Any human activity is not allowed within this protected zone. Therefore, it was determined that otters were not exposed to any danger in these zones and their habitats were conserved. As a result of these observations, it was concluded that these zones covering dams are crucial for otters. In addition, net fishing in Kızılırmak River was determined to pose significant threats for otters and otters that were caught by fishing nets and got drowned were found during the study.

Other hazards for otters are traffic accidents and getting killed due to the fact that they harm fish farms (Kayaöz 2002; Uysal 2002). Traffic accidents are primary death cause of otters, detected as dead in Shetland (Kruuk and Conroy 1991). 64 of 77 dead otters obtained in southwestern England between 1988 and 1996 passed away due to traffic accident (Simpson 1997). Highways are among important factors influencing elements of wild life and result in both deaths by accidents and destruction of habitat due to road construction activities (Langevelde *et al.* 2009).

It was determined as a result of the study that traffic accidents were a critical threat factor for both otters and other elements of wild life and otters dying due to traffic accident were determined both directly and indirectly in the light of information given by local people.

Otters generally inhabit in their holts nests in their habitats and sometimes also use dens of animals such as brown hare (*Lepus europeus*), red fox (*Vulpes vulpes*), and badger (*Vulpes vulpes*) (Erdoğan *et al.* 2000). A holt of otter was detected in the section of Kızılırmak River near Hasandede town and it was recorded that this holt was located in root system of a willow tree (Albayrak 2000). When habitat characteristics are taken into consideration, holes, openings between tree root systems, and cracks between rocks in the river banks are used as holt by otters (Mason and Macdonald 1986; Chanin 2003). Harrison and Bates (1991) reported that otters released various secretions on objects such as rocks and trees in their habitat to identify their territories.

In field studies, three types of holts were determined for otter as in the tree root system, between rocks, and in soil tunnel. Additionally, intense smell of urine was determined in areas where the detected holts were present.

Diet of otter has been mainly examined in studies conducted so far and a great part of otter's diet was recorded to be fish. Observations conducted under laboratory conditions revealed that otters preferred preys which they could easily hunt (Erlinge 1968). Findings obtained from feces in Spain indicated that 94% of otter's diet were fish and the remaining part included insects and amphibians. It was also observed that its diet varied based on seasons and they preferred reptiles more between April and September and fish and insects between October and March (Adrian and Delibes 1987). When feces of otters distributing around Killarney Lake of Ireland were examined, their diet was determined to consist of eel, trout, frog, and birds, respectively (Fairly and Murdoch 1989). Diet of otters in southeastern Poland consists fish (63.4%), insects (20.2%), and amphibians (14.5%) (Harna, 1993). Otters in northeastern Czech Republic were observed to eat mainly fish and *Cottus poecilopus* (71%) and *Salmotrutta m. fario* (65%) were found to be the mostly consumed fish species (Polednik *et al.* 2004). Stomach content of 171 otters obtained from southwestern England was determined to contain eel (*Anguilla anguilla*) at most (Britton *et al.* 2006). Baltrūnaitė (2006) reported that there were seasonal differences in diet of otters and they preferred fish in cold season and both fish and amphibians in hot season. Additionally, habitat diversity leads to a variety of food types of the otter (Georgiev 2006; Bouroş and Murariu 2017).

Fecal analysis of otters in Central Anatolia Region revealed that 67% of their diet were fish, 13% invertebrates, 6% amphibians, 6% mammals, 5% unidentified pieces, and 3% birds (Güven 2000). It was recorded in a study conducted in Kızılırmak River that diet of otters consisted of fish (73%), invertebrates (8%), birds (7%), reptiles (5%), mammals (5%), and unidentified pieces (2%) (Albayrak 2002).

Our findings are similar to previous diet analysis given by different researchers for the same species.

Ognev (1931) reported that otters frequently made loud sounds like whistle during reproduction period in the spring. Chanin (1993) indicated that there are three types of vocal communication among otters, the first one of them is a high frequency sound like a sudden whistle to communicate with other otters, the second is the sound made by female individual to alert her pups, and the third was complicated sounds made by pups.

In the observations made during April and May in this study, otters were determined to make high frequency sounds like scream.

Otters had distribution in an about 44-km part in this study conducted in an approximately 130-km long area. However, investigations could not be carried out in some zones of study area due to rough geographical conditions.

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