

**To Cite:** Yağcı Gurbanov, T. & Meşe, M.B. (2025). Distribution of Eurasian Otter, *Lutra lutra* (Linnaeus, 1758) on the Sakarya River: Identification of New Localities and Habitat Conservation Strategies. *Journal of the Institute of Science and Technology*, 15(3), 809-816.

**Distribution of Eurasian Otter, *Lutra lutra* (Linnaeus, 1758) on the Sakarya River: Identification of New Localities and Habitat Conservation Strategies**

Tuba YAĞCI GURBANOV <sup>1\*</sup>, Mustafa Berat MEŞE<sup>1</sup>

**Highlights:**

- New localities in the distribution of *Lutra lutra*
- Conservation biology
- The risks in aquatic ecosystems

**Keywords:**

- Habitat degradation,
- Conservation management,
- Wetland ecosystem,
- Otter distribution
- Bilecik

**ABSTRACT:**

This study aims to investigate the distribution of the Eurasian otter (*Lutra lutra*), an important component of Türkiye's mammalian fauna, in the wetland ecosystems of Bilecik province, formed by the Sakarya River, and to identify the factors affecting biodiversity in the region. The Eurasian otter is classified as a species at risk by the IUCN and is listed as "Near Threatened" (NT), facing various threats such as habitat loss and pollution. In this study, fieldwork was conducted in the wetland areas of Bilecik province, taking into account previously identified suitable habitats. Observations were carried out over four seasons, and indirect monitoring methods such as spraint and footprint tracks were used to detect the presence of the Eurasian otter. Additionally, technological tools such as drones and cameras were utilized during the research process. Information from local people, including fishermen, hunters, and farmers, was collected, and the study focused intensively on the specified regions. As a result of the fieldwork, four potential regions for otter habitation were identified, but detection was only made in two locations. The research findings will significantly contribute to the development of effective management strategies for the conservation of otter populations in the region.

<sup>1\*</sup> Tuba YAĞCI GURBANOV ([ORCID: 0000-0003-1705-5107](https://orcid.org/0000-0003-1705-5107)), Mustafa Berat MEŞE ([ORCID: 0009-0009-8672-992X](https://orcid.org/0009-0009-8672-992X))  
Bilecik Şeyh Edebali University, Faculty of Science, Department of Molecular Biology and Genetics, Bilecik, TURKEY.

**\*Sorumlu Yazar/Corresponding Author:** Tuba YAĞCI GURBANOV, e-mail: tuba.yagci@bilecik.edu.tr

Makale 3-5 Ağustos 2022 tarihlerinde online düzenlenen “9. Uluslararası Bilimsel Çalışmalar Kongresi’nde” sözlü olarak sunulmuştur.

## INTRODUCTION

Eurasian Otter (*Lutra lutra*), a species represented by only one type among the mammalian fauna of Türkiye, belongs to the Lutrinae subfamily of the Mustelidae family, and it is distributed in the Palearctic region with 13 species (Kruuk, 2006). The Eurasian otter is classified as Near Threatened (NT) by the IUCN due to threats including habitat loss and pollution, maintaining this status in Türkiye despite its relatively broad distribution in the country (Ross et al., 2015). Among the distribution records from Türkiye, there are documented records with and without samples from Kütahya province, which borders Bilecik, and non-sample-based records from Eskişehir (Toyran & Albayrak, 2016). In the literature regarding Bilecik, although the exact location is unknown, no findings have been reported until today, except for five otters killed by fishermen in 1996 (Güven, 2000). However, considering the presence and habitat preferences of the Eurasian otter in the neighboring provinces of Bilecik, it is still possible that it may be present in Bilecik.

The Eurasian otter is a semi-aquatic species, preferring freshwater ecosystems and coastal waters, such as rivers, lakes, marshes, and swamp areas (Loy et al., 2022). This species lives not only in freshwater habitats like rivers, streams, canals, and lakes but also in surrounding marine ecosystems (Galanaki et al., 2019). Although otters live in the water, they require dens on land to rest safely, protect their young, and spend the night. These dens are typically found in tunnels under tree roots or among piles of stones along the water's edge. The entrances to these dens are usually closed, providing added security. Each otter usually claims an area of 5-10 km<sup>2</sup>, which can sometimes exceed 20 km<sup>2</sup>; these areas are marked by their spraint. Riparian vegetation is of great importance for breeding, as otters use gaps under tree roots or rock piles as den sites. The selection of home range is determined by factors such as food sources, habitat conditions, and the availability of suitable den sites (Sivasothi & Nor, 1994). Otters can reproduce year-round, with mating occurring both on land and in water; however, the main breeding season is in February-March and July. The gestation period is approximately two months, and the pups are cared and fed by the mother for three months (Heggberget and Christensen, 1994). Despite the diet composition differences depending on habitat type and season, the primary food source for otters is fish, while amphibians and crayfish are alternatively considered as food sources (Lanszki et al., 2014).

As an indicator of pollution and habitat degradation in freshwater ecosystems, otters play a critical role in maintaining ecosystem balance (Wang et al., 2021). Studies on the species conservation emphasize the need for effective planning to reduce the factors threatening its habitat. Additionally, programs and campaigns aimed at raising public awareness about the conservation of the Eurasian otter are recommended (Bhattacharya et al., 2019). Research on the detection of the Eurasian otter employs both direct and indirect monitoring methods. Common indirect monitoring methods include signs such as dens, footprints, feces, food remains, and scat, while direct monitoring methods involve cameras and camera traps (Pamukoğlu, 2002; Toyran, 2010; Turan et al., 2015; Ulutürk & Yürümez, 2017).

The geological changes that Anatolia has undergone for millions of years, along with its geographical and climatic diversity, have also led to differences in its flora and fauna. Furthermore, its unique geographical location, where three continents converge, makes it one of the rare regions in the world in terms of biodiversity (Atik et al., 2010). However, the rich biological diversity observed in the country is being rapidly degraded due to human-induced threats. Losses in biodiversity are of great importance for both species and entire ecosystems. The importance of biodiversity research lies in its role in identifying endangered species and helping to take necessary conservation measures. Pollution, human activities, and the destruction of freshwater habitats (e.g., dam construction and removal of riparian vegetation) are significant threats that have led to the extinction of otters in much of Europe

(Kruuk, 2006; Duplaix & Savage, 2022). Today, however, thanks to conservation policies such as inclusion in CITES Appendix I and the Habitat Directive (Council Directive 92/43/EEC) Annex II and IV, as well as the banning of harmful pollutants, the Eurasian otter is slowly re-establishing its presence in its former range, with increasing populations in Europe (Leoncini et al., 2023). In Türkiye, research on species detection and conservation has identified factors reducing the population, such as industrial pollution, destruction of habitats by human activities, traffic accidents, improper agricultural practices, and, rarely, fishing-related hunting (Toyran & Albayrak, 2016; Eker et al., 2024).

This research emphasizes the importance of biological diversity in Türkiye, aiming to expand the mammalian faunal diversity in the region by adding an updated species record of the Eurasian otter to existing records, explaining the factors that increase and decrease this diversity, and identifying the measures to be taken for its conservation. The continuation of research efforts to scientifically identify and protect species is essential for preserving Türkiye's biological wealth for future generations.

## MATERIALS AND METHODS

The areas where field studies would be conducted in Bilecik province were determined by reviewing the literature data on habitats identified in previous studies. Indirect detection methods were implemented according to the IUCN *Lutra lutra* monitoring protocol. Surveys were conducted within 10x10 km grid squares, following predefined transect lines in each potential habitat. For every 5 km of river length, 1 hour of active search and a 100-meter shoreline survey were conducted early in the morning (06:00-10:00) and at sunset (16:00-19:00). Habitat parameters and findings were recorded on data sheets. Taking seasonal variability into account, observation studies were conducted in the selected localities throughout the four seasons. Indirect methods, such as den structures, fur presence, spraints, tracks, and sounds, were used to detect the *Lutra lutra* and drones and cameras were also incorporated into the research process. In addition, local knowledge and observations were gathered through interviews with local people, fishermen, hunters, and farmers. Based on the data obtained from the field studies conducted in wetland habitats, four potential areas for otter presence were identified, but only two localities could be confirmed (Figure 1).



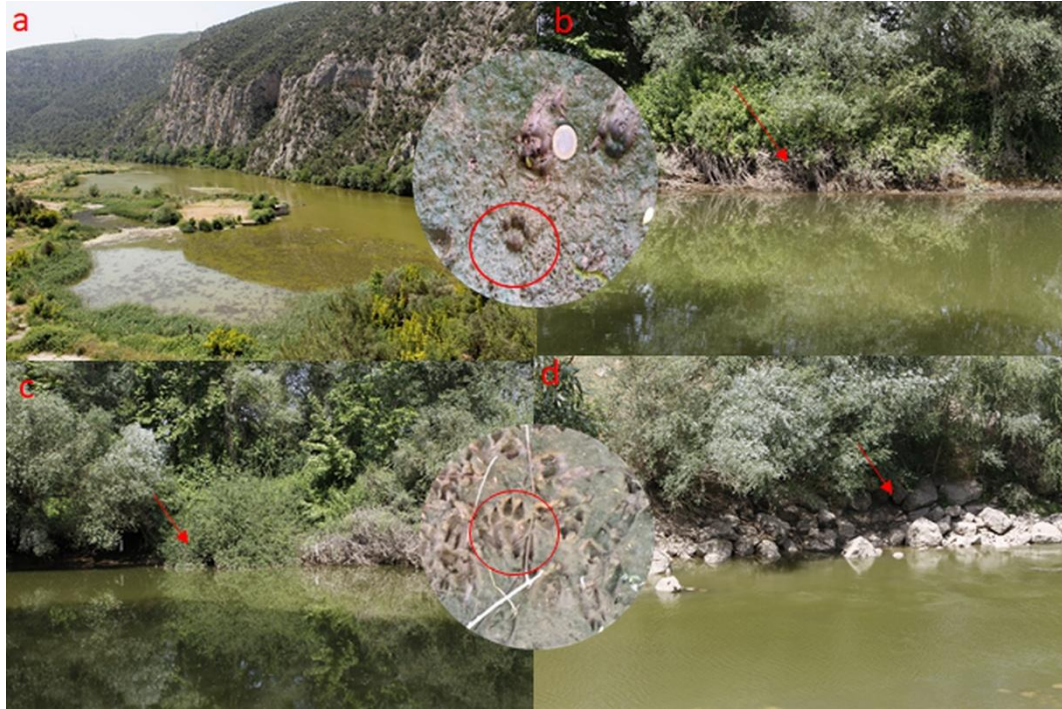
**Figure 1.** The areas where *Lutra lutra* have been indirectly and directly detected in Bilecik province (★) and potential habitats (★)

## RESULTS AND DISCUSSION

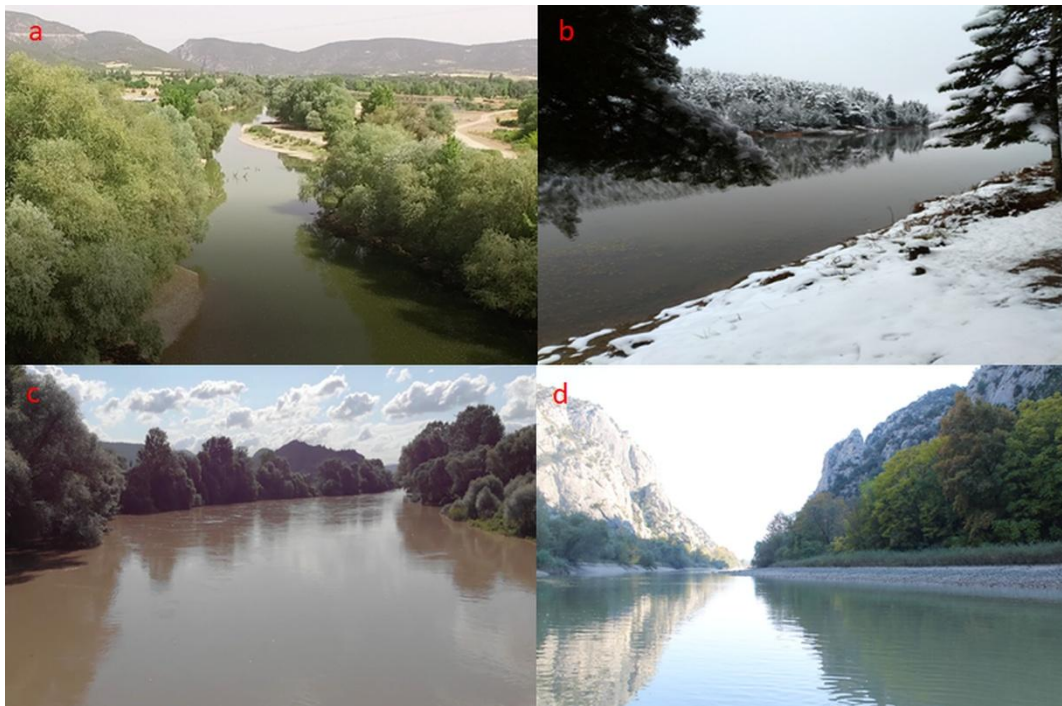
The limited research on determining the habitat use of otters in our country, along with the difficulties in detecting these animals due to their nocturnal activity and avoidance of humans, as well as the shrinking of wetland habitats, is highlighted. In the wild, direct tracking of otters is possible through their droppings, footprints, and other signs, which are considered valid evidence for their detection (Karakaş & Albayrak, 2014). In this study, although suitable habitats were identified in four different locations within the Bilecik province, otter presence was only confirmed in the Gölpazarı and Vezirhan districts based on both nest and footprint evidence, verifying that otters are active in these areas (Figure 2). Particularly, in fieldwork conducted in the Gölpazarı Küçük Yenice area, two otters were observed; however, due to the distance and the animals' diving movements, these observations could not be clearly captured (Figure 2a). Bilecik province is strategically located in the southeastern Marmara Region, serving as a transitional zone between four major geographical regions: Marmara, Black Sea, Central Anatolia, and Aegean. The province borders five neighboring provinces (Bursa, Eskişehir, Kütahya, Bolu, and Sakarya) and is bisected by the Sakarya River, which originates in the İnhisar district and forms the region's primary watershed. This river system is complemented by numerous tributaries including the Karasu, Söğüt, Sorgun, Karapınar, Değirmen, Göksu, Kırılbağı, and Akçay streams, along with Çerkeşli Lake, the province's only natural lake. This diverse aquatic network creates critical habitat corridors for aquatic species. The different branches of the Sakarya River that develop within the boundaries of Bilecik create many aquatic ecosystems in the region (Figure 3). In research conducted using camera traps at 11 different points to determine the habitat use characteristics of otters, otter activity was detected at only three locations that shared the common features of shoreline, sand, and mud vegetation, which are expected to support otter life (Özkazanç et al. 2019). In the Kızılırmak River, otters were detected in areas with dense vegetation. Otters use reed beds, dam gates, and artificial rock areas as dens. They typically build their dens in bank areas facing riverbeds, in spaces between rocks, and in areas where tree root systems are developed. Otter activities were observed more frequently in habitats with better vegetation cover, compared to treeless or modified riverbanks (Karakaş & Albayrak, 2014; Toyran & Albayrak 2019). Habitat characteristics suitable for otter life in Bilecik province are similar to those recorded in previous studies. However, factors such as intense human activity, water pollution, the withdrawal of water from rivers for irrigation, the discharge of wastewater into rivers, dams, and sand quarries are believed to negatively impact on otter populations in the Sakarya River of Bilecik province, likely reducing their numbers (Figure 4, Tablo 1). The construction of developments near otter habitats, along with activities such as hunting, agricultural land expansion, sand quarries, the establishment of recreational areas, and deforestation, all contribute to habitat destruction, leading to a decline in otter populations (Ulutürk & Yürümez, 2017). The Pelitözü Dam Reservoir in Bilecik center, along with the pine trees and shrub vegetation around the Küçükelmali and Bozcaarmut Reservoirs in Pazaryeri district, create suitable areas for otter habitats (Figure 2). However, anthropogenic activities, including the use of these areas as picnic spots during the spring and summer months, create a significant disadvantage for otters, which prefer isolated areas. Anthropogenic pollutants from agriculture, industry, and urban activities significantly affect freshwater ecosystems worldwide, negatively impacting aquatic organisms (Dibbern et al., 2021). The most suitable otter habitats in Bilecik province are primarily dense shrub areas around the Sakarya River and the occasionally found rocky areas along the riverbank. However, a total of six Hydroelectric Power Plants (HEPs) have been established in the districts of Osmaniye, Gölpazarı, Bozüyük, and İnhisar within Bilecik province. These power plants might be significant threats to otter populations, with negative effects such as the degradation of surrounding



riverbeds and a decrease in water flow. Additionally, sand quarries along riverbanks might lead to habitat degradation. (Figure 4).



**Figure 2.** Areas where otter footprints were detected (Nest types: a and b Vezirhan, c and d Gölpazarı)



**Figure 3.** Aquatic ecosystems of the Sakarya River in Bilecik province, a) Gölpazarı, b) Bozcaarmut Reservoir, c) İnhisar, d) Osmaneli



**Figure 4.** Potential factors increasing the degradation of aquatic ecosystems in Bilecik: a) hydroelectric power plants, b) sand quarries, c) waste and drainage, and d) reduced water flow

**Table 1.** Assessment of Otter (*Lutra lutra*) Presence and Threats in Bilecik

| Location  | Detection Method         | Otter Presence  | Potential Threats      |
|-----------|--------------------------|-----------------|------------------------|
| Gölpazarı | Camera + Observation     | ☑ (Direct)      | Low water levels       |
| Vezirhan  | Nest and Footprints      | ☑ (Indirect)    | Agricultural expansion |
| Osmaneli  | Camera / Drone           | ✗ (No detected) | High pollution         |
| Pazaryeri | Observation + Interviews | ✗ (No detected) | Human activity         |

Eurasian otters (*Lutra lutra*), which are apex predators in freshwater ecosystems, are considered indicators of healthy aquatic systems and are among the priority species in conservation efforts (Wang et al., 2021). As a species at the top of the food chain, their extinction threatens environmental stability and the survival of other species, which may indirectly affect human life (Mousavi et al., 2023). Major factors contributing to the decline of otters include water pollution, climate change, roadways, railways, agricultural activities, dams, and insufficient hunting areas, all of which lead to habitat degradation and result in population losses worldwide (Sergio et al., 2008; Bedford, 2009; Toyran & Albayrak, 2016). Researchers have emphasized the urgency of inventory studies and the importance of investigating the population size, structure, and habitats of otters in Türkiye for their conservation and survival (Özen & Gündüz, 2015).

## CONCLUSION

The freshwater ecosystem of Bilecik Province is suitable for the survival of *Lutra lutra* populations. The distribution of *Lutra lutra* in Bilecik Province is geographically divided into three localities. The Karasuderesi in the Vezirhan district, Göksu Stream in the Osmaneli district, and Gölpazarı, with dense tree and shrub vegetation, are the localities where otter nests and footprints are most frequently observed. These areas are under the influence of the Marmara climate and show climatic variations. Hamsu Stream and Sorgun Stream, located in Bilecik center, are close to human settlements and consist of narrow habitats, making them unfavorable factors for otter distribution. In the İnhisar and



surrounding areas, forested areas are relatively scarce. In some localities studied in this region, no otter signs were found due to the absence of suitable denning sites, such as insufficient riparian vegetation and lack of rock cavities. Although the reservoir lakes in Bilecik Province are suitable for *Lutra lutra*, the frequent use of these areas by people for picnics and recreational activities acts as a deterrent for the population. The Sakarya River in Bilecik Province flows with a muddy color and is polluted by domestic and industrial waste. According to interviews with fishermen, it was noted that the fish population, which was once abundant in the Sakarya River, has decreased due to pollution. The dams built on the Sakarya River reduce the water flow and negatively affect the distribution of *Lutra lutra* populations. The extraction of water from the river for irrigation is another negative factor. It is also assumed that sand quarries prevent otters from building their nests along the riverbanks. Based on the findings, Gölpazarı and Vezirhan should be prioritized as Protected Conservation Areas to prevent habitat degradation;

- Collaborative efforts between local authorities and conservation agencies are necessary to regulate agricultural activities near otter habitats.
- Monitoring programs should be implemented to assess long-term population trends in the region.

The data from this study will contribute new localities to the literature for the conservation and continuation of the species in Bilecik Province and will help develop conservation strategies for *Lutra lutra* in future studies in Türkiye. Furthermore, as no records of otters have been reported in the literature within the borders of Bilecik since 1996, this study definitively confirms that the species continues to persist in the region.

## ACKNOWLEDGEMENTS

This study was supported by the TÜBİTAK 2209-A Project (1919B011903942). We would like to thank Prof. Dr. Refik Arıkan from the History Department at Bilecik Şeyh Edebali University for his contributions during the fieldwork.

## Conflict of Interest

The article authors declare that there is no conflict of interest between them.

## Author's Contributions

Tuba Yağcı Gurbanov has planned the study, participated in the fieldwork, and written the article. Mustafa Berat Meşe has participated in the literature research and conducted the fieldwork.

## REFERENCES

- Atik, A. D., Öztekin, M., & Erkoç, F. (2010). Biyoçeşitlilik ve Türkiye'deki Endemik Bitkilere Örnekler. *Gazi University Journal of Gazi Educational Faculty (GUJGEF)*, 30(1).
- Bedford, S. J. (2009). The effects of riparian habitat quality and biological water quality on the European Otter (*Lutra lutra*) in Devon. *Bioscience Horizons*, 2(2), 125-133.
- Bhattacharya, M., Watham, T., & Gopi, G. V. (2019). Photographic Records of Eurasian Otter (*Lutra lutra* Linnaeus, 1758) from Nyamjang Chu River, Arunachal Pradesh, India. *IUCN Otter Spec. Group Bull*, 36(2), 103-109.
- Dettori, E. E. (2021). The Eurasian otter (*Lutra lutra*) as an environmental bioindicator in relation to exotic invasive species: Giant reed (*Arundo donax*), Red swamp crayfish (*Procambarus clarkii*) and American mink (*Neovison vison*). *Proyecto de investigación*.
- Dibbern, M., Elmeros, M., Dietz, R., Søndergaard, J., Michelsen, A., & Sonne, C. (2021). Mercury exposure and risk assessment for Eurasian otters (*Lutra lutra*) in Denmark. *Chemosphere*, 272, 129608.
- Duplaix, N., & Savage, M. (2022). *The global otter conservation strategy*. eScholarship, University of California.
- Eker, B., Ünal, Y., & Koca, A. (2024). Köprülü Kanyon Milli Parkında su samuru-insan çatışması. *Turkish Journal of Forestry*, 25(4), 534-539.

- Galanaki, A., Kominos, T., Zogaris, S., Gasteratos, I., & Lymberakis, P. (2019). Presence of the Eurasian otter *Lutra lutra* on the islands of Greece: a review. *Folia Zoologica*, 68(4), 246-252.
- Güven, N. (2000). Türkiye Su samuru (*Lutra lutra*) projesi. *Tabiat ve İnsan Dergisi, Ankara*, 34(1), 32-36.
- Heggberget, T. M., & Christensen, H. (1994). Reproductive timing in Eurasian otters on the coast of Norway. *Ecography*, 17(4), 339-348.
- Karakaş, M. M., & Albayrak, İ. (2014). Bioecology of the Otter *Lutra lutra* in Kızılırmak River in Kırıkkale Province. *Hacettepe Journal of Biology and Chemistry*, 42(3), 313-321.
- Kruuk, H. (2006) Otters: ecology, behaviour and conservation. Oxford University Press, Oxford.
- Lanszki, J., Bauer-Haáz, É. A., Széles, G. L., & Heltai, M. (2014). Diet and feeding habits of the Eurasian otter (*Lutra lutra*): experiences from post mortem analysis. *Mammal Study*, 40(1), 1-11.
- Leoncini, F., Semenzato, P., Di Febbraro, M., Loy, A., & Ferrari, C. (2023). Come back to stay: landscape connectivity analysis for the Eurasian otter (*Lutra lutra*) in the western Alps. *Biodiversity and Conservation*, 32(2), 653-669.
- Loy, A., Kranz, A., Olenikov, A., Roos, A., Savage, M., & Duplaix, N. (2022). *Lutra lutra* (amended version of 2021 assessment). *The IUCN red list of threatened species, 2022*.
- Mousavi, S. P., Ramzanipour, M. M., & Vajargah, M. F. (2023). An Overview on *Lutra lutra*. *Journal ISSN*, 2766, 2276.
- Ozkazanc, N. K., Ozay, E., Ozel, H. B., Cetin, M., & Sevik, H. (2019). The habitat, ecological life conditions, and usage characteristics of the otter (*Lutra lutra* L. 1758) in the Balıkdami Wildlife Development Area. *Environmental Monitoring and Assessment*, 191, 1-8.
- Özen, A., & Gündüz, M. (2015). A new record in distribution region of Otter (*Lutra lutra*) in Turkey. *Gazi University Journal of Science*, 28(3), 353-358.
- Pamukoğlu, N. (2002). Kayseri Kızılırmak Su Samuru (*Lutra lutra* L. 1758) Populasyonunun Bazı Ekolojik Özellikleri. *Su Samurunun Türkiye'deki Durumu II. Sempozyum*, 21-22.
- Roos, A., Loy, A., de Silva, P., Hajkova, P., & Zemanová, B. (2015). *Lutra lutra*. *The IUCN Red List of Threatened Species 2015: e. T12419A21935287*.
- Sergio, F., Caro, T., Brown, D., Clucas, B., Hunter, J., Ketchum, J., ... & Hiraldo, F. (2008). Top predators as conservation tools: ecological rationale, assumptions, and efficacy. *Annual review of ecology, evolution, and systematics*, 39(1), 1-19.
- Sivasothi, N., & Nor, B. H. M. (1994). A review of otters (Carnivora: Mustelidae: Lutrinae) in Malaysia and Singapore (pp. 151-170). Springer Netherlands.
- Toyran, K. (2010). Kırıkkale Kızılırmak su samuru, *Lutra lutra* (Linnaeus, 1758) yayılış alanlarının belirlenmesi. Doktora Tezi, Kırıkkale Üniversitesi, Fen Bilimleri Enstitüsü.
- Toyran, K., & Albayrak, I. (2019). Distribution and ecology of *Lutra lutra* (Linnaeus, 1758) in Kızılırmak river (turkey). *JAPS: Journal of Animal & Plant Sciences*, 29(3).
- Toyran, K., & Albayrak, İ. (2016). Avrasya Su samuru, *Lutra lutra* (Linnaeus, 1758)'nın Türkiye'deki yayılış kayıtları. *Süleyman Demirel Üniversitesi Fen Bilimleri Enstitüsü Dergisi*, 20(3), 575-578.
- Turan, İ., Keten, A., Yorulmaz, T., Doğan, C., & Baştar, F. (2015). Abant Gölü'ndeki Su Samurunun (*Lutra lutra*) habitat tercihi. *Ormancilık Araştırma Dergisi*, 1(2 A), 51-56.
- Ulutürk, S., & Yürümez, G. (2017). Türkiye'den yeni *Lutra lutra* Linnaeus, 1758 kayıtları. *Commagene Journal of Biology*, 1(1), 21-24.
- Wang, Q. Y., Zheng, K. D., Han, X. S., He, F., Zhao, X., Fan, P. F., & Zhang, L. (2021). Site-specific and seasonal variation in habitat use of Eurasian otters (*Lutra lutra*) in western China: implications for conservation. *Zoological research*, 42(6), 825.
- Wang, Q. Y., Zheng, K. D., Han, X. S., He, F., Zhao, X., Fan, P. F., & Zhang, L. (2021). Site-specific and seasonal variation in habitat use of Eurasian otters (*Lutra lutra*) in western China: implications for conservation. *Zoological research*, 42(6), 825.