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Road kills of amphibian and reptile species in Edirne and Kırklareli Provinces of Turkey

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Abstract

Many wild animals are exposed to road kills in the world. Amphibians and reptiles which live near the roads are the most endangered groups among vertebrates related to the road kills. However, there are only few studies about the road kills of amphibians and reptiles in Turkey. We recorded 23 individuals (6 amphibian individuals belonging to 2 species and 17 reptile individuals belonging to 9 species) exposed to road kills on the E87 highway on June 18-22, 2016 in Kırklareli province while we found 134 individuals (114 amphibian individuals belonging to 3 species and 20 reptile individuals belonging to 8 species) killed on the Enez-Ipsala highway on June 22-25, 2016 in Edirne province. The individuals killed more often belonged to *Pelophylax ridibundus* and *Bufotes variabilis* in the Edirne while the species more affected by road kills were *Pelophylax ridibundus*, *Lacerta trilineata*, *Dolichophis caspius* and *Testudo graeca* in Kırklareli. The results of this short-term study show that there is a need for long-term studies to show that amphibians and reptiles exposed to road kills are very common.

Keywords: traffic, *Testudo graeca*, Dereköy, mortality, Enez.

Türkiye'nin Edirne ve Kırklareli İllerindeki Amfibi ve Sürüngen Türlerinin Yol Ölümleri

Öz

Dünyada birçok yaban hayvanı yol ölümlerine maruz kalmaktadır. Omurgalılar arasında yol ölümleri ile ilgili olarak en fazla tehlike altında olan hayvan grupları yol kenarlarında yaşayan amfibi ve sürüngenlerdir. Ancak, amfibi ve sürüngenlerin Türkiye'deki yol ölümleri ile ilgili az sayıda çalışma vardır. Kırklareli ilinde E87 karayolunda 18-22 Haziran 2016 tarihlerinde yol ölümüne maruz kalan 23 ölü bireyi (2 türe ait 6 amfibi bireyi ve 9 türe ait 17 sürüngen bireyi) kayıt altına alırken, Edirne ilindeki Enez-İpsala karayolunda ise aynı yılın 22-25 Haziran günlerinde 134 bireyi (3 amfibi türüne ait 114 birey ve 8 sürüngen türüne ait 20 birey) ölü olarak bulduk. Edirne ilinde en fazla ölü bireyi bulunan türler *Pelophylax ridibundus* ve *Bufotes variabilis* olurken, Kırklareli ilinde yol ölümlerinden en fazla etkilenen türler *Pelophylax ridibundus, Lacerta trilineata, Dolichophis caspius* ve *Testudo graeca*'dır. Kısa süreli bir dönemde gerçekleştirilen bu çalışmanın sonuçları, yol ölümlerine maruz kalan amfibi ve sürüngenlerin çok olduğunu gösterecek uzun dönemli çalışmaların yapılmasına ihtiyaç olduğunu göstermektedir.

Anahtar Kelimeler: trafik, *Testudo graeca*, Dereköy, ölüm oranı, Enez.

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Introduction

The amphibian and reptilian species which are distributed in many parts of the world are threatened by numerous factors such as habitat modification and fragmentation, diseases, pollution, predations, invasive species and climate change [1-5]. Some of these threats originate from human activities, one of which is road kills [2].

Although roads have a crucial role in the modern economy and society, providing connectivity among human settlements and access to critical services, resources, and activities [6-7], it may cause a change in mortality-recruitment ratios of animal populations due to road kills [8]. The number of animals exposed to road kill had increased greatly depending on the increasing number of vehicles, fast vehicles and long road, in parallel with the developments in technology [9-11]. The road kills have potential impact on many species. Especially, it has more threat for slow-moving animals in the populations [12-16]. Many studies have been conducted on road kills of the mammals throughout the world [9, 17-30]. Recently, some studies have been conducted on amphibian and reptilian species [2, 28, 31-38].

The aim of this paper is to present the intensity of the amphibian and reptile species that die as a result of road kills on the two highways, one in Edirne and the other in Kırklareli provinces. In Edirne, the mean annual precipitation over the last 90 years (1927-2017) was 50.41 mm and the mean annual temperature was 13.8°C according to climate data provided by 1st Edirne Meteorology Regional Directorate of Turkey. In Kırklareli, the mean annual precipitation over the last 90 years (1927-2017) was 47.8 mm and the mean annual temperature was 13.3 °C according to climate data provided by 1st Edirne Meteorology Regional Directorate of Turkey.

Material and Method

The present study was carried out in more than thirty localities on two highways (Enez-Ipsala highway in Edirne and the E-87 highway between Dereköy-Bulgarian borders of Kırklareli province) which were located on the European side of Turkey (Figure 1). Before starting the present study (in the summer of 2015), we observed a large number of dead *Pelophylax ridibundus* individuals which set out from the rice fields near the Edirne-Ipsala highway and we encountered many carcasses of *Lacerta trilineata* individuals on the E-87 highway. Thus, we chose these

ways to study road kills. We performed the field survey in the activity periods of amphibians and reptiles. The field surveys commenced at midday and required approximately 7 hours (11.00 a.m. and 6.00 p.m.) on June 18-22, 2016 for E87 while the field surveys commenced at midday and it continued to night (11.00 a.m. and 10.00 p.m.) on June 22-25, 2016 for Enez-Ipsala highway. A study period of 5 days (June 18-22, 2016) was determined for Kırklareli and the cases of the road kills on E-87 highway at 5 km (only departure way) were reported for each day. A total of 25 km-road was studied in 5-day surveys for Kırklareli. In Edirne, a study period of 4 days (June 22-25, 2016) was determined and the cases of road kills on Enez-Ipsala highway at 10 km (only departure way) were reported for each day. A total of 40 km-road was studied in 4-day surveys for Edirne province. We started the field study in June because it coincides with the beginning of the summer season. The observations were performed on the Enez-Ipsala highway in an area of approximately 10 km with the altitudes of 5-65 m while the size of the study area was approximately 5 km with the altitudes of 475-525 m on the E87 highway. The both highways have two-lane roads and the maximum speed limit outside settlement areas are 90 km/h. The surveys of road kills were conducted by three observers (driver and two passengers) driving a car at slow speed (≤ 40 km/h) as reported in the literature [38]. After a carcass was detected, the car was stopped and two observers who walked along the road, one on each side, looked for carcasses, as stated in the literature [39]. For each road-killed amphibian and reptilian, the date and geographic coordinates were recorded using a GPS server (GARMIN eTrex 20x). The species, which found in the Enez-Ipsala highway and E87, were identified based on their morphological characteristics (e.g. webbed feet and absence of temporal band for water frogs, discs on the tips of the feet for tree frogs, tubercles and color patterns of dorsalium for toads, spur in the form of a small bulge on back legs for tortoise, color and pattern characteristics for lizards and snakes). The data were preserved by photographing (Nikon-Coolpix P500) to show the diversity of the species, which were exposed to car crash.

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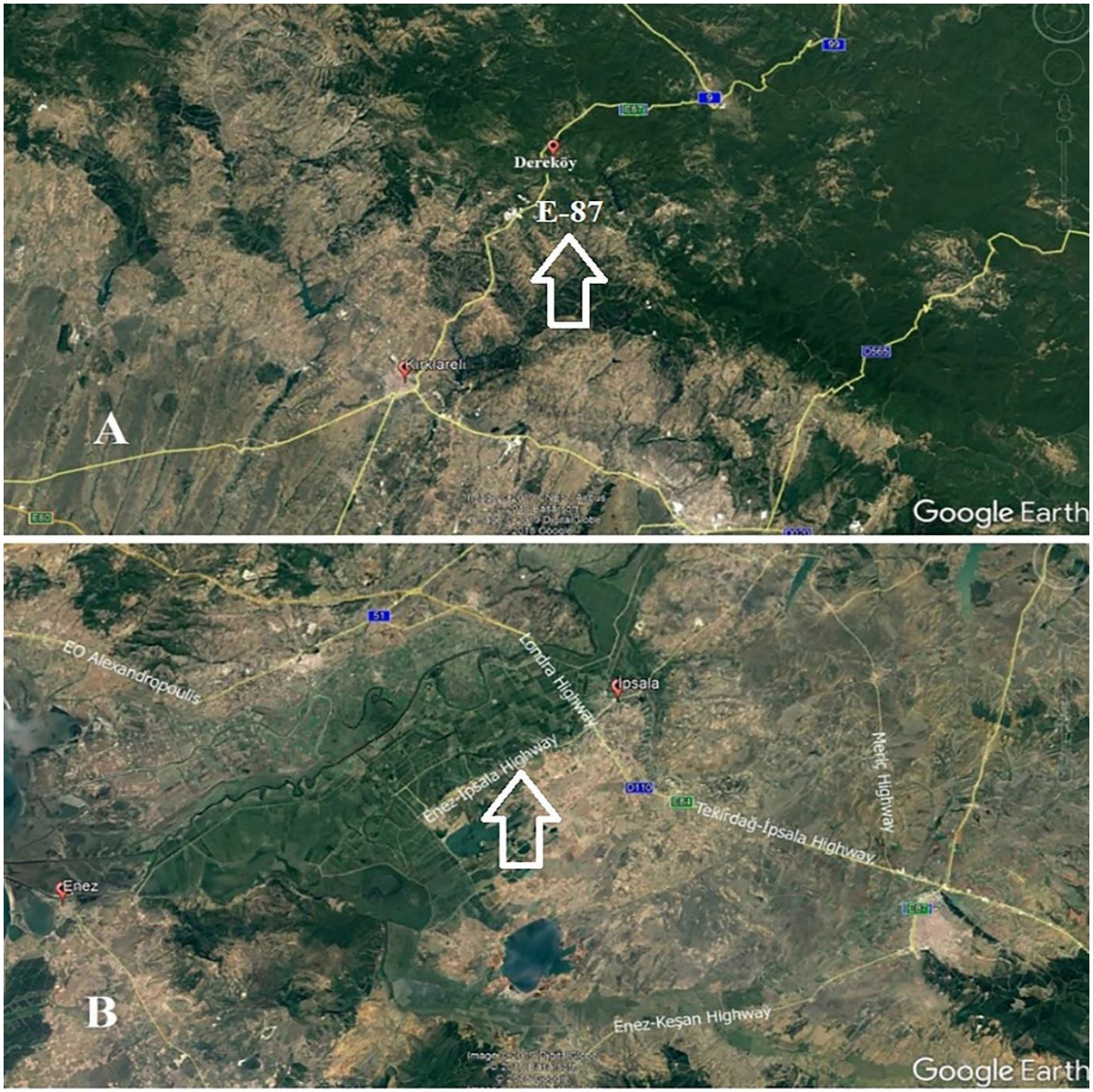

Figure 1. *The map showing the localities of the observed individuals exposed to road-kills in Kırklareli (**A**) and Edirne (**B**) provinces of Turkey.*

Results

The starting period of the study coincides with the beginning of the 3-month period (June-August) during which the average temperature increases (22.4-24.4°C in Edirne and 21.6-23.4°C in Kırklareli) and the average precipitation decreases (46.5-22.4 mm in Edirne and 47.4-21.1 mm in Kırklareli) in both provinces. According to our observations, we recorded totally 17 mortality cases of herptile species in Edirne and Kırklareli provinces. In total, 134 dead individuals [92 water frogs (68.6%), 7 tree frogs

(5.2%), 15 toads (11.2%), 1 tortoise (0.7%), 6 lizards (4.5%), and 13 snakes (9.7%)] were detected in Edirne, belonging to 11 species, and 23 ones [5 water frogs (21.7%), 1 toad (4.3%), 3 tortoises (13.0%), 9 lizards (39.1%) and 5 snakes (21.7%)] were detected in Kırklareli, representing 11 species. The species involved in the crashes are given in Table 1 and their status was reported according to IUCN criteria. Photos belonged to some of specimens, which exposed to car crashes, were given in Figures 2 and 3.

Figure 2. *Images of some reptile carcasses found on Enez-Ipsala and E-87 highways.* ***A****-Pseudopus apodus,* ***B****-Lacerta viridis,* ***C****-Lacerta trilineata,* ***D****-Dolichophis caspius.*

Pelophylax ridibundus (68.6%) and *Bufotes variabilis* (11.2%) were the most affected species by road mortality in the Enez-Ipsala highway. The carcasses of the species were observed about every one hundred meters on the way while the carcasses of *B. variabilis* were seen about every 550 meters.

On the E87 highway, *Pelophylax ridibundus* (21.7%), *Testudo graeca* (13.0%), *Lacerta trilineata* (13.0%) and *Dolichophis caspius* (13.0%) were the most affected by the road kills. The carcasses of the *P. ridibundus* were observed about every one km on the way while the carcasses of the other three species were seen about every 1500 meters.

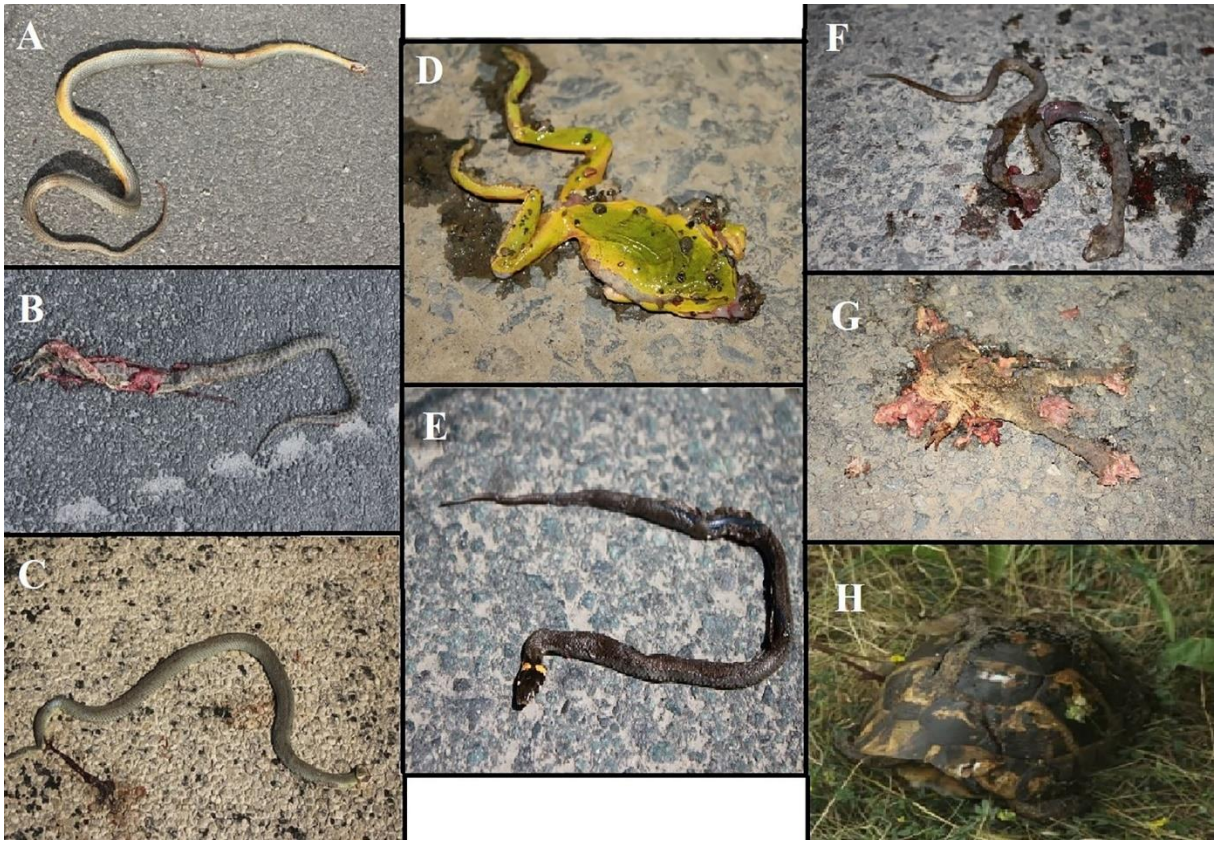

Figure 3. *Images of some amphibian and reptile carcasses found on Enez-Ipsala and E-87 highways.* ***A****-Dolichophis caspius,* ***B****-Elaphe sauromates,* ***C****- Malpolon insignitus,* ***D****-Hyla orientalis,* ***E****-Natrix natrix,* ***F****- Natrix tessellata,* ***G****-Bufo bufo,* ***H****-Testudo graeca.*

Table 1. *A list of the amphibians and reptiles exposed to road kills in Edirne (Enez-Ipsala highway) and Kırklareli (E-87 highway) provinces.*

Species	Edirne Province	Number of specimens (n)	Kırklareli Province	Number of specimens (n)	The status of the species on IUCN Red List
Pelophylax ridibundus	+	92	+	5	LC
Hyla orientalis	+	7	-	-	NE
Bufotes variabilis	+	15	-	-	DD
Bufo bufo	-	-	+	1	LC
Testudo graeca	-	-	+	3	VU
Testudo hermanni	+	1	-	-	NT
Podarcis muralis	-	-	+	1	LC
Podarcis tauricus	-	-	+	2	LC
Lacerta trilineata	+	6	+	3	LC
Lacerta viridis	-	-	+	2	LC
Pseudopus apodus	-	-	+	1	LC
Dolichophis caspius	+	6	+	3	LC
Natrix natrix	+	1	-	-	LC
Natrix tessellata	+	2	-	-	LC
Malpolon insignitus	+	2	+	1	LC
Elaphe sauromates	+	1	+	1	LC
Montivipera xanthina	+	1	-	-	LC

Discussion

Road mortality, which causes decline in the numbers of individual, has a serious negative impact on amphibian and reptile populations [40-41]. Although there are many studies related to the road kills of amphibians and reptiles in the world [33, 42-49] there is limited research on this issue in Turkey [28].

There were not high rates of traffic density on The E87 and Enez-Ipsala highways. However, we found a lot of amphibian and reptile individuals killed by the traffic on these roads. Similarly, Shepard et al. (2008) did not find a

correlation between the traffic density and the road kills. We performed our study by walking on the road. Compatible with the present study, some studies conducted by walking on the road [50-52] and the number of encountering corpses was high in these studies.

Pelophylax ridibundus (68.6%) and *Bufotes variabilis* (11.2%) were the most affected species from road mortality in Edirne province. We observed that the individuals of both species made more crossing on the road at night. The reason of the presence of high amount of frog death in Edirne may be that the frogs try to cross from the Enez-Ipsala highway which is located above the watery rice fields. Among vertebrate groups, amphibians are the most defenceless against road mortalities [19]. The reasons for this can include the migrations between aquatic and terrestrial habitats required by their life cycles [28]. In addition, six snake species (*Dolichophis caspius*, *Natrix natrix*, *Natrix tessellata*, *Malpolon insignitus*, *Elaphe sauromates* and *Montivipera xanthina*) were found as the victims of road kills on Enez-Ipsala highway observed in the present study. A similar pattern reported by other studies on roads of the Colombian Caribbean region, in which snakes are the most sensible reptile group of road kill events [38, 53-56]. The high number of snake species exposed to road-kills in the study area can be associated with an abundance of the frogs found in this area. In addition, 1 dead individual of *Testudo hermanni* was observed on the Enez-Ipsala highway. *Testudo hermanni* has been classified in the NT (Near threatened) category in the IUCN Red List and the decrease in the number of individuals will cause this species to be in danger in the near future.

On the E87 highway in Kırklareli Province, the lizards (*Podarcis muralis*, *Podarcis tauricus*, *Lacerta trilineata*, *Lacerta viridis* and *Pseudopus apodus*) were killed more often than other amphibian and reptile groups. According to our observations on live animals, *L. trilineata* and *P. tauricus* are most abundant and active lizard species in the study area. We started the field study in June 2016 when the summer temperatures increase and the lizards are more active in their breeding activities in the study areas. Although an ability to be active at high temperatures may obtain an ecological advantage, it may cause to increase the risk of road kills [2], especially reptile species. Additionally, it is known that the temperature has a direct relationship with road kills [32, 42] and it is a disadvantage

for reptile species whose habitats are fragmented by roads. The most abundant snake species in the study area was *D. caspius* in Edirne (4.8%) and Kırklareli (13.0%) provinces, respectively. Consistent with this finding, we observed that this species was the most affected snake species. In addition, we found three dead individuals of *Testudo graeca* on the E87 highway. *Testudo graec*a has been classified in the VU (Vulnerable) category in the IUCN Red List and special precautions should be taken to protect the individuals of the species in this area.

The present study was done in a month (June) of the summer season and the observation was performed in limited days (4 days in Edirne and 5 days in Kırklareli). Increasing the number of days to study will also lead to a further increase in the observed number of dead animals on the road. Future observations are necessary, especially in the spring months when amphibians and reptiles do more displacement to initiate post-hibernation activities for breeding. More accurate comments can be made by comparing the results of observations to be made in all seasons of the year (including also the autumn and the beginning of winter).

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