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Road Kills of *Bufo viridis* (Laurenti, 1768): A Case Study from Konya Province of Turkey

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ABSTRACT

The present study reports vehicle collisions of *Bufo viridis* (The green toad) in Konya province from Turkey. Our study was performed in more than fifty localities on Yunak-Akşehir highway (D-695). The records were taken in a short time; it is important and remarkable to come across a large number of dead individuals of an amphibian species in a short time. Among all recorded mortalities (n= 246), the highest value belonged to subadults (45% of the cases), followed by juveniles (35% of the cases). The lowest rate among the carcasses was belonged to the adult individuals (20% of the cases). There can be many factors that cause the road kills: These factors are grouped according to the literature under the headings of “direct causes”, “indirect causes” and “potential causes” for the road kills. In this study, we evaluated the effects of some factors for *Bufo viridis*. In general, all terrestrial and semi-aquatic amphibian species, which populations are located the roadsides, suffer from road kills. Because of this situation, there is a need for both further studies and habitat restorations for amphibians.

1. Introduction

There has been a significant decrease in amphibian populations worldwide over the past decade^[1,2]. Although some reasons have been suggested for this situation, there are important arguments indicating that anthropogenic activities are the main reason for the decline of amphibian populations^[3]. Road mortality is one of the most important human activities that cause the decline of amphibian populations^[4]. Traffic has negative effects on amphibian populations and it is possible to divide the

negative effects into two: One of them is direct and it means killing individuals. Another one is indirect and it represents fragmenting a population’s habitat^[5-7]. In both situations, amphibian populations can be severely affected by the adverse effects of road mortality^[8].

In the scope of direct effects, it is possible to encounter the mass dead of amphibians as well as to coincide the dead of amphibians individually in road kills related to amphibians. Mass mortalities of amphibians often occur where roads cut across annual migration routes between

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hibernation and breeding habitats^[9,10]. The most important reason of mass deaths of amphibian is fragmented habitats. Habitat fragmentation and habitat loss, which are considered as the indirect effects of road kills amphibians, are important threats to amphibian populations^[11].

The direct and indirect factors have been known and researched for a long time. Apart from these factors, some researchers have also grouped “potential threats” under several categories^[12]. The most noteworthy of these groupings is belonged to Collins and Storer (2003) and Waldman and Tocher (1998). According to Collins and Storer (2003), there may be six factors in a group for the decline of a species: Global change, including UV-radiation and climate change, contaminants, alien species, emerging infectious diseases over-exploitation, land use change, and over-exploitation^[13]. On the other hands, Waldman and Tocher (1998) reported nine factors in a group: UV-B radiation, habitat disappearance or destruction, fragmentation, pesticides and fertilizers, climate change, genetic causes, diseases, acid rain, and demographic causes^[14]. In some cases, a combination of several factors leads to the extinction of a species^[15].

The direct and indirect factors with “potential threats” show that amphibians are one of the groups most in danger of extinction and there are many studies in the world^[1-4,8,16-26]. However, there are only few studies about the road kills amphibians in Turkey^[27-29].

Bufo viridis (Laurenti, 1768) is one of the amphibian species which is highly vulnerable to road kills. The species lives in the woods, bushes, Mediterranean vegetation, meadows, parks, and gardens. It is present in modified habitats, including the center of large urban areas^[30]. Although *Bufo viridis* has been classified as LC (Least Concern) in the IUCN Red List since 2013 and population trend is stable, some researches on the declining population of the species have begun to be recorded^[31]. This situation may adversely affect the population trend of the species in the long-term.

The aims of this study take attention the dense road kills of *Bufo viridis* in the D-695 highway located between Yunak and Akşehir districts of Konya province in Turkey and contribute to the studies on the road kills of *Bufo viridis*.

2. Material and Methods

This study was carried out in more than fifty localities on Yunak-Akşehir highway (D-695), which was located in the Central Anatolian Region of Turkey (Figure 1). We observed a large number of dead individuals of *Bufo viridis* on the way in the summer of 2020. Therefore, this way was chosen to study road kills of the species.

The field study was performed in June which is the activity periods of amphibians. The field survey was performed at night and required only 1 hour (between 8.30 p.m. and 9.30 p.m.) on June 13, 2020. In Konya province, the mean annual precipitation over the last 91 years (1929-2020) was 25.7 mm and the mean annual temperature was 20.1 °C according to climate data provided by 8th. Konya Meteorology Regional Directorate of Turkey.

The size of the D-695 highway between Yunak-Akşehir districts of Konya province was approximately 60 km. The observers began to notice the carcasses of the species at the 50th kilometer of the highway. In other words, the observations were performed on the Yunak-Akşehir highway in an area of approximately 10 km. The highway has two-lane roads and the maximum speed limit outside settlement areas are 90 km/h. The carcasses were observed by the driver and a passenger when driving a car at slow speed (≤ 40 km/h) as reported in the literature^[32]. After the first carcass was noticed, the car was stopped and two observers who walked along the part of D-695 each side, looked for carcasses. Meanwhile, the observers noticed puddles on both sides of the road. The date, temperature, and geographic coordinates were recorded using a GPS server (GARMIN eTrex 20x). We identified the individuals based on the morphological characteristics of the species. Finally, we took the photographs of all carcasses by Nikon-Coolpix P500) to record the valuable data of the species, which were exposed to the car crash.

3. Results and Discussion

The study performed with the beginning of the three-month period (June-August) during which the average temperature increases (22 °C) and the average precipitation decreases (13 mm) in Konya province. The June is an important month for this study because of be activity periods of amphibians. In parallel with this situation, some studies which on road kills of The green toad were performed in activity periods in the literature^[31,33-35].



Figure 1. The map showing the highway (D-695) of the observed individuals exposed to road kills on Yunak-Akşehir in Konya province of Turkey

We detected more than 200 mortality cases of *Bufo*

viridis only an hour on D-695 highway and recorded both numerically and visually. The photos of individuals, which exposed to road kill, were given in Figures 2 and 3. The reason why the dead individuals of The green toad were found intensively in a short time may be that *Bufo viridis* is one of the few amphibian lives in city centers or tremendously urbanized areas in some cities [36-38]. According to study of Telenchev et al. (2016), individuals of *Bufo viridis* can die due to crashing vehicles coming towards them at low speed while high speed on highways can be dangerous for some amphibian species.

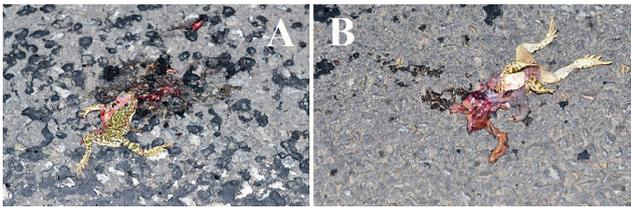


Figure 2. A general view of carcasses of a male (A) and a female (B) *Bufo viridis* found on Yunak-Akşehir highway

Bufo viridis is perfectly tolerant of reservoirs that have been designed by humans [38,39]. However, the dozens of carcasses of *Bufo viridis* were seen nearly every kilometer on the highway in Konya province. The individuals of *Bufo viridis* hibernate at high temperatures during their life cycle [40]. This situation may be causing it to expend a great energy during the hibernation period. For this reason, when the individuals of The green toad wake up from hibernation, their bodies may be more bulky than some other amphibian species. As a result, high temperatures for hibernation may be a reason why individuals of *Bufo viridis* are intensely exposed to road kills [35].

The green toad is a more thermophilic species than some other amphibian species, preferring to breed in warmer and even temporary water bodies [33], although *Bufo viridis* tolerates dry, sandy or stony habitats in the terrestrial areas [41]. Considering the month when the observations in this study and the puddles located on the sides of the road; it can be thought that individuals were returned from mass migration. Individuals of The green toad need to cross roads for the continuity of their migration. As a result of these situations, the individuals of the species may have exposed to a high rate of road kills while they returned from mass migration.

One of the important data obtained within the scope of this study is that the most deceased individuals (45% of the cases) of the species which was exposed to road kills were subadults. The second most dead individuals were juveniles (35% of the cases). Adult individuals were the least exposed to road kills (20% of the cases).

On the other hand, Valkanova et al. (2009) reported that the adult specimens of *Epidaeia viridis* have a significant predominance of the road for road kills, compared with the subadults and juveniles in Plovdiv, Bulgaria. According to study of Valkanova et al. (2009) this situation may be due to the larger size of adult individuals of The green toad. The large size of adult individuals may limit their mobility in front of the approaching vehicle [42]. In both cases, the road kills may become a threat for the future of *Bufo viridis* populations.



Figure 3. A general view of The green toad carcasses belonged to an adult female (A) and a subadult (B) individuals found on Yunak-Akşehir highway

As could be clearly seen, the direct factors (killing individuals), the indirect factors (fragmenting a population's habitat) and the potential factors [land use change according to Collins and Storer (2003) and the habitat disappearance or destruction, fragmentation according to Waldman and Tocher (1998)] play a role together in the road kills of the individuals of *Bufo viridis*.

Some important projects are performed in the world to minimize road kills of amphibians. One of the most successful examples is amphibious tunnels in this regard. The first amphibian tunnels were built in Zürich, Switzerland in 1969. Afterwards, it was recorded that road kills in amphibians decreased [12]. In Turkey, more precautions should be taken regarding road kills of amphibians to protect amphibian populations.

4. Conclusions

This study was conducted on 13th June 2020 and all observations were performed in the limited time (only an hour) on 10 kilometers of Yunak-Akşehir highway. It is remarkable that so many dead individuals were observed in a limited time and a limited area. On roads such as the highway mentioned in this study, where individuals of the *Bufo viridis* are exposed to road kills, precautions such as closure of the road to traffic during the hours (between 8 p.m. and 6 a.m.) when the toads go out on the highway for migration will prevent the decrease of these toads. The new studies which will perform over a longer period and on a wider part of the road may point that the current numbers of the dead individuals are increasing. In

the present study, we observed that individuals belonged to *Bufo viridis* suffered high rates of road kills on a single road. Exposure of individuals of The green toad to high amounts of road kills on other highways may pose a serious problem for the future of the species in the long period.

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