

## URBAN FAUNAL DYNAMICS OF BEYTEPE CAMPUS, ANKARA: Three Case Studies for Vertebrate Animals

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**ABSTRACT.** In this study we documented and discussed the effects of human settlement on the terrestrial fauna dynamics of an urbanized area: Hacettepe University, Beytepe Campus. We investigated three case studies by using red fox, long-eared owl and snake-eyed lizard as model organisms to evaluate the effects of urbanization on vertebrate fauna. Depending on human activities in the study area, red foxes narrowed their foraging and reproduction range due to their generalist behavior, long-eared owls left the habitats where they had lived before and snake-eyed lizards have transformed the conditions of rubble deposits into short-term advantages and their numbers, especially in new construction areas were increased. It is very important to monitor areas such as Beytepe Campus, where the temporal development of urbanization and human pressures can be traced, to put forward ecological changes in urbanized areas.

### 1. INTRODUCTION

Human populations intend to grow and dominate ecosystems around the world [1, 2]. Wild and valuable lands of Earth are urbanizing and humans are increasingly on the move in several parts of the world, by shifting from rural regions to newly flourishing urban centers. As a result of this, the world's urban population multiplied tenfold in the last century. United Nations prediction for 2050 shows that the global urban population will be almost equal to today's total population (~7.5 billion; UN 2017) [3]. Actually, the most urban growth is occurring in developing countries, where human populations are increasing at exponential rates (Figure 1; UN 2017) [3]. The urban population in developing countries will reach 4 billion in the next decade. In those countries, where urban growth will occur so rapidly, it will be getting tense for the ability of local governments to provide satisfactory housing, infrastructure, health care, public safety and other essential services. For this reason, the increasing human impact on ecosystems under these conditions will not result in surprisingly.

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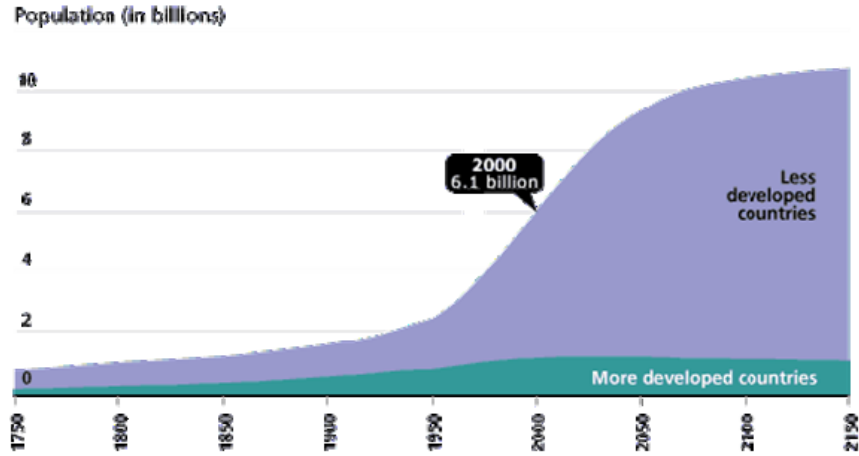


FIGURE 1. Human populations in developed and developing countries (UN 2017)

However, an important rate of the land is urbanized and populations, especially emigrants are tending to spread in suburban and/or exurban zones, cause the cities to grow faster than their regular limits. So, this will result an overflow in cities population carrying capacity. The urbanization gradient becomes increasingly complex, especially in urban characteristics. Moreover, this process - urbanization- has had remarkable effects on native flora and fauna [4-9]. According to many ecologists, one of the dominant drivers for the species extinction in the 21st century is the urbanization. This fact has been well-documented in developed countries [10-12]. However, there is a little information for the effects of urbanization in the developing or less developed countries [13].

Here our aim is to document and discuss the effects of human settlement on the terrestrial fauna dynamics of an urbanized area: Hacettepe University-Beytepe Campus. To put this current discussion into perspective, we describe three case studies to evaluate the effects of urbanization on vertebrate fauna. Diet alterations and home ranges of red foxes, leaving habitats of long-eared owls and distribution of snake-eyed lizards along the campus have been discussed respectively in this study.

## 2. STUDY AREA

Hacettepe University Beytepe Campus was considered as a rural area when it was founded in the 1970s. However, from that time to present, the area was evaluated as a suburban and urban area, respectively. In order to make this situation clearer, the change in the campus in about 50 years has been presented in the following images (Figure 2, 3, 4).



FIGURE 2. Early days of establishment of Beytepe Campus



FIGURE 3. Beytepe Campus – general view (in 1990s)



FIGURE 4. Beytepe Campus – general view (present)

### 3. CASE STUDIES

#### Case – 1: Red fox

Red fox (*Vulpes vulpes*) was the first mammal species among the large mammal group as a concern for scientific investigation in urban areas. The first awareness was recorded in British cities during 1930s; as a local phenomenon, restricted to Great Britain [14]. Additionally, there have been some other studies in both many Central-European cities (Zurich, Switzerland – [15-17], Grünwald, Germany – [18, 19] and Bristol, Great Britain – [20-22]).

These studies have revealed a number of behavioral differences between urban and rural foxes. For instance, Baker et al. (2007) found that urban foxes changed their activity patterns to reduce the risk of mortality presented by traffic collisions [23].

Although foxes living in urban areas tend to be fed with anthropogenic sources [16], they are also known to exhibit variations in food preferences by sex, season and habitat [24-26]. Ayaş et al. (2014) have put the diet composition of the fox in a three-year period from May 2010 to May 2013 (Figure - 5) [27].

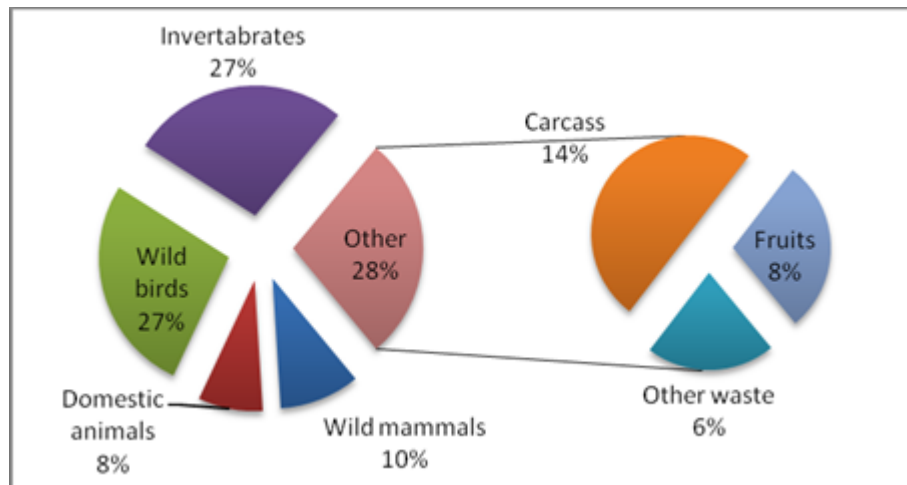


FIGURE 5. Overall diet composition of red fox in Beytepe Campus between 2010 – 2013

Moreover they placed 8 camera traps in the campus with 1x1 kilometer patches to determine the area of foxes in the same period. Both diet composition and camera traps assisted activity pattern studies have shown that foxes are sustaining their lives in more and more constricted areas. Increasingly urbanized dynamics of Beytepe Campus, as well as the urbanization network (new or revised roads and buildings) that surround the campus, and in addition to these, student-based population increase in the university, may have caused serious pressure on foxes. In this case, the ecosystem capacity for this species is seriously challenging. Foxes can survive in suburban habitats where they are resistant to anthropogenic repression up to a level as well as in rural areas where human pressures are low. However, as in every ecosystem, semi-urban ecosystems, where carrying capacities are challenging, responses of these species are noteworthy. Indeed these findings are consistent with the result reported in the literature. For instances foxes in urban areas also tend to rely on anthropogenic food items [16] and consume fewer rodents compared to animals in natural environments [17]. As a consequence of resource patterns, home-range sizes of foxes also tend to be smaller in urban than in rural areas [18].

It is well known that foxes can survive in suburban habitats where they are resistant to anthropogenic pressure to a level where human effect is relatively not strong. However, the response of the animals is noteworthy when carrying capacity of semi-urban ecosystems is coerced. It has been revealed by various studies that red fox can change its spatial and temporal distribution according to season and sex status [24, 26, 28-30]. This situation is coherent with the strategy of foxes in Beytepe Campus.

#### Case – 2: Long-eared owl

Long-eared owls (*Asio otus*) inhabit dense vegetation close to grasslands, as well as open forests shrub lands from sea level up to 2000 m elevation. They are common in tree belts along streams of plains and even desert oases. They can also be found in shelterbelts, small tree groves, thickets surrounded by wetlands, grasslands, marshes and farmlands. The species is considered a restricted feeder, that is, it is more specialized in diet than other sympatric owls [31]. Diet is typically concentrated on a few species of small mammals; particularly voles (*Microtus* spp.) and mice (*Peromyscus* spp. in North America and *Apodemus* spp. in Europe) are preminent only in some areas [31-33].

Black pine (*Pinus nigra*) plantation forest in Beytepe Campus was monitored from March until June in 2008–2012, and the monitoring was repeated between June 2013-June 2017. In the first monitoring survey, the diet composition of the owls

revealed by assessing pellets. These pellets were separated into bones, hair, and feathers following the procedures reported in Marti (1987). Prey remains were identified to the lowest taxon possible, especially for mammals using guides [34] and reference collections [35-37].

The richness of the mammal species content in the diet composition of the owls is given in the table below as the result of the studies conducted between 2008-2012 (Table 1) [38]. However, it is worrying that neither enough pellets were found nor the individuals were observed in that area when the study was repeated between 2013 and 2017.

TABLE 1. Diet of Long-eared Owl and the biomass calculating

Species	N	Abundance (%)	Approximate wt. of prey (g)	Total biomass (g)	Total biomass (%)
<i>Microtus guentheri</i>	93	43.7	38	3534	42.4
<i>Microtus sp.</i>	37	17.4	32.5	1202.5	14.4
<i>Apodemus flavicollis</i>	24	11.3	21	504	6.1
<i>Mus macedonicus</i>	23	10.8	15	345	4.2
<i>Microtus levis</i>	16	7.5	27	432	5.3
<i>Rattus norvegicus</i>	9	4.2	190	1710	20.5
<i>Crocidura suaveolens</i>	6	2.8	8	48	0.7
<i>Nannospalax xanthodon</i>	3	1.4	155	465	5.7
<i>Cricetulus migratorius</i>	2	0.9	26	52	0.7
<b>Total</b>	<b>213</b>	<b>100</b>		<b>8383.5</b>	<b>100</b>

Home range size of owls appears to vary considerably between pairs, seasons and localities. Studies have estimated mean home range sizes are approximately 5.25 km<sup>2</sup> [39-41]. Although the observation distance was increased for field studies in the light of this information, no record of the species was found. However, there has also been an increase in the number of construction activities in the same period. According to our data, owls, which are quite sensitive to noise, could not be collected in the following years due to these intense anthropogenic activities.

### Case – 3: Snake-eyed Lizard

Construction is the most common activity when the discussion is about urbanization. Therefore, it is inevitable that stone or concrete blocks will form as a wasteland for the increasing construction activities. Increasing population of Beytepe Campus year by year, and depending on this, construction ruins, which were formed together with the construction of new dormitories, education and social centers, surprisingly provided new living spaces for some species. *Ophisops elegans* is one of those species.

Snake-eyed lizard, *Ophisops elegans* Ménétriés, 1832, is widely distributed throughout Bulgaria and northern Greece, Turkey and Southwestern Asia, and has also been recorded from North Africa. Its range extends as Far East as Pakistan and northwest India [42, 43]. *Ophisops elegans* is a ground-dwelling lizard, typically found in open and arid plains, cultivated fields and stony hillsides, in areas with sparse vegetation or low shrubs [42]. Snake-eyed lizards prefer rocks and bare ground for basking [44] and tend to be well-adapted to withstand hot environments [45]. It is the most common lizard in Beytepe Campus, because they are observed especially in the dry grass of hillsides. Moreover, in the deep rocky gorges they would be found wherever grass-covered flats occurred along vegetation.

In this context, the rubble belonging to the new buildings built on the way from the main entrance to the main settlement in Beytepe Campus has formed new and wide habitats for these individuals. The area was divided into two zones (Zone A and B) as a result of routine herpetological surveys (Figure – 6, 7). Population size estimation studies were done between May and September in each year according to a modified technique of Heckel and Roughgarden (1979) [46]. Zone B and its neighborhoods have been identified as the zone with the highest population density including juvenile and sub-adult individuals in the last two years (Table 2).





FIGURE 6. Studied area view in 2015 (before constructions)



FIGURE 7. Studied area view in 2018 (after constructions)

TABLE 2. Population densities of snake-eyed lizard (*Ophisops elegans*) in both zones between 2014 and 2018

Year	Zone A			Zone B		
	Adult	Sub-adult	Juvenile	Adult	Sub-adult	Juvenile
2014	21	7	4	6	2	2
2015	23	6	6	7	3	1
2016	25	5	8	14	4	3
2017	17	4	6	19	5	6
2018	13	5	8	20	7	8

Thus the increase in population density may be due to two reasons: i) The zone formed by the debris presents appropriate habitat characteristics and thus it allows opportunities for foraging and reproduction activity and/or ii) Lizards which are close to this zone, moved to this debris habitat.

#### 4. CONCLUSION

Urban areas, and particularly urban green spaces have been playing an important role for recreational ecosystem services [47]. Contrary to this, there has been relatively less study on the dynamics of wildlife in urban areas, especially in developing countries. Therefore, due to the increasing pressure of urbanization and human activity in Beytepe Campus, the responses of natural populations are extremely important. According to current conditions, i) Foxes narrowed their foraging and reproduction range, ii) The owls left the habitats where they had lived before, iii) The lizards have transformed the conditions of rubble deposits into short-term advantages. However, their strategies to follow after the debris is removed are not yet known. Therefore, areas such as Beytepe Campus, where the temporal development of urbanization and human pressures can be traced, should be followed up with long-term monitoring programs. In this way, species and/or habitat specific action programs can be carried out and possible scenarios of human effect on nature, such as construction to be carried out need to be evaluated.

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