TÜBİTAK

Turkish Journal of Zoology

http://journals.tubitak.gov.tr/zoology/

Short Communication

Turk J Zool
(2020) 44: 209-213
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doi:10.3906/zoo-1910-29

The first record of raccoon dog (*Nyctereutes procyonoides*) in Turkey

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Received: 17.10.2019 • **Accepted/Published Online:** 01.01.2020 • **Final Version:** 04.03.2020

Abstract: The raccoon dog (*Nyctereutes procyonoides*) was recorded for the first time in Turkey on May 10, 2019, and June 5, 2019, in the same location after 4668 nights of camera trapping in the forests of the Sarıkamış region and Allahuekber Mountains in eastern Turkey. It was recorded in a Scots pine (*Pinus sylvestris*) forest at 2340 m above sea level with extensive snow cover. Given that the nearest known population is in the forests of Georgia approximately 105 km away, there may already be a viable population in Turkey. As an omnivorous species with a high adaptive ability and high reproductive potential, the raccoon dog has strong dispersal capability. It is considered an invasive species in Europe and there are some ongoing eradication activities in several countries. Therefore, we strongly advise that the raccoon dog in Turkey be evaluated as an invasive species and that the relevant authorities conduct extensive research and any necessary management, especially where the habitat and local climate are more favorable for the species' reproduction and range expansion.

Key words: Conservation biology, eastern Turkey, ecology, invasive species, range expansion

As a newly established alien species in Europe, the raccoon dog (*Nyctereutes procyonoides* Carnivora, Canidae; Gray, 1834), has succeeded in rapidly expanding its geographic distribution from the East Asian countries and is now found in many European countries (Jeong et al., 2017). At present, *N. procyonoides* is widespread in northern and eastern European countries. The native geographic range of *N. procyonoides* extends from south China and the Korean Peninsula to Russia and Mongolia (Nowak, 1999; Ćirović, 2006; Figure 1). The length of the growing season, mean annual temperature above 0 °C, and low snowfall and duration (snow depth < 80 cm, snow cover < 175 days, growing season > 135 days) facilitate the species' presence (Nasimovic, 1985; Kauhala et al., 2007). Such environmental variables seem to mainly affect breeding, growth rate, and hibernation behavior of this monogamous species (Helle and Kauhala, 1995; Thompson et al., 2006). Climate change and global warming have positively influenced the species' dispersal capability to occupy new habitats in northern Europe (Oerlemans and Koene, 2008).

Raccoon dogs are omnivorous canids that prefer to be near water sources such as streams or rivers (Kauhala, 1996), mainly in open forest habitats that provide a diversity of food resources and shelter. However, raccoon dogs have also been reported in open meadows and farmlands (Judin, 1977; Kowalczyk and Zalewski, 2011). As the only hibernating canid, the maximum length of the hibernation period of a monogamous pair during harsh winters has been reported to last about five months (Helle and Kauhala, 1991). Day length and temperature have been considered as the main environmental factors that trigger this species hibernation (Kauhala et al., 2007).

We have been conducting a long-term (2006–2020) intensive camera trap survey of the large mammalian fauna of the Sarıkamış Allahuekber Mountains National Park and the surrounding high plateau forests (1900 m to 3120 m a.s.l.), dominated by Scots pine (*Pinus sylvestris*),

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as part of the KuzeyDoğa Society's conservation work and wildlife research in northeastern Turkey (Akküçük and Şekercioğlu, 2016). Additional details of the study site may be found in the work of Capitani et al. (2016). During 4668 trap nights from June 2018 to August 2019 with 28 camera traps, we recorded two videos of raccoon dog at the same location in Sarıkamış (40°14′49.551″N, 42°30′47.838″E) on May 10 and May 19, 2019, at 22:31 and 23:57, respectively (Figures 1 and 2).

We extracted video frames as separate image files and compared them with the images of other similar-sized mammals in the region, including foxes (*Vulpes vulpes*), badgers (*Meles meles*), beech marten (*Martes foina*), and lynx (*Lynx lynx*). A black facial mask, small rounded ear

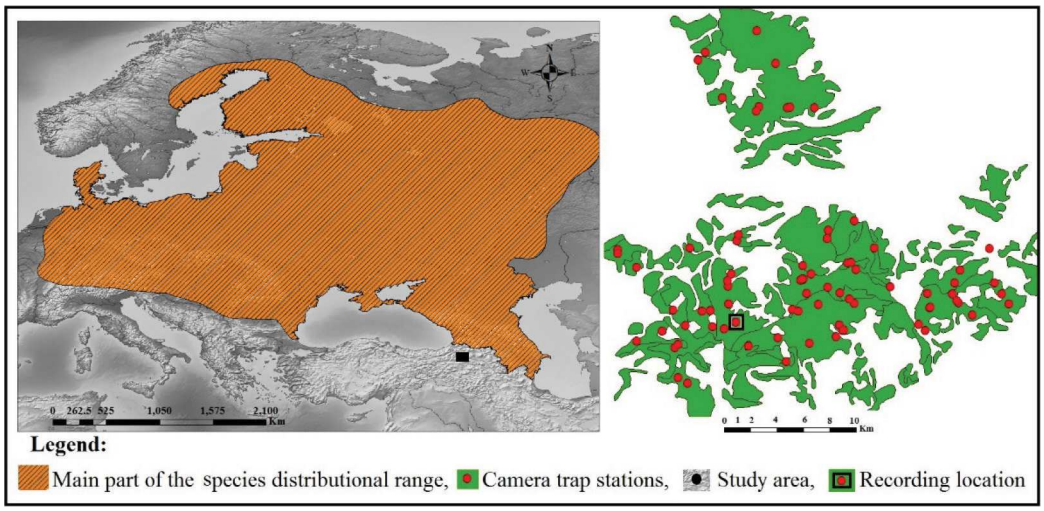

Figure 1. The raccoon dog's extant range and the study area in eastern Turkey. The recorded locality has been marked with a black rectangle. Red dots indicate positions of camera traps during the long-term surveys.



Figure 2. Camera trap screenshot of a raccoon dog walking on snow recorded at 22:31 on May 10, 2019, and the same location on June 5, 2019. These pictures were extracted from two different videos and the first and third pictures from the left have been processed with image tools to be more visible and comparable with other species, especially from the family Mustelidae. The habitat, which is shown in this photo, is the same location where we recorded the target species.

pads measuring 4–4.6 cm (Sochinobu et al., 1997), and a pointed muzzle like other canids are some of the major morphological characteristics of a raccoon dog. Shoulder height ranges from 28.5 cm (Sochinobu et al., 1997) to 50.8 cm (Sheldon, 1992). The color varies across the species range and is usually yellow to gray or even reddish, sometimes with a dark line from the shoulders to the tail. Long guard hairs, found throughout the dorsal side, are tipped black (Sheldon, 1992). In adults, the demarcation line that separates the darker underparts from the lighter upper parts is clearly visible. The bushy tail, covered with thick hair, is colored light yellow ventrally, with a usually darker or black tip. Tail length ranges from 13–25 cm and is more than 1/3 of the total body length, but it does not reach the ground (Sheldon, 1992). The body size is comparable to that of a red fox but with shorter legs and tail (www.nobanis.org). The overall impression is of a medium-sized mammal with short and stubby legs. Although the length of the skull is similar to that of a badger, other external morphological characteristics differ significantly (Kauhala and Saeki, 2004a). The captured image frames were used to make relative measurements, including the relative length of the head and body (HB) to tail length (TL), indicating that HB/TL is about 3.5, which is typical for raccoon dogs (Sheldon, 1992). This number for badgers (*M. meles*) has been reported to be more than 4.5. External characters like facial color pattern, the relative height of the shoulder, body length, tail length, hind feet length, and shape (Figure 2) also confirm our finding as a raccoon dog (*Nyctereutes procyonoides*).

The camera at this locality was active for 384 consecutive trap nights. The vegetation community of the recorded location is Scots pine (*Pinus sylvestris*) forest with a density of ~1600 trees per hectare. August is the warmest month (mean: 15.6 °C, max: 23 °C) and January has the lowest mean temperature (–8.1 °C). Snowfall usually starts in October and the mean depth of the snow cover normally exceeds 53 cm from January to March (Figure 3). The growing season in the study areas lasts approximately 150 days and there are more than 200 days of snow cover (Table). Even though the average length of the growing season, mean snow depth, and mean annual temperature provide suitable environmental conditions for raccoon dogs, the high number of days of snow cover is not favorable for this species (Nasimovich, 1985; Kauhala et al., 2007).

Using quadrat sampling in an area of 100 × 100 m^2 and sampling 26 squares (1 × 1 m^2), we estimated the percent coverage of the understory to be approximately 70 ± 5%. The raccoon dog was recorded 450 m from the forest edge, in agreement with the dependence of this species on more open forests and ecotone areas (Kowalczyk and Zalewski, 2011). The environmental conditions of the site where this raccoon dog was recorded are not substantially different from those observed in other studies (Nasimovich, 1985; Kauhala et al., 2007), and the mean growing season in Sarıkamış is sufficient to enable reproduction and successful hibernation for raccoon dogs. The raccoon dog has been mentioned as a potential prey for lynx (Lavrov, 1971). Even though this is positive for the Caucasian lynx (*Lynx lynx dinniki*) and gray wolves (*Canis lupus*) living in this study area with relatively low mammalian prey availability (Chynoweth et al., 2015; Capitani et al., 2016), the raccoon dog's capacity as an expanding nonnative species, its ability to cope with new environments, its capacity as an important host for rabies, and its omnivorous feeding strategy that results in raccoon dogs preying on and competing with other native mammals combine to make it an overall threat to Turkey's forest ecosystems.

The first record of the raccoon dog in Turkey, in the Scots pine forest of the Sarıkamış region, Kars province, eastern Turkey, suggests that this species is expanding its

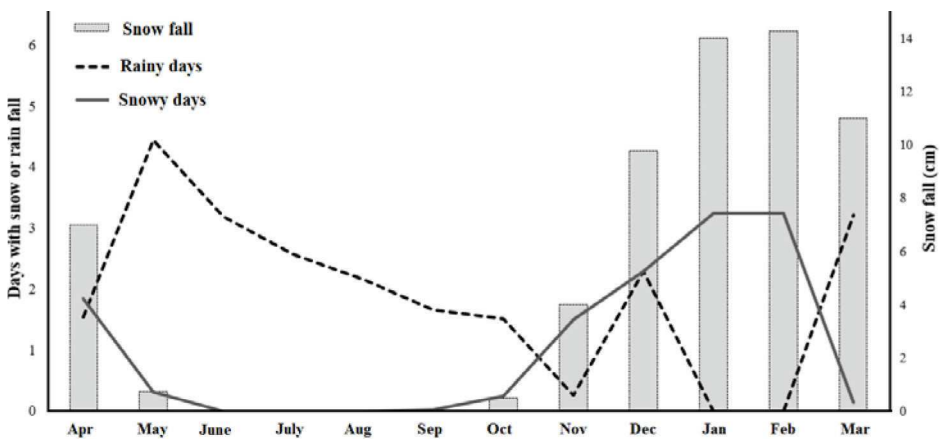

Figure 3. Average precipitation (rain and snow) between 2007 and 2018 (data adapted from https://www.snow-forecast.com/resorts/Sarikamis/history).

Table. Climatic characteristics of the study area (https://www.snow-forecast.com/resorts/Sarikamis/history).

Temperature (°C)	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Avg.	–8.1	–6.9	–3	3.9	8	11.6	15.5	15.6	11.8	6	0.2	–5.5
Min.	–13	–11.9	–7.5	–0.7	2.7	5.4	8.7	8.2	4.2	–0.2	–4.6	–10
Max.	–3.1	–1.9	1.6	8.6	13.4	17.8	22.4	23	19.5	12.2	5	–0.9
Precipitation as rainfall (mm)	33	41	50	69	86	72	46	34	26	48	45	37

geographical distribution from the Caucasus forests (the nearest known location) towards the forests of the Iran–Anatolian global biodiversity hotspot. This individual likely originated from southern Georgia and may also have colonized the forests of Ardahan province north of Kars. Turkey is experiencing a biodiversity conservation crisis and invasive species are a growing problem (Şekercioğlu et al., 2011a, 2011b). With the appearance of this new invasive species, especially in the forests of Turkey's northeastern provinces, there is an urgent necessity for surveys to determine the presence and population size of raccoon dogs, an invasive species with a high potential for negative impacts on the native mammal communities of Turkey's forests. In biodiverse developing countries like Turkey, with relatively few professional field biologists and inadequate biodiversity research, data collected by citizen scientists are crucial for documenting new species and distributions of existing species (Abolafya et al., 2013). Camera trap data increasingly collected by hundreds of citizen scientists in Turkey need to be screened systemically for the presence of raccoon dogs and other invasive mammal species, ideally as part of a coordinated citizen science camera trap research program. Since raccoon dogs have been recorded only 159, 242, and 173 km from the forested areas of Armenia, Azerbaijan, and Iran, respectively, the species' expansion into other neighboring countries like Iran can be expected. Northeastern Turkey has a high degree of human–wildlife conflict (Chynoweth et al., 2016), and as a new invasive carnivore species, raccoon dogs can increase this conflict. There is an urgent need in the entire region for focused surveys to determine the presence of raccoon dogs and their ecological impacts.

Acknowledgments

We are grateful to the Fondation Segré for providing the majority of the funding for the field season during which we recorded this species. This research was also supported by other generous donors, including Arkadaşlar, Bilge Bahar, Faruk Eczacıbaşı, Seha İşmen, Deniz İyigün, Yalın Karadoğan, Ömer Külahçıoğlu, Burak Över, Emin Özgür, Batubay Özkan, Alan Peterson, Suna Reyent, Faruk Yalçın Zoo, National Geographic Society, Sigrid Rausing Trust, STGM, TANAP, and the Whitley Fund. We thank Turkey's Department of Nature Conservation and National Parks and the Ministry of Agriculture and Forestry for granting our research permits. We greatly appreciate the dedicated support of the staff and volunteers of the KuzeyDoğa Society.

References

Abolafya M¸ Onmuş O, Şekercioğlu ÇH, Bilgin R. (2013). Using citizen science data to model the distributions of common songbirds of Turkey under different global climatic change scenarios. PLoS One 8: e68037.

Akküçük U, Şekercioğlu ÇH (2016). NGOs for environmental sustainability: the case of the KuzeyDoğa Foundation. Fresenius Environmental Bulletin 25: 6038-6044.

Capitani C, Chynoweth M, Kusak J, Çoban E, Şekercioğlu ÇH (2016). Wolf diet in an agricultural landscape of north-eastern Turkey. Mammalia 80 (3): 329-334.

Chynoweth M, Çoban E, Şekercioğlu ÇH (2015). Conservation of a new breeding population of Caucasian lynx (*Lynx lynx dinniki*) in eastern Turkey. Turkish Journal of Zoology 39: 541-543. doi: 10.3906/zoo-1405-10

Chynoweth MW, Çoban E, Altın Ç, Şekercioğlu ÇH (2016). Human-wildlife conflict as a barrier to large carnivore management and conservation in Turkey. Turkish Journal of Zoology 40: 972-983.

Ćirović D (2006). First record of the raccoon dog (*Nyctereutes procyonoides* Gray, 1834) in the Former Yugoslav Republic of Macedonia. European Journal of Wildlife Research 52 (2): 136-137. doi: 10.1007/s10344-005-0106-z

Helle E, Kauhala K (1991). Distribution history and present status of the raccoon dog in Finland. Holarctic Ecology 14 (4): 278-286.

Helle E, Kauhala K (1995). Reproduction in the raccoon dog in Finland. Journal of Mammalogy 76 (4): 1036-1046. doi: 10.2307/1382597

Jeong W, Kim DH, Yoon H, Jong KH, Kang YM et al. (2017). Home range differences by habitat type of raccoon dogs *Nyctereutes procyonoides* (Carnivora: Canidae), Journal of Asia Pacific Biodiversity 10 (3): 349-354.

Judin VG (1977). Enotovidnaja sobaka Primor'ja v Priamur'ja. Moscow, USSR: Nauka.

Kauhala K (1996). Habitat use of raccoon dogs (*Nyctereutes procyonoides*) in southern Finland. Zeitschrift für Säugetierkunde 61: 269-275.

Kauhala K, Holmala K, Schregel J (2007). Seasonal activity patterns and movements of raccoon dog, a vector of disease and parasites, in southern Finland. Mammalian Biology 72: 342-353. doi: 10.1016/j.mambio.2006.10.006

Kauhala K, Saeki M (2004). Nyctereutes procyonoides. In: Sillero-Zubiri C, Hoffmann M, Macdonald DW (editors). Canids: Foxes, Wolves, Jackals and Dogs. Status Survey and Conservation Action Plan. Cambridge, UK: IUCN/SSC Canid Specialist Group, pp. 136-142.

Kowalczyk R, Zalewski A (2011). Adaptation to cold and predation - shelter use by invasive raccoon dogs *Nyctereutes procyonoides* in Bialowieza Primeval Forest (Poland). European Journal of Wildlife Research 57 (1): 133-142. doi: 10.1007/s10344-010-0406-9

Lavrov NP (1971). Results of raccoon dog introductions in different parts of the Soviet Union. Trudy kafedry biologii MGZPI 29: 101-160 (in Russian with an abstract in English).

Nasimovich AA (1985). Enotovidnaja sobaka. In: Nasimovich AA, Isakov YA (editors). Pesec, lisica, enotovidnaâ sobaka: Razmesenie zapazov, ekologijâ, ispol'zovanie i ohrana. Moscow, USSR: Nauka, pp. 116-145.

Nowak RM (1999). Walker's Mammals of the World (6th ed.). Baltimore, MD, USA: The Johns Hopkins University Press.

Oerlemans M, Koene P (2008). Possible implications of the presence of the raccoon dog (*Nyctereutes procyonoides*) in the Netherlands. Lutra 51 (2): 123-131.

Şekercioğlu ÇH, Anderson S, Akçay E, Bilgin R (2011a). Turkey's rich natural heritage under assault. Science 334: 1637-1639.

Şekercioğlu ÇH, Anderson S, Akcay E, Bilgin R, Can OE et al. (2011b). Turkey's globally important biodiversity in crisis. Biological Conservation 144: 2752-2769.

Sheldon J (1992). Wild Dogs: The Natural History of the Nondomestic Canidae. San Diego, CA, USA: Academic Press.

Thompson RCA, Kapel CMO, Hobbs RP, Deplazes P (2006). Comparative development of *Echinococcus multilocularis* in its definitive hosts. Parasitology 88: 84-88. doi: 10.1017/S0031182005009625