



New Locality Record for Indian Crested Porcupine *Hystrix indica* Kerr, 1792 in Afyonkarahisar Province, Türkiye

Hint Oklu Kirpisinin *Hystrix indica* Kerr, 1792 Afyonkarahisar ilinde Yeni Lokalite kaydı, Türkiye

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Abstract: The Indian crested porcupine (*Hystrix indica*, Kerr, 1792) is a large rodent species that is listed as Least Concern (LC) on the IUCN Red List at the international level and is listed as Endangered category (EN) in Türkiye. The presence of the Indian crested porcupine was determined in Sandıklı region of Afyonkarahisar province and the first locality record was given in this study for this province. The study was carried out using direct and indirect observation techniques. In addition, information about the habitat characteristics and conservation measures of the Indian crested porcupine in the region was given in this study.

Keywords: *Hystrix indica*, Ecology; Habitat, Conservation, Camera Trapping

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Öz: Hint oklu kirpisi (*Hystrix indica*, Kerr, 1792), uluslararası düzeyde IUCN Kırmızı Listesi'nde En Az Endişe Verici (LC) olarak listelenen ve Türkiye'de Tehlike Altında (EN) kategorisinde yer alan büyük bir kemirgen türüdür. Afyonkarahisar ili Sandıklı ilçesinde Hint oklu kirpisinin varlığı tespit edilmiş ve bu il için ilk lokalite kaydı bu çalışmada verilmiştir. Çalışma doğrudan ve dolaylı gözlem teknikleri kullanılarak gerçekleştirilmiştir. Ayrıca bu çalışmada Hint oklu kirpisinin bölgedeki habitat özellikleri ve koruma önlemleri hakkında bilgi verilmiştir.

Anahtar Kelimeler: *Hystrix indica*, Ekoloji; Habitat, Koruma, Fotokapan

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INTRODUCTION

Porcupines belong to the family Hystricidae of the order Rodentia. The Old-World porcupines (Hystricidae) distributed in the southern Asia, Mediterranean Europe and throughout Africa (Kahraman et al., 2022; Siler, 2023; Yürümez and Ulutürk, 2016). The Indian crested porcupine (*Hystrix indica* Kerr, 1792) is the exclusive representative of its family found in Türkiye, as documented by Yürümez and Ulutürk (2016), Kahraman et al., (2022), and Siler (2023). The first description of the Indian crested porcupine in Türkiye was made by Yılmaz et al., in 1998, who classified it as *H. cristata*. It was later confirmed by several authors, including Kumerloeve (1975) as *H. indica*, the largest rodent in Türkiye, distributed in the Aegean, Mediterranean, south-eastern Anatolia, Bitlis and Siirt. (Arslan, 2008; Fattorini and Pokheral, 2012). Presence of porcupines has been reported to date in Adana, Adıyaman, Antalya, Aydın, Balıkesir, Bursa, İskenderun, İzmir, Kahramanmaraş, Kocaeli, Kütahya Mersin and Muğla (İnaç et al., 2011), Batman (Yürümez and Ulutürk, 2016), Hatay (Hassa, Reyhanlı districts) (Çoğal et al., 2016), Adıyaman, Adana and İçel (Arslan, 2006), Gaziantep (Arslan, 2008), Manisa (İlemin, 2022). İskenderun, Mersin, Muğla, Aydın (Söke, Koçarlı, Karpuzlu, Yenipazar, Çine districts), İzmir, Balıkesir (Kahraman et al., 2022). According to Kumerloeve (1975), with reference to Corbet and Morris (1967), a record of the species was also given in Finike.

The Indian crested porcupine is classified as a species of "least concern" on the IUCN Red List; however, it is considered a endangered rodent species in Türkiye (Kahraman et al., 2022; Siler, 2023). Although they are called "hedgehogs" because of the quill which are hollow and hardened bristles, that start from the shoulder part of their body to the tail, they are not related to porcupines.

There is an ongoing requirement for research on porcupines in Türkiye (Yürümez and Ulutürk, 2016). Crested porcupines are known for their monogamous nature and generally prefer a solitary existence, only coming together for mating or the nurturing of their young (Coppola and Felicioli, 2021; Gurung and Singh, 1996; Kleiman, 1977; Lovari et al., 2013; Mori et al., 2017). It accompanies a mate during the mating season, followed by the offspring for a period of up to one year (Fattorini and Pokheral, 2012; Mori et al., 2017). This animal is primarily active during the night and rests in a burrow or a small cave throughout the day. (Amr et al., 2004; Gurung and Singh, 1996; Siler, 2023).

In environments characterized by aridity or semi-aridity, the availability of wild fruits is limited throughout the year, compelling porcupines to traverse extensive distances, occasionally up to 3.5 km from their dens, in search of sustenance (Lovari et al., 2013; Mori et al., 2017). Underground storage organs of plants and agricultural products enable porcupines to survive without the need for drinking water, which is a crucial adaptation in a semi-arid climate (Alkon and Saltz, 1988; İnaç et al., 2011; Mori et al., 2017).

It is known that they live on deserted slopes, away from human influence and where the Mediterranean climate prevails (Siler, 2023). They prefer grassy and wetland areas with vegetation such as oaks and shrubs. They live close to wetlands, they get water from the food they eat but need to drink it and they are good swimmers (İnaç et al., 2011; Yürümez and Ulutürk, 2016).

Average lifespan of porcupines is 15-20 years (İnaç et al., 2011). These wild animal species mate in April. Data collected from captured wild Indian crested porcupines indicates that their reproductive activity is ongoing, particularly from April to September (Coppola and Felicioli, 2021). Male and female stay together during the mating and offspring time. After a pregnancy lasting 60-70 days (nine weeks), the female gives birth to 2-4 cubs with open eyes and soft spines in her own nest (İnaç et al., 2011). Certain studies (Amr et al., 2004; Gurung and Singh, 1996), it is noteworthy information attracts attention that the mother brings water to the young animals with her hollow terminal spines. The duration of inbreeding of the Indian crested porcupine from birth to dispersal varies from 1 to 2 years, depending on when subadults reach sexual maturity (Coppola and Felicioli, 2021; İnaç et al., 2011).

The main food source of the species is vegetal matter such as cultivated crops, grains, fruits, roots, bulbs and tubers (Bruno and Riccardi, 1995). It has been reported that it causes damage to agricultural areas such as grapes, vineyards and orchards, and therefore is caught by farmers in traps (İnaç et al., 2011; Khan et al.,

2022). Currently, *H. indica* faces significant threats primarily due to habitat destruction, the use of pesticides, and hunting for their meat by non-Turkish nomads in certain areas, resulting in a decline in the porcupine population in Anatolia (Amr et al., 2004; Çoğal et al., 2016; İlemin, 2022; İnaç et al., 2011; Yürümez and Ulutürk, 2016). According to Turkish law, hunting is prohibited (İnaç et al., 2011; Yürümez and Ulutürk, 2016).

MATERIAL AND METHOD

Sandıklı district is affiliated with Afyonkarahisar province and located in the Aegean region. The geographical location of Sandıklı, which has a surface area of 1036 km², is between 29°50'-30°30' Eastern meridians (Longitude) and 38°15'-38°45' Northern parallels (Latitude). Sandıklı district has a hot and very dry climate in summer and a cold and snowy climate in winter. According to the data between 1929-2022 in Sandıklı, which has a continental climate, the lowest average temperature is -3°C in January and the highest temperature is +26°C in August (MGM, 2023). The vegetation cover of the area varies according to the local climate, with a diverse range of species including black pine, red pine, Scots pine, and white pine, as well as skunk juniper, gray juniper, Finike juniper, dwarf juniper, Turkish oak, alder, elm, maple, ash, and sweetgum trees. Short trees of the maquis flora species are encountered. The plains are completely open and thorny plants can be seen. Willows, poplar trees, blackberries, grapes, and rosehips appear along the edges of the streams (URL 1.). Although farmers mostly deal with dry farming (barley, wheat, vetch), they also engage in irrigated agriculture (poppy, potatoes, sugar beet, onion, walnut, sour cherry).

The study was carried out in the Sandıklı region between January 2023 and May 2024. Camera traps were installed in ten different locations (Table 1) by the Opportunity point method, and direct (Bushnell 8-16x40 binoculars, DSLR CanonEOS 750D) and indirect (footprint, quill, feces) observations, which are among wildlife observation techniques, were carried out in and around these locations. Bushnell brand camera traps were used in the study. The camera trap recordings underwent inspection on a biweekly basis, with battery replacements conducted as required. In addition, local people and hunters were interviewed and information was collected about wild animals in the field, the presence of porcupines and their habitats.

Table 1. Locations where camera traps are set up.
Çizelge 1. Kamera tuzaklarının kurulduğu lokasyonlar.

No	Location	Coordinates	Altitude
1	Alamescid	38°20'23.65"N, 30°08'10.11"E	1054
2	Celiloğlu	38°23'20.51"N, 30°9'18.88"E	1105
3	Yayman	38°23'49.74"N, 30°6'42.14"E	1208
4	Asmacık	38°19'29.19"N, 30°6'18.45"E	1203
5	Alamescid	38°20'16.67"N, 30°8'37.54"E	1058
6	Çamoğlu	38°21'36.58"N, 30°5'10.27"E	1190
7	Alamescid	38°20'19.90"N, 30°8'24.06"E	1065
8	Asmacık	38°20'33.34"N, 30°7'44.76"E	1134
9	Asmacık	38°20'12.12"N, 30°7'30.69"E	1087
10	Alamescid	38°20'23.80"N, 30°8'17.56"E	1070

RESULTS AND DISCUSSION

The fields in the Sandıklı district were scanned using direct and indirect observation techniques, and camera traps were set in areas that porcupines can use as nests. It was determined that the target species was very sensitive and did not leave its nest during night observations. To avoid disturbing the species, only camera traps were utilized on the remaining days, with a preference for indirect observations.

Camera traps were set up at 10 locations using the point of opportunity method, and 11 porcupine images were recorded at location 1. The images were recorded inside the cave and in front of the cave at location 1. in different days. Sandıklı, Alamescid village is located at 38°20'23.65"N, 30°08'10.11"E and 1054m altitude (Figure 1.) One porcupine individual was recorded in the images captured by the camera trap at the Alamescid location.

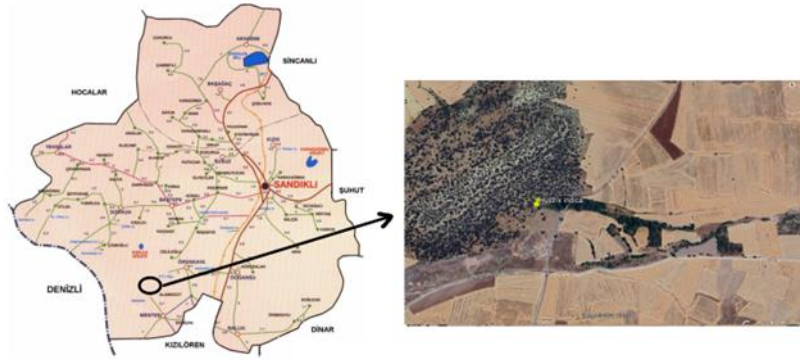


Figure 1. Porcupine recorded location 1 Alameşid village. 38°20'23.65"N, 30°08'10.11"E.

Şekil 1. Hint oklu kirpisi kaydedilen lokasyon 38°20'23.65"N, 30°08'10.11"E.

It was estimated that the species lived in a cave located at the intersection triangle of agricultural areas, forest borders and wetlands in the region. However, a camera trap set up at the entrance to the cave at (Alameşid location 1) showed that the species was nesting in the cave (Figure 2).



Figure 2. a) Cave entrance, b) Indian crested porcupine (*H. indica*).

Şekil 2. a) Mağara girişi, b) Hint oklu kirpisi (*H. indica*).

It has been determined that the species is sensitive to smell and sound, like other wild mammalian species. At the Alameşid location, a porcupine was seen sniffing the camera in a 20-minute photocapture.

The cave is at an altitude of 1050m and its view is in a southern location. According to the results of a similar study, it is understood that porcupines generally prefer areas with low altitude (700-900m), slope (50-75%) structures as habitats. It has been observed that there are nests or caves especially in areas close to the stream passing through the study area (İnaç et al., 2011).

The cave where our target species nests aspect is south. Similar to our study results, in another study it was reported that porcupines prefer southern exposures and only a few data were recorded in northern (N) exposure (İnaç et al., 2011). Diggable soil and southern aspects are preferred elements for ground-nesting wild animals (Aksan et al., 2014).

The cave entrance, where the target species resides and builds its nest, measures 80cm in height and 192cm in width. Cave entrance has a width of 5m². The cave's interior extends with a passage that measures 70cm in height and 90cm in width. During interviews with local people, one person who entered the cave stated that, the length of the cave was 200m. He stated that there were multiple galleries in the cave, some of which contained water while others were dry. He reported seeing bone remains and porcupine quill in some of the galleries.

The cave is located at the intersection of dry and irrigated agricultural lands and the forest (*Juniperus communis* and *Quercus ithaburensis*) border (Figure 3). Right next to the cave (near the cave, up to 50 m),

there is a wetland formed because of the accumulation of an underground water source with a diameter of 50m. Similarly, İnaç et al., (2011), stated that porcupines prefer areas covered with Anatolian bonito oak (*Q. ithaburensis*) and holm oak (*Quercus ilex*) species for nesting and agricultural areas for feeding. Another study on porcupines found that their habitat is sparsely covered with coniferous forests and has similar types of hilly habitats and vegetation (Khan et al., 2022).



Figure 3. Habitat of *H. indica* a) Forest border, b) Wetland, c) Dry and irrigated agricultural areas.
Şekil 3. *H. indica* habitatı a) Orman sınırı, b) Sulak alan, c) Kuru ve sulu tarım arazileri.

Like as our results the place where porcupines nest in Batman province is on the banks of the Tigris River and the dominant vegetation consists of oak (Yürümez and Ulutürk, 2016). In the study by Fattorini and Pokheral (2012), analysis of habitat selection between forests and grasslands showed that porcupines preferred grasslands. The factors influencing this selection could include the distribution of food resources or the presence of major forest predators, for instance, the leopard (*Panthera pardus*). Aksan (2018) stated that in her study (2018), the diversity of herbaceous and woody plant species along with the structural diversity in the area increases the habitat richness that wild animals can use for activities such as shelter, shelter, hiding, feeding and resting. Our findings are like Arslan (2008) in terms of the species' habitat and the cave characteristics in which it nests. Moreover, Arslan (2008) discovered the presence of a river or a waterhole in proximity to five burrows excavated by porcupines in the regions of Ceyhan and Bozyazı. The author indicated that the burrows were found on the side of heavily forested areas, the entrance of burrows had 40cm height and this height went on throughout tunnel which is average 4.5m length. Aksan and Akbay (2018) reported that the presence of water resources, agricultural areas and natural areas around it led to an increase in species diversity.

It is known that porcupines use agricultural areas for both feeding and hiding. It was determined from the indirect traces/signs (path, gnaw marks, feathers, porcupine quills, etc.) and feces found in the field that porcupines feed on potatoes, sugar beets, barley, wheat grown in agricultural areas, vegetable gardens in the fields, various fruits (grapes, jujubes, apples, pears, cherries, plums, etc.) and fruits of forest trees and shrubs such as acorns, blackberries, and rosehips that grow naturally. It was observed that they gnaw on tree bark when they cannot find enough food. In the study by Yürümez and Ulutürk (2016), it was found that the primary dietary sources for porcupines included grains, fruits, vegetables, and cultivated crops. The nests of these animals were also found to be in close vicinity to the fields where watermelons were

grown (Yürümez and Ulutürk, 2016). Arslan reported in his study that there were roots in the stomach contents of porcupine and that, unlike the study of Kadhim (1997) the stomach contents did not contain any traces of animal remains (Arslan, 2008). Although it is a herbivorous animal that generally feeds on tuber and bulbous plants and both natural and agricultural products such as grain, its diet also includes insects and small vertebrate animals such as birds and mice (Albayrak, 2022). Khan et al., (2022) stated that 31 plant species were identified from the feces of the Indian Crested Porcupine in their research; these are categorized as vegetables (8), fruits (6), trees (5), cereal grains (3), herbs (3) shrubs (2) grasses (2) and flowering plants (2).

The research conducted by Khan et al., (2022) indicated that the stem constitutes the primary dietary component for the Indian crested porcupine. Following this, seeds were identified as the second most consumed part, while underground plant parts were also recognized as significant dietary items across various seasons in the present study. Roots, rhizomes, and tubers are noted for their high carbohydrate content (Alkon and Saltz, 1985; Lovari et al., 2013). Additionally, Mori et al., (2017) described the inclusion of roots and tubers in the diet of the Indian crested porcupine throughout the year in both Türkiye and central Italy.

In our study, it was observed that porcupines did not leave their burrows during the day or full moon phases and windy nights. Similar to our results, Fattorini and Pokharel (2012), reported that a clear tendency of *H. indica* to avoid moonlight and no diurnal activity was recorded. In this study the times when the porcupine left and returned to the cave were determined as 10:16 pm. in 19 September 2024 and 04:50 am. in 20 September 2024, respectively (Figure 4). Similar to our study results, Ngcobo et al (2019) stated that porcupines are nocturnal and are on the move from sunset to sunrise in summer 07:00 pm.- 04:00 am. and in winter between 05:00 pm.-08:00 am. (Fattorini and Pokharel, 2012). In only one recording, the porcupine was recorded leaving the cave and came back entering the cave by passing in front of the camera, at the mouth of the cave. On other days, although there were two different cameras installed to see the mouth of the cave, no recordings were made of the porcupine leaving and returning to the nest on the same day. When the porcupine entered the cave, it may have passed through the rocks at the cave entrance, which may not have triggered the camera sensor and prevented it from starting to record. The reason for the record of exiting the nest but not entering the nest on the same day could be due to a technical problem or the camera trap not working, as reported by Özkazanç (2018), or there could be another secret entrance to the nest. The fact that the cave where the porcupine lives is frequently visited by treasure hunters and that the area right in front of the cave is used as a picnic and resting place by poachers at night strengthens the idea that the porcupine may be disturbed and may reach the cave through a second entrance.



Figure 4. Time when the *H. indica* leave the nest 10:16 pm. in 19 September 2024 and back to nest 04:50 am. in 20 September 2024.

Şekil 4. Eylül 2024'te *H. indica*'nın yuvadan çıkış saati 10:16 gece 19 Eylül 2024 ve yuvaya dönüş saati 04:50 sabah 20 Eylül 2024.

Fattorini and Pokharel, (2012), made the following comment on the porcupine's temporal activity patterns, activity patterns and home range size for out-of-nest time vary with distance from food and food abundance: As the proximity to food and the abundance of food increases, the time spent outside the nest

will decrease, similarly, as the abundance of food and the nutritional quality of the food increase, home range size will decrease. Based on the work of Fattorini and Pokheral, (2012), we can say according to Figure 4, when the time spent by the porcupine outside the nest is taken into consideration, it can be said that porcupine meets its nutritional needs with dry and irrigated agricultural products and wild plants in its habitat and returns to its safe nest in a short time. Similarly, Sonnino (1998) reported that in agricultural areas characterized by high environmental diversity, these porcupines exhibited smaller home ranges.

Other wild animals that share the habitat of the *H. indica* in our study area are as follows. Domestic small and large cattle, horses, donkeys, dogs and cats that come to drink water from the pond next to the cave where the *H. indica* nests, as well as wild animal species such as water turtles, little egrets, purple herons, coots, rabbits, martens, badgers, foxes, jackals, wolves, wild boars and deer coming down from Akdağ have been observed and recorded both directly and indirectly (Figure 5). It has been determined that carnivorous species both benefit from the water directly and use it to hunt other animals that live in the pond (worms, snails, frogs, fish and water turtles, etc.) or come to the lake to drink water.



Figure 5. Recorded in location observations a) Stone marten, b) Jackal, c) Wolf feces.
Şekil 5. Lokasyon gözlemlerinde kaydedilen a) Kaya sansarı, b) Çakal, c) Kurt dışkı.

It is also seen in the camera trap video footage that the porcupine shares the cave it uses as its nest with many mice and bats. Camera trap images of cats, martens and foxes entering the cave to hunt mice and bats were recorded (Figure 6). Similar to our findings, Siler (2023), who observed the animal presence in Akçatepe Cave, reported that both bats (Chiroptera) and porcupines (*H. indica*) used the cave as a habitat.



Figure 6. Other mammals caught in the camera trap in the porcupine cave a) Mouse, b) Fox.
Şekil 6. Oklu kirpi mağarasında fotokapana yakalanan diğer memelilerden a) Fare, b) Tilki.

During the observations made in the field both day and night, poachers were encountered. Many cartridges were found next to the pond (Figure 7). It is estimated that they hunted wild animals that came to the pond to drink water.



Figure 7. a) Catriges near pond, b) Hunted wild boar.

Şekil 7. a) Gölet kenarında bulunan fişekler, b) Avlanmış yaban domuzu.

Although the nest of the target species is known, it has not been caught in order not to disturb it. In case of capture, its health status and genetic relationship with other porcupines registered in our country can be explained through morphological (gender, weight) and physiological (blood, DNA) tests. Arslan (2006) performed karyotypic analyzes on blood samples taken from porcupines in İçel and Adana regions and give the diploid number of chromosomes is $2n=66$ at *H. indica*. However, for the animal not to be stressed and to continue its existence and generation, we are currently researching its daily, monthly and annual behavioral states, circadian rhythms, habitat and ecology through direct and indirect observations.

It has been determined that the cave where the porcupine nests arouses curiosity among people and that the species is disturbed by frequent visits. At the same time, picnicking in the wetland right next to the cave and illegal hunting increase the risk of human-animal encounters and seriously negatively affect the species' ability to safely survive and reproduce in the area. When local people near the porcupine habitat were interviewed, many of them stated that they had no knowledge of the species and had not observed any damage to their fields or crops. The local people were informed that the species was harmless and needed to be protected for biodiversity.

Although some publications state that arrowed porcupines are harmful to agricultural areas (İnaç et al., 2011; Khan et al., 2022), this is not the case for our study area. With human intervention (agriculture and some forestry practices), as areas become more uniform, wild animals are drawn to areas that are suitable for them and become trapped in these areas. Due to the decrease in suitable areas to meet the needs of wild animals, human and wild animal encounters and thus conflicts of interest (crop/food) are increasing. Animals are forced to approach agricultural areas or settlements for their needs such as food and water. Enclosing agricultural areas with wire fences prevents wild animal damage. The most appropriate way to prevent wild animals from entering agricultural areas is to ensure that wild animals remain in their natural habitats by applying methods such as planting and planting plant species that have a positive relationship with wild animals in natural areas and creating water resources. However, these practices can be realized through renovation and rehabilitation works that will not disrupt the natural structure of the area.

CONCLUSION

H. indica is the IUCN Red List at the international level and is listed as Endangered category (EN) in Türkiye. Conservation measures can be implemented more effectively if the distribution areas of the species and the ecological characteristics of these areas are known. In this study, the presence of the species has been proven in Afyonkarahisar province. For conservation in its own habitat where it naturally occurs, habitat information, wild animal/domestic animal species with which it shares its habitat and findings about human impacts are presented. The study compares the fossil findings related to the species with the areas where it lives today and provides background data to create distribution maps realized as a result of climate, human, etc. factors over time. DNA information gained from porcupines living in different locations to be obtained from the species, studies on kinship levels can be carried out. However, to carry

out all these studies, the existence of the species must first be proven and it must be protected in the area where it is found.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest regarding this article.

DECLARATION OF AUTHOR CONTRIBUTION

The ŞA designed and laid out the field work, collected data and writing the original draft and review and editing.

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