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## New records of the Anatolian leopard (*Panthera pardus tulliana* Valenciennes 1856) in Türkiye

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### Abstract

In this study, new records of the Anatolian leopard obtained in Türkiye after 2004 were presented. Many field studies were carried out in 37 provinces in Türkiye, from Kars in the far east to Edirne in the west, from Antalya in the south to Kastamonu in the north. Until 2013, footprints of the leopard were primarily used to indicate leopard presence, and in later studies, camera traps and thermal cameras were also used in addition to the footprints. As a result of the study, a total of 84 new records from 54 different localities were obtained from all regions except the Marmara region in Northwestern Türkiye. Most of the records were obtained from Northeastern (NE) Türkiye, where most field studies were carried out. A total of 84 new records are listed as follows; 66 footprints, 4 camera trap photos, 1 camera trap video, 3 thermal camera videos, 2 cell phone videos, 1 cell phone photo, 4 locals seen, 1 full skin, 1 death, and 1 fatal attack.

**Keywords:** *Anatolian leopard*, *Panthera pardus tulliana*, *footprint*, *camera trap*, *thermal camera*

### Introduction

Although populations have become fragmented, leopards still occur throughout Africa with the exception of the Sahara Desert, from the Arabian Peninsula to Türkiye and across the southern half of Asia, and north through Eastern China to the land bordering the Amur River (Richardson 1992). *P. p. tulliana* subspecies, living and identified in 1856 in Türkiye, was incorrectly defined under *P. p. saxicolor* subspecies described in 1927 without any analysis by Miththapala et al. (1996). However, Kitchener et al. (2017) decided to collect these two subspecies that have the same characteristics under the name of *P. p. tulliana*. The number of subspecies of leopard living in the world is stated as eight in total in the taxonomic revision of the Felidae family (Kitchener et al. 2017). Also, Kitchener et al. (2017) stated that *P. p. tulliana* (Valenciennes 1856) included *P. p. ciscaucasica* (Satunin 1914) as well as *P. p. saxicolor* (Pocock 1927). The subspecies

of leopard living in Türkiye is the Anatolian leopard (*P. p. tulliana* Valenciennes 1856) (Kumerloeve 1956; Borner 1977; Kitchener et al. 2017; Sarı et al. 2020).

In Türkiye, the status of leopards has been unclear. There are records from at least 1879, but records have been rare since the 1960's. Most of the twentieth century data on leopards in west, south, and southeast Anatolia has been obtained from Kumerloeve in Türkiye, and the total number of leopards in Anatolia was estimated to be 13–14 individuals in 1974 (Gürpınar 1974) and 15–23 individuals in 1978 (Goodwin & Holloway 1978). The records are from Amanos Mountain, Osmaniye, in 1879 (Kumerloeve 1975), Gündoğmuş/Antalya, in 1925 (Anadolu Panteri 2017), Milas/Muğla, in 1928 (Anonymous 1953), Hatıpkışla Village/Aydın, in 1928 (Anonymous 1936), Karacahisar Village/Balıkesir, in 1928 (Anadolu Panteri 2017), Söke/Aydın, in 1936

(Anonymous 1936), Seferihisar/İzmir, in 1936 (Anonymous 1936), Kovada Lake/Isparta, in 1939 (Anadolu Panteri 2017), Kadirli/Osmaniye, in 1940 (Kumerloeve 1956), Çine/Aydın, in 1940 (Kayaöz 1999), Urla/İzmir, in 1942 (Anonymous 1946), Tatvan/Bitlis, in 1945 (Anadolu Panteri 2017), Kaş/Antalya, in 1945 (Anadolu Panteri 2017), Çine/Aydın, in 1948 (Üstay 2008), Söke/Aydın, in 1949 (Anadolu Panteri 2017), Salihli/Manisa, in 1950 (Anadolu Panteri 2017), Selçuk/İzmir, in 1950 (Üstay 2008), Ödemiş/İzmir, in 1950 (Üstay 2008), Selçuk/İzmir, in 1950, 1951 (Üstay 2008), Kuşadası/Aydın, in 1952 (Kayaöz 1999), Dursunbey/Balıkesir, in 1952 (Anadolu Panteri 2017), Doğubayazıt/Ağrı, in 1955 (Anadolu Panteri 2017), Alanya/Antalya, in 1955 (Kumerloeve 1971), Marmaris/Muğla, in 1955 (Üstay 2008), Köyceğiz/Muğla, in 1955 (Üstay 2008), Hopa, Artvin, İspir, Erzurum (Kumerloeve 1956; Huş 1967), Abant Lake/Bolu, in 1967 (Gürpınar 1974), Karakale Village/Kars, in 1970 (Baytop 1973), Erüh/Siirt, in 1971 (Borner 1977), Ağrı Mountain in 1972 (Baytop 1973), Çatacık/Eskişehir, in 1972 (Gürpınar 1974), Samandağ/Hatay, in 1974 (Borner 1977), Beypazarı/Ankara, in 1974 (Gürpınar 1974), Hakkari (Kumerloeve 1975), Çine/Aydın, in 1975 (Borner 1977), Altınova, Korucutepe, Norşuntepe, Elazığ (Kumerloeve 1980), Kaş/Antalya, in 1989 (De Marinis & Masseti 2009), Yusufeli, Artvin, in 1990 (Başkaya 2003), Alanya, Antalya, in 1991 (De Marinis & Masseti 2009), Güllük Mountain, Antalya, in 1992 (Ullrich & Riffel 1993), Aşağı Kavron Yayla, Yukarı Kavron Yayla, Rize, in 1995, Aşağı Ceymakçur Yayla, Dübedüzü, Adsız Göl, Yedigöl, Rize, in 1996, Çitrik Gölü, Ceymakçur Hill, Yukarı Kaçkar Yayla, Karagöl, Rize in 1997, Eğribakacak Hill, Çukunet Yayla, Artvin, in 1997, Kito Yayla, Rize, in 1998, Cevizli Yayla, Artvin, in 1999, Sukavuşumu/Yusufeli/Artvin, in 1999, Çamdalı Yayla, Artvin, in 2000, Dilberdüzü, Rize, in 2001 (Başkaya & Bilgili 2004), Tatvan/Bitlis, in 2008 (Toyran 2018), Erüh, Siirt, in 2010 (NTV 2017), Azdavay/Kastamonu, in 2011 (Başkaya et al. 2011), Çat/Erzurum, in 2012 (Başkaya et al. 2012; Sarı 2018; Sarı et al. 2020), Çamoluk, Giresun, in 2013, 2014, 2015, 2016 (Arpacık 2018; Sarı 2018; Sarı et al. 2020), Şiran, Gümüşhane, in 2013 (Sarı 2018; Sarı et al. 2020), Kağızman, Kars, in 2013 (Sarı 2018; Sarı et al. 2020), Posof, Ardahan, in 2013 (Sarı 2018; Sarı et al. 2020), Yedigöller, Sırakonaklar, İspir, Erzurum, in 2013, 2014, 2016, 2017 (Arpacık 2018), Çaykara, Trabzon, in 2014, 2016 (Arpacık 2018), Şiran, Gümüşhane, in 2014, 2015 (Arpacık 2018),

Çaykara, Trabzon, in 2014 (Sarı 2018; Sarı et al. 2020), İkizdere, Rize, in 2013, 2017 (Sarı 2018; Sarı et al. 2020), Çınar/Diyarbakır, in 2013 (Anadolu Ajansı 2017), Yusufeli, Artvin, in 2014, 2015 (Sarı 2018; Sarı et al. 2020), Su Kavuşumu, Yusufeli, Artvin, in 2014, 2015, 2016, 2017 (Arpacık 2018), Çamlıhemşin, Rize, in 2014, 2015 (Arpacık 2018), Yedisu/Bingöl, in 2015 (Sarı 2018; Sarı et al. 2020), İkizdere, Rize, in 2016 (Arpacık 2018), Şebinkarahisar/Giresun, in 2016 (Arpacık 2018; Sarı 2018), Üzümlü/Erzincan, in 2016, 2017 (Sarı 2018; Sarı et al. 2020), Silopi/Şırnak, in 2018 (Karatat et al. 2021) and Antalya, in 2022 (Anonymous 2022).

After a leopard was shot in Ankara in 1974, however, there were many publications about the extinction of the leopard in the country, while only a few authors stated that the leopard was not extinct (Gürpınar 1974; Başkaya 2003; Başkaya & Bilgili 2004; Arpacık 2018; Sarı 2018; Sarı et al. 2020). Also, Can (2004) stated that the leopard shot in 1974 was probably an escaped animal from the Ankara Zoo, and that there is no hard evidence for the presence of leopards in the Turkish part of the Caucasus eco-region. Lukarevsky et al. (2007) did not confirm the presence of leopards in Northeastern (NE) Türkiye during a short field trip. Also, Lukarevsky et al. (2007) and Zimmerman et al. (2007) stated that the habitat in NE and Eastern Türkiye would, however, be suitable for the species, and the area remains interesting for further surveys – mainly the regions bordering Armenia and Iran – but more decisive and robust monitoring methods will be needed. Spassov et al. (2016) visited the region of the Eastern Black Sea for only 1 week between 18 and 26 August 2015 and did not confirm the presence of leopards during this short field trip along the roads.

There have, however, also been reports of leopard presence in Türkiye. For example, Başkaya and Bilgili (2004) found leopard footprints in 16 different locations in the Eastern Black Sea Mountains, where no records of leopards have been found since 1956. Arpacık (2018), Sarı (2018) and Sarı et al. (2020) presented presence data of the Anatolian leopard in Northeastern Anatolia including the Eastern Black Sea Mountains. To clarify leopard status in Türkiye, this paper summarizes existing records of the Anatolian leopard in the whole of Türkiye between 2004 and 2022 except for Arpacık (2018), Sarı (2018), Sarı et al. (2020), Karatat et al. (2021) and Anonymous (2022) and presents new data from trail cameras and thermal cameras confirming leopard presence.

## Materials and methods

From 2004 to 2021, many field studies of 2–10 days were conducted focusing on the Anatolian leopard in all regions throughout Türkiye including Thrace and most extensively in NE Türkiye. We were also able to obtain evidence for leopards during the field studies on different subjects. Field studies were carried out in the cities of Edirne, Kırklareli, Istanbul, Balıkesir, Bursa in Marmara Region, Aydın, Muğla, Kütahya, Denizli in Aegean Region, Antalya, Mersin, Adana, Hatay, Kahramanmaraş in Mediterranean Region, Konya, Ankara, Eskişehir, Çankırı, Sivas in Central Anatolia, Bolu, Kastamonu, Çorum, Sinop, Tokat, Giresun, Trabzon, Rize, Gümüşhane, Artvin in Black Sea, Ardahan, Erzurum, Kars, Erzincan, Bingöl, Tunceli in Eastern Anatolia, and Şanlıurfa and Diyarbakır in Southeastern Anatolia.

While the Eurasian lynx (*Lynx lynx*) footprints were rarely encountered in studies carried out in Thrace, no sign of the leopard was detected. No signs were found in the provinces of Istanbul, Balıkesir, Bursa in Marmara; Aydın and Muğla in the coastal Aegean; Adana, Hatay, Kahramanmaraş in the Mediterranean; Konya, Ankara, Eskişehir in the Central Anatolia; Bolu, Sinop in the Western Black Sea; Şanlıurfa and Diyarbakır in the Southeast. Because the most suitable habitat for leopards is in NE Türkiye, this region had the highest amount of fieldwork followed by Western Black Sea, Marmara, Western Anatolia, Central Anatolia, Mediterranean and Southeastern Anatolia, respectively. For example, a total of 20 days of field studies was carried out in Aydın, Aegean region; 30 days in Antalya in the Mediterranean; 15 days in Bolu, 40 days in Sinop, 100 days in Kastamonu in the Western Black Sea; 25 days in Bingöl in the eastern; 150 days in Giresun on the Eastern Black Sea; only 5 days in Diyarbakır in the southeast.

Observations were carried out in many different habitats such as forest, high altitude forest, agricultural areas, river banks, rocky areas, steppe, subalpine and alpine zones in areas where there had been little human intervention. Direct and indirect observation methods were used during the field studies. Binoculars (10 × 42) and telescopes (20–60x) were used to scan likely habitat, and during field studies from 2004 to 2013, the footprints of the leopard were recorded as indicating leopard presence. After 2013, camera trap images and thermal camera images were also used in addition to direct observations and footprints. In addition, all potential leopard signs such as trails, scat, scratching, scraping, urine, food remains were recorded in all field

studies, but not considered as definitive evidence for now. Because the samples identified as leopard hair in microscopic examinations and leopard feces in morphological examinations have not been evaluated as definitive evidence since they have not been subjected to DNA analysis yet. We also recorded and evaluated leopard skin from studying areas, reports from local people, seen notice, shooting and sighting records in Türkiye over recent years.

In areas where leopards had and had not been reported, two to four people scanned for their sign along a transect 20–50 meters apart, depending on the seasonal terrain. Observations of tracks and signs, especially footprints, were used to determine the existence of leopard. We measured the width and length of the footprints with a ruler and noted all details of toe pads (finger) and hind pads (heel) as well as shapes and every characteristic in the footprints. The only other cat species' footprints to be confused with leopard in Türkiye is the Eurasian lynx. We differentiated leopard tracks from those of the Eurasian lynx based on size. Tracks of the Eurasian lynx are 4–7 cm long and 4.5–8 cm wide (Green 1991; Richardson 1992; Başkaya & Bilgili 2004; Van Maanen 2006; Sarı et al. 2020). We considered tracks larger than 9 cm in length and width to be of the Anatolian leopard.

Following the field scanning, we used camera traps to obtain photos and video images of leopard. Some of the camera-traps were placed along established leopard trails on ridge tops and in deep valleys and river ecosystems to maximize capture probabilities over a large area only in Northeastern Anatolia. Trap locations were selected based on cues such as footprints, scats, scrapes, scratch marks. We also placed camera traps based on the design described by Karanth (1995) and York et al. (2001), side by side at randomly chosen trapping sites. We also obtained thermal video camera images taken during field scanning activities carried out by the Turkish security forces within the sampling areas and interviewed hunters and local people including shepherds about leopard presence.

## Results

Since 2004, 84 new records were obtained from 54 different localities from all regions in Türkiye except Marmara and the coastal Aegean. These 84 new records were determined as a result of field studies and confirmed notices. Footprint records were obtained from 50 of the 54 localities. Of the 50 localities, 52 records were obtained based on only footprints, and 14 of them were based on both confirmed notices and footprints. Localities without

footprints are Kütahya, Şırnak and Sivas, where confirmed records were obtained and no field studies were conducted. The new records obtained were, respectively, 66 footprints, 4 camera trap photos, 4 seen by local people, 3 thermal camera videos, 2 cell phone videos, 1 camera trap videos, 1 cell phone photo, 1 full skin, 1 kill and 1 fatal attack. These new records were obtained from a wide geographical area in Türkiye, from Kars in the east to Kütahya and Denizli that are 1200 km away from the Inner Aegean in the west, from Antalya and Mersin in the south, to Kastamonu, approximately 600 km to the north. The distribution of both literature and new records of the Anatolian leopard are given on the map (Figure 1).

A total of 54 different record localities have been obtained from a total of 20 provinces. These provinces were 19 out of 37 provinces where field studies were carried out and in addition, Şırnak province where thermal camera records were obtained. Footprint records were also obtained from 12 localities where confirmed notices were obtained, except Kütahya/Çerte, Sivas/Sızır and Şırnak. In 9 provinces where unconfirmed notices were received, new records were obtained in different ways from those except Afyonkarahisar and Çorum.

Most of the records were obtained from NE Türkiye, where most field studies were carried out

the most. No records of leopards could be obtained in five provinces in the Marmara region where field studies were conducted and in two provinces in the Southeastern Anatolia where little field study was conducted. However, thermal camera recording was obtained from Şırnak province, where no field study was conducted in the Southeastern Anatolia. Of the 84 newly confirmed records, 71 of them were obtained during field studies as footprints and camera trap records (Table I).

The remaining 13 new records were confirmed notices, consisting of those seen by local people, full skin, cell phone photo or video taken by local people, thermal camera video, fatal attack by leopard and leopards killed by locals (Table II). Footprints were determined in 50 of the 54 localities, excluding the provinces of Kütahya/Çerte, Sivas/Sızır and Şırnak (Tables I and II).

Unconfirmed notices from local people, consisting of 9 seen by local people, and 2 killed by local people are given in Table III.

Although most of the records obtained from field studies were footprint records, 3 camera trap photos and 1 camera trap video from Giresun and one camera trap photo from Artvin province were also recorded. In addition, the confirmed records obtained from local people, including 2 thermal cameras, 2 cell phone videos, and 1 cell phone photo recordings, are other camera records.

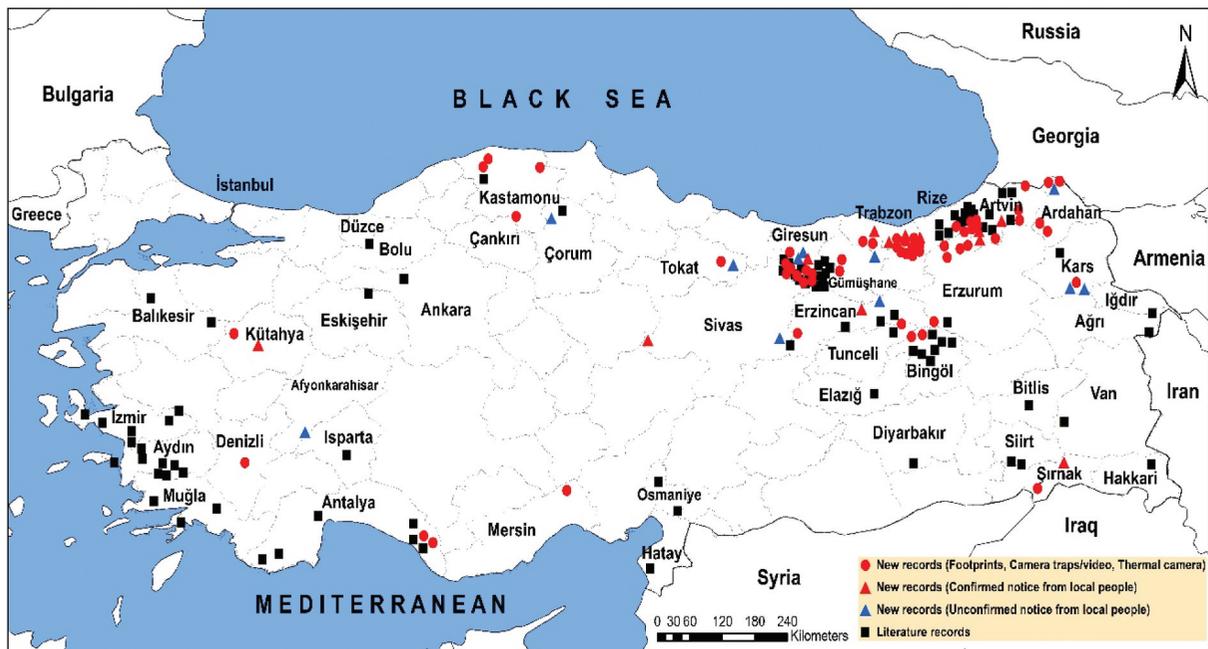


Figure 1. Localities of the literature and new records of the Anatolian leopard in Türkiye.

Table I. Location of the Anatolian leopard records [Record type: Footprints, Camera Trap Photos (CTP) and Camera Trap Video (CTV)].

No	Locality	Altitude (m)	Date	Record Type
1	Ardahan, Bağdaşen	2300	9 July 2005	Footprint
2	Ardahan, Posof, Sarıçiçek	2000	10 September 2005	Footprint
3	Ardahan, Yeniköy	2100	20 August 2006	Footprint
4	Erzurum, İspir, Karakale	1600	25 August 2008	Footprint
5	Bingöl, Kiğı, Topraklık	1400	13 March 2009	Footprint
6	Antalya, Alanya, Bucak	700	24 March 2009	Footprint
7	Erzurum, İspir, Sırakonak	1150	26 May 2009	Footprint
8	Kastamonu, Şenpazar, Fırincık	1200	17 July 2009	Footprint
9	Denizli, Honaz Dağı National Park	1500	26 July 2009	Footprint
10	Ardahan, Posof, Erim	1700	9 August 2009	Footprint
11	Gümüşhane, Artabel Gölleri Nature Park	2300	15 November 2009	Footprint
12	Antalya, Alanya Çeltek	800	6 March 2010	Footprint
13	Trabzon, Maçka, Akarsu, Tekmezar	1500	2 April 2010	Footprint
14	Kastamonu, Azdavay, Zümürüt	1300	20 June 2010	Footprint
15	Erzurum, İspir, Özlüce	1500	20 September 2010	Footprint
16	Çankırı, Ilgaz, Çomar	1600	10 July 2011	Footprint
17	Kastamonu, Taşköprü, Yarılgöz Mt.	1400	28 August 2011	Footprint
18	Erzincan, İliç, Kayacık	900	19 April 2012	Footprint
19	Giresun, Şebinkarahisar, Eskine Yaylası	1900	15 May 2012	Footprint
20	Kars, Kağızman, Madur Mt.	1500	12 August 2012	Footprint
21	Kütahya, Simav, İhlamur	1100	19 October 2012	Footprint
22	Erzurum, Çat, Kumaşlı	1800	20 October 2012	Footprint
23	Mersin, Kadıncık Wildlife Res. Area	1000	22 December 2012	Footprint
24	Artvin, Yusufeli, İşhan	1500	28 December 2012	Footprint
25	Trabzon, Uzungöl, Dorinori Mezrası	1750	12 May 2013	Footprint
26	Artvin, Meydancık, Taşköprü Yaylası	2000	22 May 2013	Footprint
27	Rize, Çamlıhemşin, Huser Yaylası	2400	5 November 2013	Footprint
28	Trabzon, Çaykara, Demirli	1400	30 June 2014	Footprint
29	Gümüşhane, Şiran, Yukarı Kulaca	2000	23 November 2014	Footprint
30	Giresun, Dereli, Aksu	1500	28 June 2015	Footprint
31	Artvin, Ardanuç, Meşeköy	1500	5 July 2015	Footprint
32	Tokat, Reşadiye, Çakmak	600	28 August 2016	Footprint
33	Artvin, Yusufeli, Hastaf Yaylası	2400	6 August 2017	Footprint
34	Artvin, Ardanuç, Meşeköy	1500	10 September 2017	Footprint
35	Trabzon, Uzungöl, Filah	1050	15 December 2017	Footprint
36	Giresun, Çamoluk, Gürçalı	1400	4 February 2018	Footprint, CTP
37	Trabzon, Maçka, Taşköprü Yaylası	1600	22 April 2018	Footprint
38	Trabzon, Köprübaşı, Kahvedüzü Yaylası	1000	10 June 2018	Footprint
39	Giresun, Çamoluk, Gürçalı	1300	25 September 2018	Footprint, CTV
40	Erzurum, İspir, Yedigöller	3200	14 October 2018	Footprint
41	Bingöl, Yedisu	1500	5 July 2019	Footprint
42	Trabzon, Çaykara, Uzuntarla Mezrası	2000	7 July 2019	Footprint
43	Giresun, Çamoluk, Gürçalı	1200	5 August 2019	Footprint, CTP
44	Giresun, Şebinkarahisar, Tepeltepe	1200	31 August 2019	Footprint
45	Giresun, Çamoluk, Gürçalı	1300	4 April 2020	Footprint, CTP
46	Giresun, Şebinkarahisar, Yakınca	900	8 June 2020	Footprint
47	Trabzon, Çaykara, Celepçayırı Mezrası	2050	4 July 2020	Footprint

(Continued)

Table I. (Continued).

No	Locality	Altitude (m)	Date	Record Type
48	Tunceli, Pülümür, Üçdam	1400	19 July 2020	Footprint
49	Giresun, Çamoluk Gürçalı	1350	5 December 2020	Footprint
50	Trabzon, Uzungöl	1150	20 December 2020	Footprint
51	Artvin, Yusufeli, Demirdöven	2000	26 December 2020	Footprint
52	Trabzon, Uzungöl	1150	13 January 2021	Footprint
53	Trabzon, Çaykara, Multat Yaylası	1600	13 January 2021	Footprint
54	Artvin, Yusufeli, Demirdöven	2000	12 February 2021	Footprint
55	Artvin, Yusufeli, Demirdöven	1800	15 February 2021	Footprint, CTP
56	Artvin, Yusufeli, Demirdöven	1700	13 March 2021	Footprint
57	Trabzon, Uzungöl	1150	3 July 2021	Footprint

Table II. Confirmed notices of the leopard from local people and Turkish Security Forces [Record type: Footprints (FP), Cell phone photo (CPP) and Cell phone video (CPV), Thermal camera video (TCV)].

No	Locality	Altitude (m)	Date	Record Type
1	Sivas, Gemerek, Sızır	1500	1993	Fatal attack
2	Artvin, Yusufeli, Kılıçkaya	1000	17 May 2007	Full skin and FP
3	Giresun, Şebinkarahisar, Eskine Yaylası	1900	2013	Seen by locals and FP
4	Artvin, Ardanuç, Meşeköy	1500	5 March 2014	Seen by locals and FP
5	Trabzon, Çaykara, Uzuntarla Mezrası	2000	26 June 2016	Killed by locals and FP
6	Şirnak	~1000	17 August 2017	TCV
7	Trabzon, Uzungöl, Filah	1050	10 December 2017	Seen by locals and FP
8	Erzincan	~1200	29 March 2019	TCV and FP
9	Kütahya, Emet, Çerte	1100	5 May 2019	CPV taken by locals
10	Trabzon, Maçka, Yazlık	1200	4 November 2019	Seen by locals and FP
11	Trabzon, Uzungöl	1150	2 July 2020	CPV taken by locals and FP
12	Artvin, Yusufeli, Demirdöven	1700	24 December 2020	CPP taken by locals and FP
13	Şirnak, Cudi Dağı, Habis Tepe	~2100	17 November 2021	TCV

Table III. Unconfirmed notices of the leopard from local people.

No	Locality	Altitude (m)	Date	Record Type
1	Ardahan, Posof, Sesödile Mt.	2100	1966	Seen by locals
2	Sivas, Divriği	1500	1980	Killed by locals
3	Kars, Kağızman, Çemçe Mt.	1800	2005	Seen by locals
4	Giresun, Şebinkarahisar, Asarcık	1600	2005	Seen by locals
5	Erzincan, Çayırılı, Başköy	1900	2010	Seen by locals
6	Kars, Kağızman, Madur Mt, Görecek	1700	2010	Seen by locals
7	Afyonkarahisar, Dinar, Eldere	1000	2010	Seen by locals
8	Giresun, Şebinkarahisar, Şaplıca	1600	2013	Seen by locals
9	Tokat, Reşadiye, Altıparmak	700	20 May 2014	Seen by locals
10	Çorum, Kargı, Abdullah	1500	20 October 2015	Seen by locals
11	Gümüşhane, Camiboğazı Yaylası	2300	5 September 2020	Killed by locals

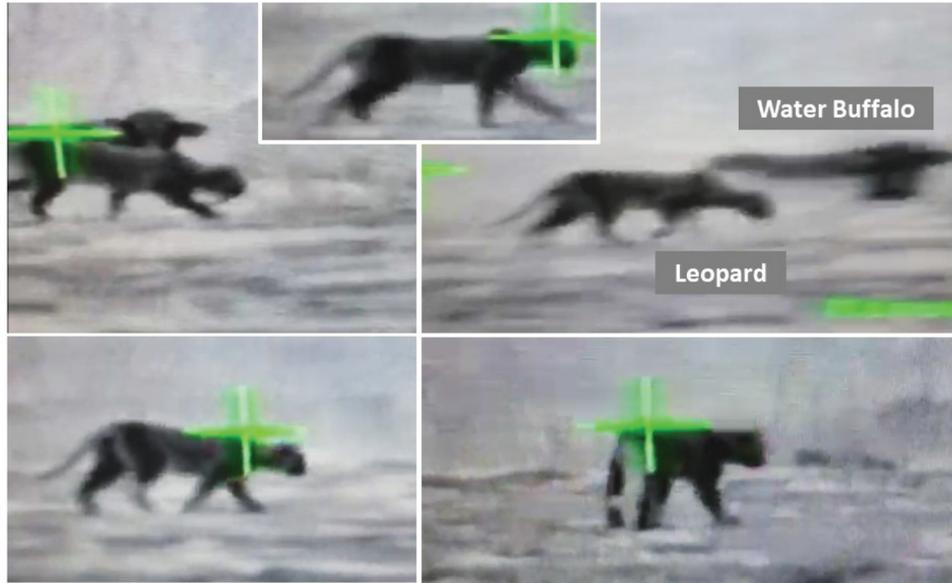


Figure 2. Screenshots taken from the thermal camera video of the leopard in Şırnak.

We obtained three thermal camera videos recorded by Turkish security forces. In the one recorded from Şırnak in 2017, the leopard's distance was about 107 m to the thermal camera. The screenshots taken from the thermal camera video have the leopard walking alongside a water buffalo with the leopard's body structure such as body length, shoulder height and tail are clearly visible (Figure 2).

Another thermal video obtained by Turkish security forces was recorded in Erzincan provinces in 2019. The leopard was about 200 m away from the thermal camera (Figure 3), and in the screenshots taken from the thermal camera video, the body structure, tail and neck of the leopard can be clearly seen. In the original video recording, the body structure and characteristic movements of the leopard can be distinguished more clearly.

The last thermal video obtained from Turkish security forces was recorded in Şırnak provinces from Cudi mountain (Habis Tepe) in November 2021. The leopard's distance from the camera was about 50 m (Figure 4). In these screenshots taken from the thermal camera video, the body structure, tail, and rosettes of the leopard can be clearly seen. The sex of the recorded leopard is difficult to determine as the testicles are not clearly visible.

In addition to the images, 66 footprints above 9 cm in diameter belong to the Anatolian leopard were obtained different times from all study areas given in Tables I and II (Figure 5).

Besides these, there was one full skin (Figure 6), one kill, and one fatal attack record among the confirmed records obtained from local people.

One of the most interesting records here was a fatal attack in Sivas province in 1993, long before 2004. This fatal attack information was given by the general practitioner (today Surgeon Prof), who took part in the treatment process of a middle-aged male who was treated for a long time due to serious wounds and regained his health.

## Discussion

There are many records showing that leopards have lived in a large part of Türkiye from past to present. Especially in publications published after 1990, leopard records came from the Eastern Black Sea, Eastern Anatolia, Southeastern, Western Black Sea and Mediterranean Regions (Ullrich & Riffel 1993; Kayaöz 1999; Başkaya 2003; Başkaya & Bilgili 2004; Üstay 2008; De Marinis & Masseti 2009; Başkaya et al. 2011, 2012; Anadolu Panteri 2017; Anadolu Ajansı 2017; Arpacık 2018; Sarı 2018; Toyran 2018; Sarı et al. 2020). Despite this, there were some who claimed that there is no hard evidence that the leopard was still present in Türkiye (Can 2004; Breitenmoser et al. 2010). Furthermore, Can (2004) claimed that the leopard did not live in the north as well and that the records in Başkaya and Bilgili (2004) could be lynx or something else. Similarly, Lukarevsky et al. (2007) did not confirm the presence of leopards in NE Anatolia. However, in the same year, a team including

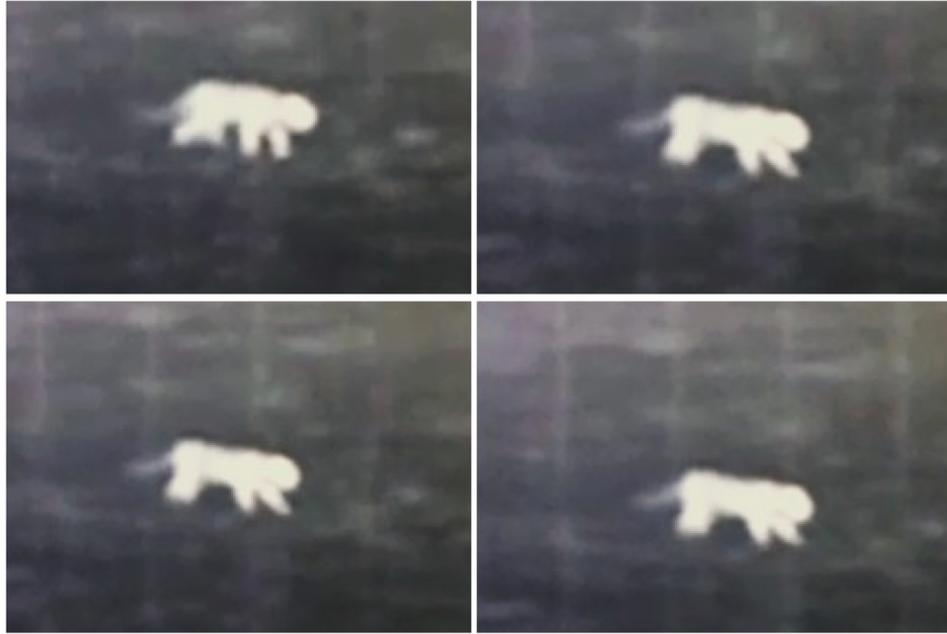


Figure 3. Screenshots taken from the thermal camera video of the leopard in Erzincan.



Figure 4. Screenshots taken from the thermal camera video of the leopard in Şırnak.

Lukarevsky et al. (2007) stated that NE Türkiye is the potential habitat of the leopard (Zimmerman et al. 2007). Khorozyan (2008) stated that leopards in Türkiye are probably transboundary migrants, exists in a small area bordering Southeastern and Northeastern Türkiye. In this study, however, we confirmed leopard presence from trail camera photos, thermal camera footage, cell phone photos, footprints as well as leopards killed by locals, primarily in

Northeastern Türkiye but also many other areas except Thrace.

Başkaya and Bilgili (2004), Arpacık (2018), Sarı (2018) and Sarı et al. (2020) stated that the leopard is found in NE Türkiye. Many records, mostly new, were obtained in almost all localities in 9 provinces where leopard was recorded from NE Türkiye by Arpacık (2018), Sarı (2018) and Sarı et al. (2020). In the western part of Türkiye, where more

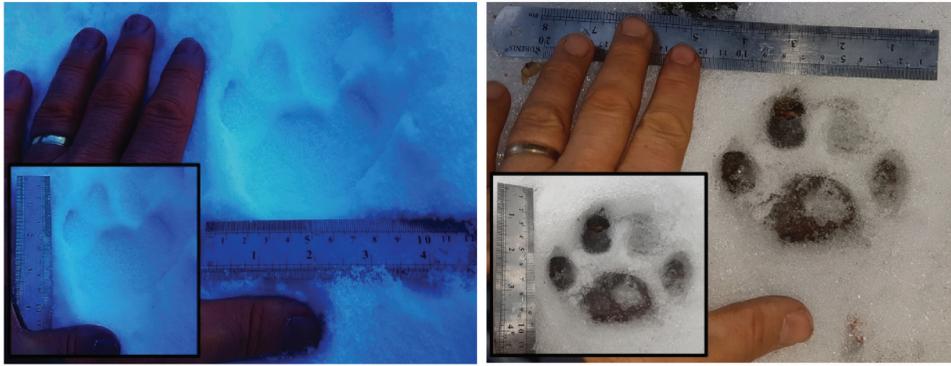


Figure 5. Two different leopard footprints with ruler on the snow (Photos: Şağdan BAŞKAYA).



Figure 6. Full skin of the leopard from Kılıçkaya/Yusufeli/Artvin in 2007 (Photos: Ebru Başkaya).

fieldwork has been done in number and days, there are no records in the Thrace region. Footprints were found, however, in the inner Aegean and the Mediterranean, where less fieldwork was done. This situation suggests that the presence of the leopard in the Inner Aegean and the Mediterranean is much better than what has been detected. Here, the footprints found in dense forests in the Western Black Sea where it is very difficult to find footprints are also very valuable.

Our study also confirms the importance of border areas for leopards in Türkiye. The leopard was thought to exist only in the Southeastern tip of Türkiye in a narrow area bordering Iran and Iraq (Jacobson et al. 2016; Sanei et al. 2016; Khorozyan et al. 2017; Parchizadeh & Adibi 2019), and leopards are shown to be extant in a very narrow area just on the other side of the border in Nakhchivan and Armenia territories (Khorozyan et al. 2008, 2010, 2017; Jacobson et al. 2016). Also, Sanei et

al. (2020) indicates that the corridor from Iran to Azerbaijan and Armenia supports the presence of leopards in the Caucasus. However, all these studies consider that there are no leopards in Türkiye. In fact, the Caucasian populations in the north are likely to support each other with the transitions between Türkiye, Georgia, Armenia and Nakhichevan. Even in the north, it is highly likely that there is a connection between Türkiye, Georgia and Russia. It is natural that there are migrations in the border regions, but we believe that these migrations are also made mutually between countries. More data is necessary on transboundary leopard movements between countries, and our study shows the potential importance of thermal video footage from border security personnel.

Based on our records and field experience so far, although the leopard has decreased in the past years, it has never been extinct in many regions of Türkiye. Especially in the last 20–30 years, it seems to have increased considerably as a positive result of the increase in prey and consciousness level. There is a considerable number of leopards in the country, although the existence of the species in the country is disputed without fieldwork knowledge.

Despite many records, it was assumed by experts and government officials that the leopard disappeared in the country because they could not see the color photograph or video. Until now, our leopard projects in the whole country or in certain regions have not been supported by the state, as the leopard is believed to be extinct by almost all the experts and bureaucrats in the country. After the new records presented in this study, more detailed results can be obtained if the studies on leopard are supported.

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### Disclosure statement

No potential conflict of interest was reported by the authors.

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