BROWN BEAR (*URSUS ARCTOS*) POPULATION DENSITY IN THE EASTERN BLACK SEA MOUNTAINS IN TÜRKİYE

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Abstract. Brown bear (*Ursus arctos*) population density has not been determined so far in the Eastern Black Sea Mountains, Türkiye, where the most fatal attacks are experienced in the country. Therefore, in order to determine the bear population density, studies were carried out from 2008 to 2017 in 12 sampling sites with a total area of 900 km^2. Field studies were carried out in all sampling sites, in groups of 2-4 people, generally by establishing tented camps. In addition, 5 comprehensive inventory studies were conducted with groups of 10-30 people in 3 of these sampling sites. Direct and indirect counting methods were used together in all inventories in the sampling sites. Direct counts were performed using line counting, point counting, camera traps and thermal camera. Indirect counts are the recording of tracks and signs. As a result of the study, while the population density of bears in the sampling sites varied between 40-466 bears/1000 km^2, the average density was determined as 194 bears/1000 km^2. The population size of bears in the study area, which is approximately 28,000 km^2, was calculated as 5432 individuals, of which 3259 are adults and 2173 are cubs and yearlings.
Keywords: *bear inventory, point count, camera trap, thermal camera, footprint*

Introduction

The human-bear conflict is most intense in the Eastern Black Sea Region in Türkiye. As a result of these conflicts, many people are seriously injured, some of them experience permanent trauma, and some of them lose their lives. In addition, people also suffer significant economic losses. After the bear attacks in Türkiye between 2009-2021, it was determined that 31 people were killed and about 120 people were injured. Of these, 7 deaths and 30 serious injuries occurred in the Eastern Black Sea Region. The number of injuries here is very likely to be higher than detected.

Bears come into conflict with humans more or less in parallel with their population density wherever they live in the world. In total, 44 subpopulations of brown bear have been identified globally; most occur in the southern portions of their circumpolar distribution across the northern hemisphere (McLellan et al., 2008; Calvignac et al., 2009; Proctor et al., 2012). The total number of brown bears on earth is estimated to exceed 200000 (Lynch, 2021). It is stated that 123,869 bears live in Russia, where the most bears live (Swenson et al., 2000). Today the total number of brown bears in Europe is about 50000 bears (ca. 14000 outside Russia) within an area of more than

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2.5 million km^2 (800000 km^2 outside Russia) (Zedrosser et al., 2001). Bear populations in Europe are very scattered and their densities are very low. The Carpathians are home to the largest number of bears in Europe, with 8100 individuals (4455 adults) in an area of 122600 km^2. The population density of 6000 individuals living on 69000 km^2 in the Carpathian Mountains in Romania is 100-200 bears in 1000 km^2 (Servheen et al., 1999; Swenson et al., 2000; Ministry of Agriculture, Forestry and Rural Development - Ministry of Environment and Water Management -MAFRD-MEWM-, 2005). The local bear population has been reported to exceed 400 bears/1000 km^2 in the Dinaric mountains of Slovenia (Jerina et al., 2013).

In North America, there are 58000 bears (Lynch, 2021). In Kodiak Island, where they are most abundant in North America, a total of 3500 individuals (2400 adults older than 3 years of age) with an increasing trend live in an area of 9311 km^2 (Van Daele et al., 2012). They have high reproductive rates (Smith and Van Daele, 1991; Van Daele et al., 2012) and are found in high densities (Miller et al., 1997; Van Daele, 2007; Van Daele and Cyre, 2007). Coastal bear populations in Alaska range from 191–551 per 1000 km^2 (Morton, 2013). Bear densities in Alaska vary from region to region; 551 bears/1000 km^2 of all ages on the coast of Katmai National Park; 439.5 bears/1000 km^2 on Admiralty Island; 342 bears/1000 km^2 at Terror Lake (Kodiak Island); 323 bears/1000 km^2 at Karluk Lake (Kodiak Island); 191 bears/1000 km^2 in Black Lake, 27 bears/1000 km^2 in the Middle Susitna River Basin, 10.7 bears/1000 km^2 in the Upper Susitna River (Miller et al., 1997). In British Colombia, the most densely bear populations in 2015 were at 40-50 bears/1000 km^2 (Committee on the Status of Endangered Wildlife in Canada -COSEWIC-, 2012).

It is stated that a total of 6300 individuals, 3465 of which are adults, live in an area of 2400000 km^2 in Central Asia, East Turkestan and Western China (Gong and Harris, 2006). In Japan, a total of 2200-6500 bears lives in an area of 78000 km^2. The Shiretoko Peninsula, located in eastern Hokkaido, has one of the highest bear densities in Japan. The minimum population size was estimated at 200 in 1135 km^2 including the towns of Shari and Rausu (Shimozuru et al., 2017). In the Northern and Central Taiga Section of the European part of Russia and the North Caucasus Mountain Forest Zone in 1990, an average of 0.18 bears per 1000 km^2 was detected, while in the Southern Taiga and Northern Temperate Forests of the European part of Russia 0.26 bears per 1000 km^2; 0.19 bears per 1000 km^2 in the Ural Mountains; 0.40 bears per 1000 km^2 in the Altai Mountains; 0.05-0.06 bears per 1000 km^2 have been detected in Siberia (Servheen et al., 1999).

It is estimated that 2000–2500 bears remain in the South Caucasus, where they are protected in Georgia and Armenia but hunted in Azerbaijan (Lortkipanidze, 2010). The minimum density in Central Georgia is given as 13 bears/1000 km^2 (Lortkipanidze, 2010). Similarly, it is reported that the total number of brown bears in the Caucasus Ecoregion does not exceed 3000 individuals (Caucasus Biodiversity Council -CBC-, 2012). Bear density in Iran's Arasbaran Biosphere reserve was determined as 48.8 bears/1000 km^2 (Murtskhvaladze and Tarkhnishvili, 2006; Moqanaki et al., 2018). In Armenia, a total population density estimates of 59.4 bears/1,000 km^2 (Burton, 2018).

Brown bear lives in all regions of Türkiye except the European part (Başkaya et al., 2012). It is stated that a maximum of approximately 4300 bears live in Türkiye (International Union for Conservation of Nature -IUCN-, 2016). The population size of the brown bear in Türkiye is estimated to be less than 3000 (Can, 2004). It is stated that

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the total potential in Türkiye is 17500 individuals (Gündoğdu and Başkaya, 2013). It is stated that the largest number of bears in Türkiye live in Eastern Anotolia-Lesser Caucasus with an area of 161,880 km^2 with 2000-2400 individuals (IUCN, 2016). Other populations living in Türkiye are 750-800 individuals in Küre Mountains-Western Black Sea, 300-400 individuals in Western Anatolia, ~<250 in Eastern Toros Mountains, ~<250 in Western Toros Mountains, 100-150 in Aegean and Datça <50 (Ambarlı et al., 2016; IUCN, 2016). Similarly, it is emphasized that brown bear is abundant in Eastern Black Sea and Eastern Anatolia, but rare in other regions (Turan, 1990; Demirsoy, 1996). According to a study conducted in Bolu, in the Western Black Sea region, it is stated that there are 10 bears in every 1000 km^2, and the population status in other regions is not clear (Can and Togan, 2004). It is stated that the density of 230-260 bears per 1000 km^2 detected in the upper parts of Yusufeli, Barhal valley is the highest density in Türkiye (Ambarlı, 2012).

Brown bear, Türkiye's largest predatory mammal species, is a protected species (Central Hunting Commission Decision -CHCD-, 2021). However, in the recent past, it has been allowed to hunt in certain numbers in the provinces where the damage has been detected. Finally, in 2015, a total of 15 bears were allowed to be hunted throughout the country, 7 of which were in the Eastern Black Sea Region (CHCD, 2015). It is known that it is poaching in the country, especially in many regions where human-bear conflict is intense.

Bears are indicator taxa to monitor ecosystem health. Protecting bears and maintaining their habitat also helps protect the habitat of many other species. In addition, as a result of the protection of bears, resources needed by local people such as water, wildlife and local culture are also protected. However, it is reported that most of the populations of bear species, whose distribution has narrowed, will be in a constant trend of extinction in the next 20 years (Servheen et al., 1999).

In the Eastern Black Sea Region, the Bears use it from the seaside to the 3700 m altitude of Kaçkar Mountain, the highest mountain of the region. After the human-bear conflict in the region, since there is no regional population study, administrative decisions regarding bears cannot be made or are taken incorrectly. Bear populations are increasing in the country, where the rulers only try to protect the bears with stricter measures. As a result of increasing populations, human-bear conflict increases, citizens lose faith in authorities, reactions increase and citizens resort to illegal solutions. Therefore, in this study, it is aimed to determine the population density of the Bear in the Eastern Black Sea Region, where the human-bear conflict is most intense in the country.

Material and methods

Study area

The Eastern Black Sea Mountains, with a total of 32000 km^2, are the second highest mountainous region in Türkiye. Kaçkar Mountain (3932 m), which has the highest peak of the mountain ranges in the region, is the fourth highest peak in the country. Populated areas are mostly at lower altitudes, and above 1000 m the density of people is <50 per km^2. The Eastern Black Sea Mountains are located on the territory of six provinces. The most populous of these provinces is Trabzon with 811901 people, and Bayburt has the least population with 81910 people. The average population density in the region is 66 people per km^2 (Türkiye Statistical Institute -TUIK-, 2020). In the

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Eastern Black Sea Mountains, the most intense human destruction was experienced on the slopes facing the sea. There are extreme human settlements and agricultural areas on these slopes, which are up to about 800 m above sea level. The forests in this belt have been transformed into tea gardens in the east of the region and hazelnut orchards in the west.

About 10% of the study area is protected area. It is the region with the highest rainfall in the country. The maximum precipitation occurs in Rize (altitude 30 m), with an average total of 2500 mm, and where the mean daily temperature is 8–14ºC. The alpine zone above 2000 m is usually covered with snow for at least 6 months of the year. Forests covering 63% of the region are the main vegetation type. Other vegetation types in the region are dune, stream, pseudo-maquis, subalpine and alpine vegetation. The brown bear is the region's largest predatory mammal species. Other major predator species; Leopard (*Panthera pardus*) (Başkaya and Bilgili, 2004), Lynx (*Lynx lynx*), Wolf (*Canis lupus*), Golden jackal (*Canis aureus*) and Striped Hyena (*Hyaena hyaena*) (Sarı et al., 2020).

Sampling sites

This study was carried out in 12 sample areas with a total area of 900 km^2 (*Figures 1 and 2; Table 1*). Sampling sites include all habitat types except densely populated and agricultural areas below 800 meters. Eleven sampling sites were selected in the Eastern Black Sea Mountains, and one in the neighboring region of Posof, Sesödile Mountain (2438 m). Sesödile Mountain is a sample area that is very similar to the region in many ways such as climate, vegetation and geographical features.

Figure 1. *Distribution of the brown bear in Türkiye (Başkaya et al., 2008) and 12 sampling sites in Eastern Black Sea Mountains*

The areas from the Black Sea coast to an altitude of about 800 meters contain the most densely residential and agricultural areas. In this belt below 800 meters, bears come down to the beach only in some seasons and in some parts. In the sampling and density calculations, altitudes lower than 800 m were excluded and the remaining 28,000 km^2 area was studied.

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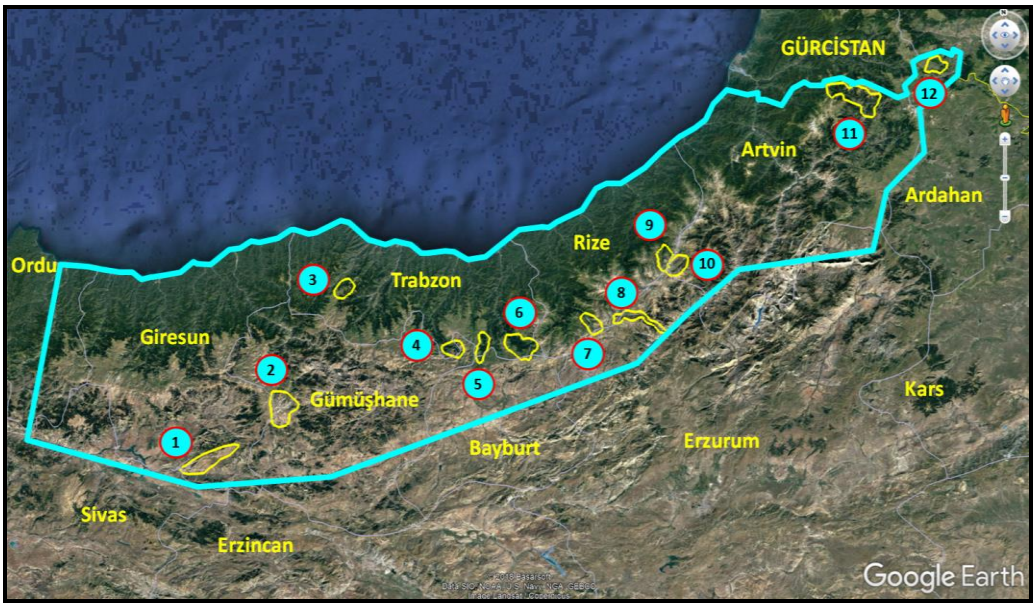

Figure 2. *Sampling sites in the Eastern Black Sea Mountains*

Table 1. *Area of sampling sites, elevation zones, important settlements and protected areas at some sites*

No.	Sampling sites (Province / County)	Area (km^2)	Elevation zone (m)	Important settlements and protected areas at some sites
1	Sarıçiçek Mt. (Giresun / Alucra, Çamoluk, Şebinkarahisar)	140	950-2335	Sarpkaya, Doludere ve Çamlıyayla Plateau, Arda, Yeniköy, Eğnir
2	Gavur Mt. (Gümüşhane / Şiran - Torul; Giresun / Alucra)	100	1600-3331	Yukarı Kulaca, Yeniköy, Akbulak, Kopuz, Gülaçar, Gümüştuğ, Yukarı Kulaca Wildlife Reserve Area, Artabel Nature Park
3	Haçka Plateau (Trabzon / Düzköy, Akçaabat, Maçka)	50	1000-1970	Haçka Plateau, Yerlice Plateau, Kayabaşı Plateau
4	Tilkibeli (Trabzon / Araklı)	50	1400-2450	Tilkibeli, Bahçecik, Erikli, Boğalı, Güngören, Yağmurdere, Aslanca
5	Uzuntarla (Trabzon / Çaykara; Bayburt / Aydıntepe)	50	1200-2400	Uzuntarla, Sultan Murat Plateau, Limonsuyu Plateau, Günbuldu
6	Uzungöl (Trabzon / Çaykara)	80	1100-3376	Demirli Köyü, Yaylaönü, Arpaözü, Demirkapı, Demirkapı Mts., Uzungöl Special Environmental Protection Area
7	Ovit Mt. (Rize / İkizdere; Erzurum / İspir)	50	1500-3300	Çamlıköy, Sivrikaya, Ovit Pass
8	Yedigöl (Erzurum / İspir; Rize / İkizdere)	70	980-3375	Aksu-Yedigöl Valley
9	North Kaçkar (Rize / Çamlıhemşin)	50	1650-3932	Galer düzü, Yukarı Kavron Plateau, Yukarı Ceymakçur Plateau, North of Kaçkar National Park
10	South Kaçkar (Artvin / Yusufeli; Erzurum / İspir)	60	1900-3932	Yaylalar, Olgunlar, Dübe Plateau ve Hastaf Plateau, South of Kaçkar National Park
11	Meydancık (Artvin / Şavşat, Borçka)	150	800-2800	Meydancık, Papart Plateau, Akdamla, Dutlu, Demirci
12	Sesödile Mt. (Ardahan / Posof)	50	1600-2400	Sarıçiçek, Yaylaltı, Kurşunçavuş, Binbaşı Eminbey, Posof Wildlife Reserve Area

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The main features taken into account in the selection of sampling sites are as follows; Sample areas were selected from all kinds of places such as Alucra, Şavşat, Çamlıhemşin and Çaykara, where the human-Bear conflict is most intense, and Trabzon / Düzköy, where there is less conflict in general. The data on the Human-Bear conflicts were obtained from many studies on different wildlife issues in the Eastern Black Sea Mountains for about 30 years, news in the media and the last 10 years of complaint records of the General Directorate of Nature Conservation and National Parks. The sample areas were chosen to represent the entire Eastern Black Sea Mountain range and to have at least one from each province. The sampling sites were chosen to represent all the elevation, aspect and habitat types between 800 m and the Kaçkar peak, which is the highest elevation of the region with 3932 m.

Counting methods

Studies were carried out on 12 sampling sites from 2008 to 2017 (*Table 2, Figure 2*). For the population density of each sampling site, only the census results from the highest bear numbers in 2016 and 2017 were used. Because, in these censuses, more attention was paid to making inventory in the same period at sampling sites that are close to each other. Although it is difficult to count all sites in the same period in the same year, counting was made in 10 sites in 2016 and 7 sites in 2017. As an exception, only the 2013 census results in Meydancık were taken into account. Because, in this census made with large teams of 15-20 people, observations could be made in much larger areas on sampling sites. All other census results after 2008 are presented here in order to compare the census results used for population density and to give more information about the sites (*Table 2*).

Direct and indirect counting techniques were used in the inventories. Direct counting is seeing bears with eye, binoculars, telescope and thermal camera or photographing them with any device. Direct counts were performed using line counting, point counting, camera traps and thermal camera. During all direct counts, observed tracks and signs were also recorded. Footprints and fresh feaces were mainly used for indirect counts. The width and length of the detected front and hind footprints were measured. Fresh tracks with differences in measurements >4 cm was assumed to belong to different individuals. During field observations, everyone used a 10x42 binocular, and each team of two used an 80 mm (20-60x) spotting scope. In addition, digital (12-24x) and SLR (300 mm x2) cameras with different magnifications were used by each team.

Point count method

This method was carried out at 1-3 points every day with a small team of 4 people in all sampling sites. At one point, two people usually observed. Three people made observations at points in the forest, where there is a high probability of encountering a bear. In addition, counts were made twice in Meydancık and Gavur Mountain, and once in Uzungöl, with a team of 15-20 people, at 6-10 points a day, for 2-3 days, with a large team. In the counts made with large teams, each point count team included a guide, usually a hunter, and a technical staff member.

Point counts were made during the first 2-3 hours after sunrise in the morning and 2-3 hours before sunset in the evening. Sometimes, point counts are made at noon or afternoon in weather and places where bears are likely to roam during the day. In the counts made with large teams of 15-20 people, the teams generally stayed in highland houses, village houses and bungalows, and partially in tents.

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Table 2. *Inventory dates, bear numbers and population densities in the sampling sites*

No.	Sampling sites	Inventory dates	Adults	Cub and Yearlings	Directly observed highest number of bears	Indirectly observed highest number of bears	Directly and indirectly observed highest number of bears	Area (km^2)	Density (1000 km^2)
1	Sarıçiçek Mt.	Every month after May in 2013*	6	4	8	2	10	140	114,3
		every month from Apr. to Dec. in 2014*	7	4	9	2	11		
		every month from Apr. to Dec. in 2015*	5	4	7	2	9		
		May.16	8	7	11	4	15		
		Sep. 2016	5	6	10	1	11		
		Nov. 2016	7	3	4	6	10		
		May.17	8	8	11	5	16***		
		June 2017	7	5	11	1	12		
		Nov. 2017	8	6	10	4	14		
2	Gavur Mt.	21-22 Nov. 2012**	5	0	5	0	5	100	100
		27-29 Nov. 2013**	6	4	7	3	10		
		Sep. 2014	4	2	3	3	6		
		Nov. 2015	5	4	7	2	9		
		Sep. 2016	6	4	7	3	10***		
3	Haçka Plateau	July 2009	1	0	1	0	1	50	40
		Aug. 2010	1	0	1	0	1		
		Aug. 2011	1	1	0	2	2		
		Nov. 2015	1	0	1	0	1		
		Sep. 2016	1	1	1	1	2		
		May.17	2	0	1	1	2***		
		Nov. 2017	1	0	1	0	1		
4	Tilkibeli	July 2010	2	2	1	3	4	50	140
		Nov. 2011	4	2	5	1	6		
		Aug. 2013	3	2	4	1	5		
		Sep. 2015	4	1	4	1	5		
		Nov. 2016	4	3	5	2	7		
		May.17	4	3	5	2	7***		
		July 2017	3	3	5	1	6		
5	Uzuntarla	Sep. 2010	3	1	2	2	4	50	160
		July 2011	3	2	4	1	5		
		Aug. 2013	3	3	5	1	6		
		July 2014	4	4	5	3	8		
		May.15	5	3	5	2	7		
		Sep. 2016	4	4	5	3	8***		
6	Uzungöl	July 2010	5	4	7	2	9	80	187,5
		June 2011	5	3	7	1	8		
		July 2012	4	3	6	1	7		
		26-27 Oct. 2013**	7	8	7	8	15		
		July 2013	4	3	3	4	7		
		Aug. 2014	4	4	7	1	8		
		Oct. 2015	6	4	7	3	10		
		Nov. 2015	4	4	7	1	8		
		July 2015	4	3	6	1	7		

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No.	Sampling sites	Inventory dates	Adults	Cub and Yearlings	Directly observed highest number of bears	Indirectly observed highest number of bears	Directly and indirectly observed highest number of bears	Area (km^2)	Density (1000 km^2)
		June 2017	8	5	7	6	13		
		Oct. 2017	10	5	7	8	15***		
7	Ovit Mt.	July 2014	2	2	2	2	4	50	140
		Nov. 2015	2	2	3	1	4		
		Sep. 2016	5	2	4	3	7		
		May.17	3	4	4	3	7***		
		Nov. 2017	3	1	3	1	4		
8	Yedigöl	Nov. 2013	3	1	3	1	4	70	114,2
		Nov. 2014	5	3	5	3	8		
		July 2015	3	2	5	0	5		
		Aug. 2017	4	4	5	3	8***		
9	North Kaçkar	Aug. 2009	9	3	8	4	12	50	240
		Aug. 2015	4	2	4	2	6		
		July 2016	7	5	8	4	12***		
10	South Kaçkar	Aug. 2009	2	2	1	3	4	60	166,6
		July 2015	6	4	6	4	10		
		June 2016	5	2	6	1	7		
		Aug. 2017	6	4	6	4	10***		
11	Meydancık	10-12 Oct. 2012**	14	6	12	8	20	150	466,6
		22-24 May 2013**	43	22	65	5	70***		
		July 2015	14	8	21	1	22		
		Aug. 2016	17	7	23	1	24		
12	Sesödile Mt.	Aug. 2008	6	2	7	1	8	50	200
		July 2009	6	2	8	0	8		
		June 2010	3	2	2	3	5		
		July 2011	4	2	5	1	6		
		Aug. 2012	5	5	8	2	10		
		Oct. 2014	5	2	7	0	7		
		Nov. 2014	5	3	6	2	8		
		July 2015	5	5	7	3	10		
		June 2016	6	4	8	2	10***		

*Average result of all months of the year, ** Large team counts, ***Counts used for density

In the counts made with a small team of 4 people, the teams generally stayed in tents. In some point counts made with a small team, when it was concluded that the area around the point was scanned in the morning, it was moved to another point in the evening in order to scan much more area. Maximum effort has been made to ensure that the areas observed by the teams at the points do not overlap with each other. First, the observed bears were photographed and documented, sometimes very clearly, sometimes in a way that was at least identifiable.

Each team at the points recorded the information they obtained during the observations on their observation cards. The observation cards include the name of the team members, date, time, coordinate, number of adult bears, number of cubs-yearlings, gender, color, behavior, weather and habitat information. In addition, the places where the bear was seen are marked with their coordinates on the maps found in each team.

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Line count method

This method was carried out by 2 teams, each consisting of 1 or 2 people. Line counts were also made when traveling to places where point counts were to be made, returning from points, or changing points. In the selection of lines, routes with a high probability of using bears or routes that see places that bears can use were preferred.

This method was generally performed in foggy, cloudy and rainy weather where visibility is low. Sometimes counts were made by walking along two parallel lines. In these cases, the distance between the lines varied between 20-100 m depending on the factors affecting the vision such as vegetation density and rocks. Line lengths varying between 2-10 km were realized as 6 km on average.

During the walks, fields were scanned with binoculars and a telescope, stopping as the field of view changed or in case of doubt. The teams photographed traces and signs they saw walking along the line counts, such as footprints, excrement, stone turning, scraping, and fragmented logs. All census results were marked on observation cards and maps by each team.

Camera trap counts

The camera trap was used for the first time on Sarıçiçek Mountain in 2013. Later, camera traps were also used in Uzuntarla and Uzungöl. Camera traps were placed in the field considering the water and food resources, paths and roads that are important for the bears. Bushnell and Cuddeback camera traps that can shoot at night, record 720p HD video up to one minute, 12 MP resolution, 8 or 12 AA batteries, and operate between -15 °C and 60 °C were used. An average of 15-30 camera traps was installed on Sarıçiçek Mountain, and 5-10 on average in Uzuntarla and Uzungöl. The camera traps on Sarıçiçek Mountain generally shot in the field throughout the year between 2013 and 2017. The camera traps in Uzuntarla and Uzungöl were used twice in the field, with periods of approximately one month each.

Thermal camera counts

The thermal camera was only used in Uzungöl, Uzuntarla and Güney Kaçkar throughout 2017. Very successful observations were made during the day with the thermal camera, which is generally better observed at night when the objects in the field get cold. TİCAM 750 thermal camera with a range of 2 km (x2), a resolution of 640x480 and powered by 4 AA batteries was used. With the thermal camera, it was easily scanned between 500 meters and 2 km by standing at the dominant points of the area. Because the scanned area was narrowed, observations were generally made without using magnification. Double magnification was used only when a suspicious object was detected or when it was desired to see the detected animal more clearly.

Results

As a result of the censuses carried out at 12 sampling sites with a total area of 900 km^2 in the Eastern Black Sea Mountains, a maximum of 175 adults, cub and yearling bears were identified. It has been determined that 40% of 175 bears consist of cubs and yearlings. In other words, it has been determined that 175 bears are composed of 105 adults and 70 cubs and yearlings. Of these 175 bears, 132 bears were observed directly and 43 bears indirectly. While the average bear densities at 1000 km^2 at

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sampling sites varied between 40-466 bears, the average density for all sampling sites was 194.4 bears/1000 km^2 (*Table 2*).

It has been calculated that a total of 5432 individuals, consisting of 3259 adults, 2173 cubs and yearlings, live in the Eastern Black Sea Mountains, which has a suitable area of 28000 km^2 for bears. In the Eastern Black Sea Mountains, with a total area of approximately 32000 km^2, areas up to 800 m above sea level, where human use is very intense, and where bears generally do not live, are not included in the potential bear habitats. Litter size varied from 1 to 4 and averaged 2.

The lowest bear density was found in Haçka Plateau with 40 bears per 1000 km^2, and the highest density was found in Meydancık with 466 bears per 1000 km^2. The highest number of bears directly observed in a narrow area were detected in North Kaçkar. Here, 12 bears were observed between 2200-2700 m altitudes in an area of approximately 15 km^2. The reason why bears are concentrated in this area is *Petasites* sp., *Heracleum* sp. or *Angelica* sp. plants that are abundant in this region. It has been observed that bears are abundantly fed with the stems of these plants at the beginning of summer.

The highest number of bears hibernating in a narrow area were found in Demirdöven, at 1900 m altitude, on inaccessible forested steep slopes away from human influence. It was determined that 7 active dens here were excavated in an area of approximately 200 m^2 with 3-5 meters' intervals. Similarly, it was observed that 5 bears hibernate side by side in a narrow area of 50 m^2 in Uzungöl at an altitude of 1700 m. It has been determined that the dens here are located on the steep slopes of the old growth forest, at the bottom of overturned large logs or under large rocks.

Discussion

It has been determined that the bear population density in the Eastern Black Sea Mountains is 194.4 bear/1000 km^2, one of the highest bear density areas in the world. Regions with the highest bear density in the world; Katmai (551 bears), Admiralty (439.5 bears) in Alaska (Miller et al., 1997; LeFranc et al., 1987; Sellers et al., 1999), Romanian Carpathians (100-200 bears /1000 km^2) (Swenson et al., 2000; MAFRD-MEWM, 2005), Dinaric Mountains of Slovenia (exceeding 400 bears/1000 km^2) (Jerina et al., 2013) and the Shiretoko Peninsula (200 bears/1135 km^2) in Hokkaido, Japan (Shimozuru et al., 2017).

The 194.4 bears/1000 km^2 detected in the Eastern Black Sea Mountains is much higher than most areas in the world. The bear population density in most parts of the world is below 50 bears/1000 km^2. The highest population density in British Colombia in 2015 was 40-50 bears/1000 km^2 (COSEWIC, 2012). In another study, the bear density in North America was 122 bears/1000 km^2 (Miller et al., 1997), while the bear density in Alaska was 31.4-54.5 bears/1000 km^2, with an average of 40.4 bears (Walsh et al., 2010). Bear densities detected in Europe are 0.096-0.105 bears/1000 km^2 in the Cantabrian Mountains (López-Bao et al., 2021), 0.5 bears /1000 km^2 in the south of Norway, 20-25 bears /1000 km^2 in central Sweden (Swenson et al., 2000; MAFRD-MEWM, 2005), 11.1±8.9 bears/1000 km^2 in Norway and 29.3±18.9 bears/1000 km^2 in Sweden (Støen et al., 2006) and 100 bears/1000 km^2 in Slovenia (Petram et al., 2004). While only 8-9 bears remain in France, populations in many regions have also disappeared (Swenson et al., 2000).

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The density of bears detected in the Eastern Black Sea Mountains is higher than in all regions of Russia, where the most bears live in the world. In Russia, where 123869 bears live (Swenson et al., 2000), in 1990, the average density in the Northern and Central Taiga Part of the European part and the North Caucasus Mountain Forest Region was 0.18 bear/1000 km^2, the average density in the Southern Taiga and Northern Temperate Forests of the European part was 0.26 bear/1000 km^2, in the Ural Mountains the average density is 0.19 bear/1000 km^2, in the Altai Mountains the average density is 0.40 bear/1000 km^2, and in Siberia the average density is 0.05-0.06 bear/1000 km^2 was detected (Servheen et al., 1999). It is stated that a total of 6300 individuals, of which 3465 are adults, live in an area of 2400000 km^2 in East Turkestan and Western China in Central Asia (Gong and Harris, 2006). In the Southern Caucasus adjacent to the Eastern Black Sea Mountains, the bear population size is 2000-2500 and the minimum bear density is about 13 bears/1000 km^2 (Lortkipanidze, 2010). The highest density in the Caucasus was estimated at 59.4 bears/1000 km^2 in Armenia (Burton et al., 2018).

Bear densities in Alaska, which has the highest bear densities in the world, vary from region to region. Density distributions in the Eastern Black Sea Mountains also differ from region to region, as in Alaska. Bear densities in different regions in Alaska; Katmai National Park coastal (Bears of all ages, 551 bears/1000 km^2), Admiralty Island (439.5 bears/1000 km^2 per bear), Kodiak Island (342 at Terror Lake and 323 at Karluk Lake), Black Lake /Alaska (191 bears/1000 km^2 per bear), The middle Susitna River Basin/Alaska (27 bears/1000 km^2) and Portion of upper Susitna River/Alaska (10.7 bears/1000 km^2) (Miller et al., 1997). In the Eastern Black Sea Mountains, the highest population density was determined in Meydancık with 466 individuals per 1000 km^2, followed by North Kaçkar with 240 individuals and Uzungöl with 187.5 individuals. The lowest population densities were determined in the western part of the area with 40 individuals in the Haçka Plateau and in the Gavur Mountains with 100 individuals.

The main reasons for these high differences in bear densities between the east and west of the area are due to habitat qualities and human population densities. Ahmadiparia et al. (2021) determined that bears, which they define as a species dependent on water and vegetation, generally prefer high elevations and areas away from humans in Iran. While habitat quality increases towards the east of the study area, human population density decreases. The population in the eastern part of the region with difficult living conditions migrated more to big cities and abroad. Bears benefit from fruits such as pears, apples, walnuts, cherries, rosehips, wild pear and figs in the villages whose population has decreased as a result of migration, more than in the past. Also, people in areas with high bear density are much more tolerant towards bears. There is less poaching and illegal killing here. It is stated that the main reason for the high bear density in the research area is that human pressure has decreased or disappeared in most places in the last 30-40 years (Başkaya et al., 2012). This decrease in human pressure is due to the decreasing population as a result of increasing immigration in the last 30-40 years, the increasing awareness of the people, the decrease in animal husbandry, and the abandonment of rural life and traditional life. So much so that the number of young people who can shoot a bear with a rifle or set a trap has decreased in the villages, and young people with these skills are not growing. For this reason, it is not possible to deal with bears as intensely as before. In addition to all these, teams, hunters and villagers counting in Meydancık, which has the highest bear density, state that there are actually many more bears than observed in the field. In

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Meydancık inventories, only 1/4 of the area could be observed. In addition to the individuals that observers may not be able to see, it is thought that there are a large number of bears that do not come out of the forest into open areas and therefore cannot be observed.

All of the census results obtained at 12 sampling sites support each other for each site. It is seen that the results used for the population density at each site were obtained consecutively from the same sites in successive years. For example, 7 bears were observed consecutively on Mount Ovit and Tilkibeli in 2016 and 2017, and 10 bears were observed on South Kaçkar and Sesödile Mt. in 2015 and 2016 (*Table 2*). As an exception, censuses were carried out in 2015 and 2016 in Meydancık, where 2013 census results were used instead of 2016 and 2017 census results. In these censuses made with the small team of 4 people, less area of the sampling site could be observed. However, the 2015 and 2016 results obtained in Meydancık show that the census results obtained with the large teams in 2013 are still valid for the site.

Cubs and yearlings constituted 40% of the observed bears. Litter size varied from 1 to 4. The average litter size, which was determined as 2 by Nezami and Farhadina (2011) in Iran, was the same in this study. However, the average litter size was relatively lower in sampling areas with high bear density. The main reasons for this situation can be infanticide by males, high competition between females, or other predators such as wolves.

In order to minimize the duplication of counts, censuses in adjacent areas such as North Kaçkar and South Kaçkar and in areas close to each other such as Tilkibeli and Uzuntarla were carried out consecutively, with a maximum interval of one week. Only the censuses in Ovit and Yedigöl, which are close to each other, were made with an interval of two months. In cases where a clear distinction cannot be made, the records of the team that saw the most bears in that region were taken into account. The counts of other teams were not taken into account, thus avoiding duplicate counts.

Results of direct observation were combined with results of indirect observation, where very fresh footprints and feces were taken into account. For example, in an area where only male bears were observed in direct observations, fresh tracks determined to belong to a female with cubs were added to the results. Similarly, a bear footprint that is directly observed and wanders alone is considered as a separate individual since it does not belong to a mother bear walking with her cub. The footprints of a mother with a cub, a mother with two cubs, or an individual wandering alone, detected in two neighboring areas, are in different places and no matter how many, only one of the determinations has been added to the results. In addition, if there is a difference of more than 4 cm in the dimensions of the footprints, it is accepted that they belong to different individuals. A very fresh bear feaces detected in an area where no bears were seen directly was also accepted as information that there was a bear in the field. Here, in doubtful cases, data obtained from indirect observations are not added to the results.

Conclusion

The proportion of habitats with similar characteristics to Meydancık, where the highest bear density is determined, is at least 10% of the total study area. Major similar areas are the Yağlıdere Valley and the north of Karagöl in Giresun; north of Çat Valley and Verçenik Mountain in Rize; Sırakonak and Çamlıkaya Valleys in Erzurum; Dokumacılar, Çevreli, Tekkale, Balcı and Berta Valleys in Artvin. In other words, the

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high-density value obtained in Meydancık is not a factor that increases the average result. Even if Meydancık is excluded, the bear population density in the Eastern Black Sea Mountains is 161 individuals/1000 km^2, which is higher than many places mentioned in the literature.

Inventory teams, local people and hunters estimate that there are more bears than detected in all sampling areas. Because, in reality, most of the sampling areas could not be observed due to forests, vegetation and rocks. Only individuals who went out into the open field and were definitely identified were taken into account. In addition, all suspicious observations and situations with the possibility of duplicate counting were avoided. For this reason, it is estimated that much higher density values will be obtained than those obtained in this study, if counting with DNA analysis is performed.

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