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Altitudinal Distribution and Habitat Use of the Golden Jackal (*Canis aureus* Linnaeus, 1758) in Trabzon, Arsin- Yanbolu Valley in Turkey

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Key words
Altitudinal distribution, Geographic information system, Golden jackal, *Canis aureus*, Wolf footprints

ABSTRACT

In this study, altitudinal distribution and habitat use of the golden jackal (*Canis aureus*) in Trabzon, Arsin, Yanbolu Valley were tried to be determined starting from September 2019 to February 2021. In the study area with a total area of 158 km^2, 62–days fieldwork was carried out. Direct and indirect observation methods were used in field studies. Direct observations were made by one or two-person using point and line observations, as well as using camera traps. In indirect observations, signs such as the jackal's footprints, scats, etc. were used. As a result of the research, data such as 253 camera trap images of the jackal, direct observation in one area, 16 jackal howling sounds in three areas, and footprints in one area were obtained from 40 meters the upper limit of the forest at an altitude up to 1514 meters. It is also the highest altitude at which the jackal has been recorded in Europe. It is seen that the jackal is distributed in areas close to agricultural and residential areas at low altitudes whereas, it is generally distributed in forest areas at higher elevations. In forest areas, it has been observed that it can easily use forests with high closure as well as forest areas with low closure. The elements that threaten the jackal are lack of information about the species, poaching, predator pressure, stray dogs, roads, agricultural drugs, and environmental pollution.

INTRODUCTION

The jackal (*Canis aureus* Linnaeus, 1758), has been able to show its presence in extensive areas in Europe due to its ability to adapt to different habitat types and the diversity of its feeding preferences (Trouwborst *et al*., 2015; Krofel *et al*., 2017). After the first wave of expansion in urban populations in the 1950s, jackal populations were nearly extinct (Tóth *et al*., 2009). However, after the 1980s, jackal populations started to increase in Central and Northern Europe (Kryštufek *et al*., 1997; Tóth *et al*., 2009; Trouwborst *et al*., 2015; Krofel *et al*., 2017). Trouwborst *et al*. (2015), put Bosnia and Herzegovina into the list of countries where jackal populations are on the rise again. The jackal is widely distributed in the north and northeast of Africa and is also found on the west coast of Africa from Senegal to Egypt. It also spreads from the Arabian Peninsula to Austria and Bulgaria in the West (Genov and Wassiley, 1989). It is known that there are 14 subspecies of jackal worldwide (Wozencraft, 2005; Khalaf-Sakerfalke and Taher, 2008; Hoffmann *et al*., 2018; Moehlman and Hayssen, 2018). *Canis aureus moreoticus* (Geoffroy Saint-Hilaire, 1835) is a subspecies of the jackal, which is distributed in Anatolia, the Caucasus and Southeastern Europe, including Turkey (Heptner and Naumov, 1988; Wozencraft, 2005; Moehlman and Hayssen, 2018). Having increased its distribution and density in the most impressive way beyond dispute across the continent compared to other predators in Europe since 1980, the jackal can be seen today in the Middle East Asia, Middle East, Southeast and Central Europe on lands with all kinds of conditions such as semi-desert, steppe, forest, village, and town (Jhala and Moehlman, 2004; Šálek *et al*., 2014; Koepfli *et al*., 2015; Trouwborst *et al*., 2015). With their greater incidence in farmland and wetlands, they prefer low elevations and mixed consultations to nest, hide, give birth and raise offspring (Šálek *et al*., 2014). In a study conducted in Italy, it was recorded that jackals were seen at an altitude of 380 to 850 meters in the Carnic Alps (Rassati, 2013). Jackals were recorded to show presence at an altitude of 400 meters in a study conducted in the upper Soča Valley in Slovenia (Mihelič and Krofel, 2012). In a study conducted in Croatia, jackals were found at 17

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different points at an altiude of between 18 and 287 meters (Krofel, 2007). In a study conducted in Serbia, jackals were detected at altitudes between 37-362 meters in 6 different regions (Ćirović *et al*., 2014). Jackals have been detected at an altitude of 79 - 1203 meters in Bosnia and Herzegovina (Trbojević *et al*., 2018). The jackal trace was recorded at an altitude of 1200 meters on Mount Osogovo, where Bulgaria and Macedonia intersect (Zlatanova, 2005).

Jackals may tend to hunt together if they are dense in number in an area (Markov, 2012). Apart from this, the jackal usually hunts alone (Sillero-Zubiri *et al*., 2004) and this affects the size of their prey. The jackal can feed on wild birds as well as poultry such as chickens. Eggs and chicks found in nests on the ground or fallen from tree nests can also be a source of food for the jackal. Their largest known prey in Europe are the calves of the red deer (Genov and Vassilev, 1991). They may invade farmland outside the forest to eat rodents (Šálek *et al*., 2014). The jackal is opportunistic in terms of nutrition and the types of food it consumes are very large (Nowak and Paradiso, 1983). A study on jackal's nutrients in southwest Hungary showed that 54% of its nutrients were made up of animals and 46% made up of herbal products (Lanszki and Heltai, 2002).

The jackal, which lives in a very large area in Turkey, can be found especially in coastal areas and river valleys 1500 meters above sea level (Ambarlı *et al*., 2016). According to Turan (1984), the jackal is located in the northern half of the Black Sea Region, a large part of the Marmara Region, the western half of the Aegean Region, the southern half of the Mediterranean Region, and the southern coast of the South-eastern Anatolia and Eastern Anatolia Regions. According to Özkurt and Bulut (2020), the jackal is located on the northern coast of the Eastern Black Sea Region, in all of the Central and Western Black Sea Regions, in the whole of the Marmara Region, in a very large part of the Aegean and Mediterranean Regions, in the southern half of the South-eastern Anatolia Region, in the south of the Eastern Anatolia Region and in some parts of the north and west, and in most parts of the Central Anatolia Region close to its surroundings. According to Ambarlı *et al*. (2016), it is seen in the seashore of the Eastern Black Sea Region, in most of the Central and Western Black Sea Region, in the Marmara Region and in a very large part of the Aegean Region, in parts of the Mediterranean Region, in the southern half of the South-eastern Anatolia Region, in the south of the Eastern Anatolia Region and in some other parts, in the west of the Central Anatolia Region and in some other parts. The jackal is a medium-sized predatory mammal species that is spread in almost all regions of Turkey and is in constant interaction with humans. It is a species that is well known by the people in both rural and urban areas, and has a great reputation in Anatolia. It has been recorded in Turkish history since centuries, and is famous for its opportunism and ferocity, which has taken its place in stories, idioms, and daily conversations.

The number of direct and indirect scientific studies conducted on the jackal in Turkey is limited. Aksöyek (2015) conducted a master's thesis on DNA barcoding for the identification of 3 Canidae species (wolf *Canis lupus*, jackal and fox *Vulpes vulpes*) distributed in Turkey. İbiş *et al*. (2015) performed phylogenetic studies on the jackal that were based on D-loop sequences. Ambarlı *et al*. (2016) investigated the distribution and management of some predatory mammal species, including the jackal, although not directly. Similarly, Keten (2016) made evaluations about the jackal in his study, which investigated the temporal and spatial distribution of predatory mammals in Düzce province. Sarı and Arpacik (2018) included samples taken from the body hair of the jackal in the morphological hair identification key they prepared for the identification of some mammalian species distributed in Turkey. Erol *et al*. (2019) investigated the helminth infections found in jackals and their zoonotic importance. Arpacık (2021) on the other hand, examined the microanatomy of the body hair of 3 canid species (wolf, jackal and fox) in Turkey and revealed their differences.

MATERIALS AND METHODS

Study area

The study area is mostly located within the borders of Arsin, Arakli and Yomra districts of Trabzon province in the Eastern Black Sea Region and the central district of Gumushane province (Fig. 1). The Yanbolu Stream, which flows into the sea from Arsin, is approximately 25 km from the center of Trabzon.

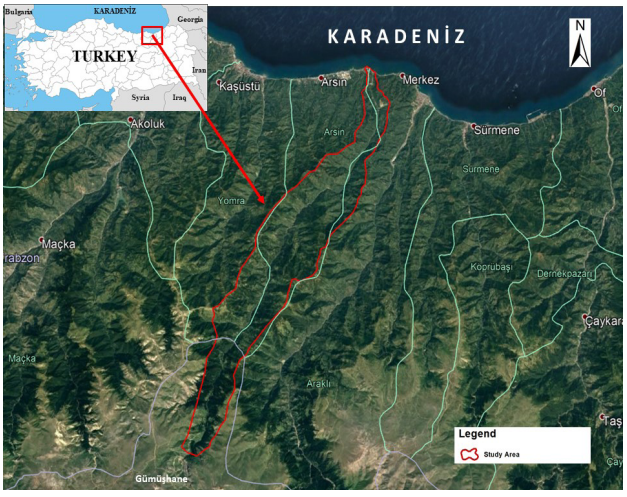

Fig. 1. Location of the study area (Google Earth, 2021).

The study area, which covers an area of 158 km^2 and ends in Yanbolu Kuzguncuk District, the last town on the seaside on the Arakli side of Trabzon's Arsin district, sometimes ends up in Arakli and sometimes Yomra districts, and connects to Gümüşhane at the top. There are large hazelnut lands in most of the seaside half of Yanbolu Valley. Scattered wide or narrow many oak lands are sometimes found among hazelnut groves, sometimes covering mountain tops, and sometimes in rocky terrains or near streams. Except for the forests, there are pathways in the hazelnut groves and oak trees in most of the land.

Fig. 2. Camera trap pictures of the jackal from study area.

Materials

In the study, firstly, photo and video images were tried to be obtained with camera traps in general. A total of 4 camera traps of various brands and models were used throughout the research. Camera traps are capable of taking infrared photos and videos. For recording the data, nearly 20 memory cards of different sizes were used according to the capacities of the devices. Although the energy needs of camera traps vary according to the model, they were generally provided with approximately 500 batteries of different sizes. While the camera traps were placed in suitable areas, galvanized thin iron wire and pliers were used in the fixing process. In addition, a large-sized tahra (a sickle-shaped knife) was used for cutting all kinds of grass, branches and leaves at a distance up to 10 meters, which could cause the devices to shoot continuously and reduce the battery life. During field observations, Swarovski brand 10 x 42 SLC binoculars and ATS/STS 80 (HD) (20–60x) Telescope were used while collecting remote information. Various types of digital cameras (3x optical zoom–5.0 Mega Pixels and 12x optical zoom–6.0 Mega Pixels) were used to photograph the periodic situation of the area and the species seen during field observations. The global positioning tool (Magellan Explorist 500L GPS) was also used to provide many important information, especially to determine the elevation and coordinates of the areas where findings were obtained. Different topographic map sheets were used in the field studies and in the creation of digital maps in the GIS environment. Topographic maps of 1:25,000 G43b1, b2, b3, b4, G43c1, c2, G44a1, a4 and d4 were used in the creation of numerical maps in the GIS environment. Stand maps of the forest management plans of the study areas and their surroundings were used as a digital base for the determination of forest assets and tree species. ArcGIS version 10.3 package program was used while processing the data.

Methods

This study, which was carried out to determine the elevation area distribution and use of the jackal, was completed with a total of 62 days of fieldwork in 18 months. All of these field studies were carried out in the form of day trips. Direct and indirect observation methods were used in field studies. Direct observations were made by a team of 2 each, with point or line-length observations. In the research, direct observations made with telescopes and binoculars and photo and video images of the jackal were tried to be obtained with camera traps. In indirect observations, signs such as jackal's footprint, excrement, scratching, scrabbing, urine, food residue were recorded. The species with which jackal footprints can be confused with in the research area are gray wolf, red fox and stray dog (*Canis familiaris*). Parameters such as shape, toe arrangement, size, diameter, heel location and the direction of the nails are decisive in the differentiation of the footprints of these species. Wolf footprints are considerably larger than jackal footprints and all domestic dog prints except for some large dog breeds. While the length of the traces of the wolf's forefoot is 11 cm on average and the width is 9.8 cm, these measurements are 6.7 and 5.3 cm, respectively, for the jackal. The hind legs are 10.1 cm long and 8.2 cm wide for the gray wolf, and 6.1 cm and 4.6 cm for the jackal, respectively. In domestic dogs, these data are highly variable according to breeds, but generally they have a length of less than 9 cm (Moskowitz and Huyett, 2019).

Although the jackal is a species that uses the night more, it is also an animal that is likely to be active during the day in areas where it feels safe. Therefore, the areas considered important in the field of research were also scanned with binoculars and telescopes. These observations were also carried out in the form of scanning large and distant areas from dominant points, as well as searching for traces and signs on foot. The entire research area was scanned by walking in a line by the team, which

were approximately 20-50 meters apart from each other, side by side, depending on seasonal terrain conditions. After these area scans, camera traps were installed in the areas where there were indirect traces considered to be belonging to the jackal and in the areas deemed appropriate based on the information received from the people living in the area. Roads and paths that are likely to be used by the jackal, elements such as trees, bushes, rocks, important water edges, and ambush areas that are likely to be used for hunting were determined, and camera traps were set up randomly throughout the area during the study (Karanth, 1995; York *et al*., 2001; Sarı *et al*., 2020). During the study, camera traps were installed at 35 different altitudes ranging from 13 meters to 1654 meters in every 100 meters, starting from the sea level to the upper elevations where the forest existence ends (Fig. 3).

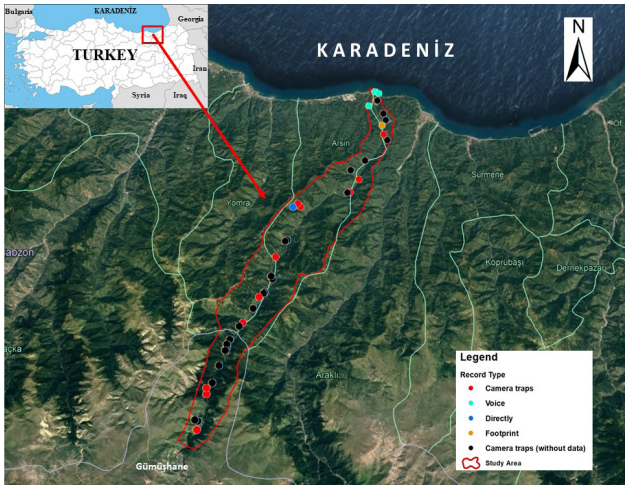

Fig. 3. Findings and detection methods during the study (Google Earth, 2021).

The camera trap installation was started from the levels of 450-550 meters (points 12, 15 and 16), which can be considered as the low elevations of the land, where the altitude of the land is low and the human density is higher than in the higher parts, due to the beginning of the work in September and the approach of the winter months. Afterwards, camera traps were systematically installed at higher altitudes in summer and spring, starting from low altitudes in winter. During the research, the study areas were constantly visited in every season and every month of the year, and field scans and control of the camera traps were carried out. In total, 2200 days of camera trap shots were taken.

During the field studies, information was tried to be obtained from the local people, who know jackals very well, both in terms of places to be seen and the mutual threats to be. There are many settlements in the study area. In order not to disturb the local people in the field studies, the works were carried out when the citizens were not busy in the field and generally away from the settlements. Field observations were mostly carried out around the highway parallel to the Yanbolu Stream and studies were intensified where camera trap and jackal filming were likely to take place.

All the data obtained as a result of the studies were processed on the 1/25000 scale topographic maps and stand maps of the provinces where the study was conducted, with their coordinates. In this way, it has been determined in which type of areas the jackal is more frequently encountered in the study areas, according to the Forest Management plans.

RESULTS

As a result of this study, which investigated the use and distribution of the elevated area of the jackal in Yanbolu Valley, 253 camera trap images of jackals were obtained at 11 different elevations (Fig. 2). Of these camera trap images, 6 are after sunrise and 247 are night shots.

The findings of the data obtained by camera traps during 62 days of field work and 2200 camera trap days in the working areas with a total of 158 km^2 are shown in Table I.

As a result of the research, in addition to 253 camera trap images of the jackal at 11 different altitudes, important findings such as direct observation in one area at 850 m elevation, jackal howling sounds detected on 16 different dates in three areas at 77 m, 82 m, and 137 m elevations and footprint in one area at 40 m elevation were reached (Fig. 3).

The species of gray wolf, red fox and stray dogs, of which footprints can be confused with the ones of the jackal, also spread in the research area, and the traces of these species can often be confused. Since the camera traps are mostly installed on the paths in the forest, not many footprints can be seen due to the unsuitable ground in these areas. The clearest footprint was found in the stream at an altitude close to the sea. When the data obtained are analysed, it will be seen that data of the jackal were obtained in every season during the study (Fig. 4). According to the findings obtained as a result of the research, the jackal may spread up to the forest border at high altitudes in the research area in spring and summer, while it tends to spread more at low altitudes in autumn and winter. The findings of the jackal were found at an altitude of at least 40 meters and at a maximum of 1514 meters. No finds of the jackal were found in the camera traps set up in the spring and summer months of May,

June, July and August, where the jackal can be seen at the highest elevations of 1631 and 1654 meters, which are the upper parts of the forest border, and where the forest cover loses its effect.

Table I. The areas where the camera traps were installed and the number of images of the jackal.

No.	Elevation (m)	Working period of camera traps		Count
1	13	12.05.2020	20.05.2020	–
2	53	02.05.2020	08.05.2020	–
3	55	12.10.2019	23.10.2019	–
4	75	10.01.2020	19.01.2020	52
5	100	05.11.2019	16.12.2019	–
6	131	12.10.2019	23.10.2019	–
7	192	10.01.2020	19.01.2020	–
8	227	05.11.2019	16.11.2019	–
9	255	05.11.2019	16.12.2019	11
10	270	17.02.2020	28.02.2020	–
11	326	17.02.2020	28.02.2020	83
12	449	03.09.2019	05.10.2019	–
13	468	20.04.2020	04.04.2020	9
14	511	20.09.2020	28.04.2020	16
15	521	03.09.2020	05.10.2020	1
16	524	03.09.2019	05.10.2019	–
17	596	25.01.2020	05.02.2020	–
18	611	25.01.2020	05.02.2020	–
19	672	21.03.2020	29.03.2020	32
20	674	29.03.2020	10.04.2020	–
21	690	29.03.2020	10.04.2020	–
22	788	10.03.2020	21.03.2020	–
23	872	21.03.2020	29.03.2020	15
24	875	10.03.2020	21.03.2020	–
25	970	05.02.2020	17.02.2020	–
26	1099	28.02.2020	10.03.2020	–
27	1110	28.02.2020	10.03.2020	–
28	1157	05.02.2020	17.02.2020	–
29	1194	28.02.2020	10.03.2020	–
30	1258	10.04.2020	20.04.2020	–
31	1313	10.04.2020	20.04.2020	22
32	1328	10.04.2020	20.04.2020	2
33	1514	28.04.2020	10.05.2020	10
34	1631	28.05.2020	10.07.2020	–
35	1654	28.05.2020	10.08.2020	–
Total				253

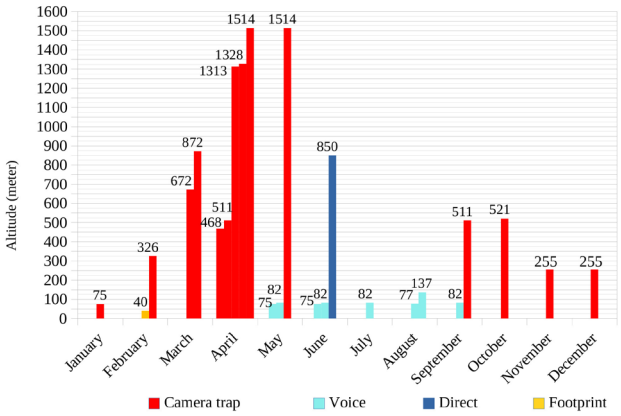

Fig. 4. Elevations and detection patterns in which the jackal is detected by months.

The jackal was recorded in many places along the valley which are close to human settlements, fields and gardens. In most areas of the land, there are woodlands and rocky terrains suitable for nesting for the jackal. Human wastes that will contribute to the jackal's feeding, farms and gardens that contain animals that it can hunt or that create an ecosystem suitable for these animals can be seen in many places. Along with the Yanbolu Stream flowing through the valley, the branches of this stream and the fresh waters flowing from the slopes meet the water needs of the jackal and its food sources.

When the presence points of jackals, which were determined as a result of the research, are plotted on the 1/25000 scaled elevation groups map of our country, it is seen that there are records from almost every altitude from the sea level to the upper forest border. For a species like the jackal, which can adapt very easily to its habitat and has a wide choice of food webs, this finding reveals the importance of the forest in the ecological demands of the species. In the light of all the data obtained from this study, in which we investigated the elevation distribution of the jackal, the evaluation of the determined points in terms of vegetation was also carried out as a result of transferring the 1/25000 scaled areas of the Forest Management plan on the stand maps to the GIS environment. Looking at the map, it is seen that the areas where the findings of the jackal are detected are located in areas close to agricultural areas and residential areas at low altitudes, while it is observed that they remain in forest areas at higher elevations. In these areas, there are forest areas with low closure (1 closed) as well as forests with high closure (3 closed). According to the forest management plan stand map in the research area, the dominant tree species within the forest borders and the codes of these species are, Eastern spruce (*Picea orientalis*), Eastern Black Sea fir (*Abies nordmanniana*),

Duglaz fir (*Pseudotsuga menziesii*), Eastern beech (*Fagus orientalis*), Anatolian vhestnut (*Castanea sativa*), Alder (*Alnus glutinosa*), common hornbeam (*Carpinus betulus*), oak (*Quercus* sp.), poplar (*Populus* sp.) and willow (*Salix* sp.) species. In these areas, findings were obtained both in open areas and in forested areas with high closure. In the areas where the forest border ends, there are rosehip (*Rosa canina*), rhododendron (*Rhododendron* sp.) and blackberry (*Rubus discolour*).

Many mammalian species sharing the same habitats with the jackal have also been encountered in the research area with camera traps and direct observation. These species are predatory species that can compete with the jackal for food and adversely affect raising the offspring. Species such as brown bear (*Ursus arctos*), gray wolf, lynx (*Lynx lynx*), badger (*Meles meles*), and stray dogs that can be encountered in almost all the research area are also a significant threat to the jackal.

Threats to jackal populations throughout the study are lack of information about the species, poaching, predator pressure, stray dogs, roads, pesticides, and environmental pollution. Increasing traffic, especially during the periods of intense human activity, increases the incidence of frequent collisions with wild animals. In this region, where the road network is developed, the density of vehicles poses a problem not only for the jackal but also for other wild animals.

DISCUSSION

The hide coat colour of the jackal is generally golden yellow, but it varies between pale creamy yellow and dark brown tones depending on the season. Its back is usually a mixture of black, brown and white (Walton and Joly, 2003). The belly and underparts are pale ginger cream colour which is a lighter colour. The tip of its bushy bronze tail is black (Poché *et al*., 1987). The jackals, which were detected both directly and with the camera during this research, have a brown neck, throat, and shoulder. The edge of the lower lip and the throat are cream-coloured while the chin is brown. In the top of the nose, forehead, and between the ears brown mixes with black. It has long, cream-colored hairs inside its ears. Its body is coloured by the homogeneous distribution of brown, white, and black hairs in small groups. The belly is cream coloured. The tail starts thick and tapers like a triangle. Its tail, which extends to the knees, is generally black.

The jackal can live in forests or in open areas. It can be observed near villages and cities, where people live (Kait and Sahi, 2010). In the examinations made in the research area within the scope of the thesis study, it was seen that the jackal lived near the villages. The howling of the jackal was heard from different points. It has been determined that they are effective in land types with different characteristics such as forestry, meadow, hazelnut orchard, stream edge, vehicle road edge in the study area.

The jackal's food habits change seasonally, but consist of wild animals, human waste and small poultry (Genov and Vassilev, 1991; Lanszki and Heltai, 2002; Sillero–Zubiri *et al*., 2004; Raichev *et al*., 2013; Šálek *et al*., 2014; Ćirović *et al*., 2016). During this study, it was reported that the jackal attacked the chickens and chicks in the hensheds while the interviews were conducted with the local people.

The jackal usually hunts late at night and near dawn (Chourasia *et al*., 2020). Although it is nocturnal, it can be found in the field effectively during the day in suitable conditions and when it does not feel threatened (Kait and Sahi, 2010). Most of the jackals, 247 of which, were detected with the camera, were caught in the camera trap during the dark time, late at night and close to the morning. The jackal, whose activity was detected by direct observation, sound and camera trap during the daytime, was constantly on the move during these times. It was detected with a camera trap in the morning and near noon, by sound during the afternoon and evening, during darkening, and by direct observation in the afternoon.

Jackals generally hunt alone, but when they reach a significant number of individuals, it can be seen that they hunt as a family (Sillero–Zubiri *et al*., 2004; Markov, 2012). In most of the findings obtained from the field during the research, the jackal was viewed alone, and it was detected as a group in only 7 images.

According to many sources, the jackal is seen all over Trabzon and Arsin district (Turan, 1984; Moehlman and Hayssen, 2018; Hoffmann *et al*., 2020). According to Özkurt and Bulut (2020), it can be seen in the parts of Arsin district close to the sea, but not in Gümüşhane side and Gümüşhane. According to Ambarlı *et al*. (2016), on the other hand, it can be seen in the Eastern Black Sea Region close to the seacoast. However, according to the information obtained from the research area, the jackal was detected at least once every 7 km in the North-South direction from Kuzguncuk Neighborhood on the Black Sea coast, and it has been seen to live in many points in Dumanlı, the border village of Gümüşhane to Trabzon.

Some elevations in Europe where the jackal has been detected in the literatureare as follows: 18–287 m in Croatia (Krofel, 2007), 37–362 m in Serbia (Ćirović *et al*., 2014), 79–1203 m in Bosnia and Herzegovina (Trbojević *et al*., 2018), 380–850 m in Italy (Rassati, 2013), 400 m in Slovenia (Mihelič and Krofel, 2012), 1200 m in Bulgaria and Macedonia (Zlatanova, 2005); some elevations in Africa and Asia are as following: 157–2150 m in Pakistan

(Roberts, 1997; Mahmood *et al*., 2013), 181–271m in Nepal (Chaudhary, 2018), 241–936 m in India (Sharma *et al*., 2006; Kait and Sahi, 2010; Lal *et al*., 2016), 982 m in Iran (Arbabi and Hooshyar, 2006), 2000 m in India and Bangladesh (Poché *et al*., 1987), 3500–3800 m in Ethiopia (Sillero–Zubiri, 1996; Admassu *et al*., 2004). The elevations where the jackal was detected in this study are between 40 m and 1514 m, is compatible with the literature.

CONCLUSIONS

As a result of the findings obtained in this study, which investigated the use of the high elevation area of the jackal in the Yanbolu Valley, it was determined that the jackal was distributed in all seasons of the year in the forested parts of the research area and where more human presence was concentrated. Although it does not directly harm humans, the jackal can use farm animals as food, feed on human waste, and hunt other creatures that breed in fields and gardens created by humans. The jackal, which can interact directly with many wild and domestic mammals, can cause great danger directly or indirectly through other animals with rabies or another infectious disease. In addition to the potential damages of the jackal, it is thought that it contributes positively to the farming of the product by hunting piglets, which cause great loss in the fields which most of the people of the region benefit from. A decrease in the jackal population in an area can result in an increase in the wild boar population and thus financial damage to the people of the area. Based on these reasons, the jackal population in the region should be kept under control and in balance. Precautions should be taken against situations that may lead to sudden population increase or decrease. The following suggestions have been made in order to help all parties related to the issue, especially those who will work on jackal-related issues and those in decision-making positions: (i) Education and awareness activities should be carried out. (ii) The natural balance must be observed. (iii) The jackal population should be monitored regularly. (iv) Environmental pollution should be prevented.

This study is the first scientific study in Turkey on the use of high elevation space by the jackal. For this reason, a lot of information has been obtained, such as the determination of the presence of the species in the area, and the determination of the preferred elevations. However, it is necessary to determine which subspecies is especially widespread in Turkey, determiAne population densities, determine the habitats exactly and reveal the other parameters of the population. Therefore, there is a need for more comprehensive studies on this species in the future.

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Satement of conflict of interest

The authors have declared no conflict of interest.

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