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Distribution, density, and important hotspots of Krüper's Nuthatch *Sitta krueperi* in Turkey and Lesvos Island, Greece

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Abstract: Atlas projects and phylogeographic studies provide detailed information of great value on key species; distribution maps of the species are the primary input for establishing hotspots, conservation, and management plans. Krüper's Nuthatch (*Sitta krueperi*) is endemic to Anatolia, Lesvos Island, and the Caucasus region. We surveyed more than 1400 point counts in Turkey and Greece, covering most of its global distribution in its potential habitat, coniferous forestland, during the breeding season. The geographical information system was used for preparing the distribution maps and depicting the hotspots for Krüper's Nuthatch. The population density of Krüper's Nuthatch in all of Turkey was 10.25 ± 0.33 birds km^{-2}, which was significantly higher than on Lesvos Island (1.94 ± 0.79 birds km^{-2}) ($P < 0.001$). We found a negative correlation between the population density of the species and longitude. These results showed that the western part of the study area had higher densities than the eastern part. In conclusion, we recommend that the Beydağları Mountains and the Aladağlar Mountains in southern Turkey, and the Ilgaz Mountains and/or Kartalkaya Mountains in northern Turkey should be considered hotspots and preserved for the conservation of the species. Furthermore, the Beydağları Mountains should be considered as an Important Bird Area for Krüper's Nuthatch due to high population density and genetic diversity.

Key words: hotspots, density, distribution, conservation

1. Introduction

Krüper's Nuthatch *Sitta krueperi* is a species endemic to Anatolia, Lesvos Island, and the Caucasus region. Krüper's Nuthatch was classified as Lower Risk/Least Concern until 2004, Least Concern until 2005, Near Threatened (due to a moderately rapid decline of the population) until 2015, and from then to now has been reclassified as Least Concern (IUCN, 2017; BirdLife International, 2016; BirdLife International, 2004). It is also listed in the Greek (Karandinos and Paraschi, 1992) and Turkish Red Data Books classified as A.2. (Kiziroğlu, 2008). Krüper's Nuthatch is threatened by habitat fragmentation and losses due to logging, fires, and forest destruction for agriculture or housing and new settlements (Albayrak, 2007). Previous studies have provided insufficient information on conservation status of the species due to unknown population density, genetic diversity, population trends, and hotspots of Krüper's Nuthatch (Karandinos and Paraschi, 1992; Cramps and Perrins, 1993; Harrap and Quinn, 1996; Hagemeijer and Blair, 1997; Albayrak and Erdoğan, 2005, 2010).

Krüper's Nuthatch was thought to be confined to the coastal periphery of the Anatolian Peninsula (Roselaar, 1995), but there have been records from central Anatolia, Yozgat (Albayrak and Erdoğan, 2010). Limited numbers are found in the coniferous forestlands of the adjacent Greek island Lesvos and the Caucasus region (Harrap and Quinn, 1996; Hagemeijer and Blair, 1997; Harrap, 2008; Albayrak et al., 2010). Krüper's Nuthatch is strictly restricted to coniferous forests (Frankis, 1991; Albayrak and Erdoğan, 2005; Harrap, 2008; Albayrak et al., 2010); a clear relationship exists between the distribution of coniferous forest, especially red pine forest *Pinus brutia*, and the occurrence of Krüper's Nuthatch (Albayrak, 2007). This species is mostly sedentary, with some postbreeding dispersal and seasonal altitudinal movements (Cramps and Perrins, 1993; Harrap and Quinn, 1996; Handrinos and Akriotis, 1997). The breeding population on Lesvos Island is small, estimated at 50–100 pairs by Handrinos and Akriotis (1997) and 550–680 pairs by Harrap and Sharpe (2018). Albayrak et al. (2012) studied the genetic diversity of Krüper's Nuthatch and found 10 haplotypes from 2 different subpopulations located in the southern and northern parts of Anatolia, respectively.

Fine-scale atlas projects provide detailed information on species distribution and abundance (Pomeroy et al.,

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2008); they play an important role for the conservation and preparation of management plans for species (Brotons et al., 2004). Used with GIS software, they provide powerful tools for predictive habitat modeling, which is very helpful for wildlife conservation and management (Brotons and Herrando, 2003; Meggs et al., 2004), and for estimating population sizes (Gottschalk et al., 2007). Phylogeographical studies give detailed information on the genetic diversity of a species through its distribution range (Albayrak et al., 2012; Rodrigues et al., 2013). This information is used for conservation and management plans for key species. The distribution map of Krüper's Nuthatch, which is prepared with the presence of anecdotal data, is relatively well known (IUCN, 2017), but we do not know the density for the locations except for southern Anatolia (Albayrak et al., 2010). We do not know hotspots for Krüper's Nuthatch using not only population density but also the genetic diversity of the species. As a consequence, this study aimed to 1) create a distribution and population density map of Krüper's Nuthatch using standard field methods in Turkey and Greece; 2) identify hotspots for Krüper's Nuthatch by determining the population density and its genetic diversity in Turkey and Greece, covering most of its global distribution.

2. Materials and methods

2.1. Study site

Surveys were conducted in coniferous forestlands in Turkey and Greece (Lesvos and Chios Islands). All study areas were located on steep slopes starting from sea level to c. 4000 m a.s.l. The study site locations were selected randomly in coniferous forestlands, which covered all of the distribution range of the species except for the Caucasus region. The coniferous species *Pinus* spp., *Abies* spp., *Cedrus* spp., and *Picea* spp. have a wide distribution in Turkey (Akman, 1995); only 1 coniferous species, *Pinus brutia,* occurs on Lesvos and Chios Islands of Greece. Turkish coniferous forests are dominated by red pine *Pinus brutia*, black pine *Pinus nigra*, Scots pine *Pinus sylvestris*, Cilician fir *Abies cilicica*, Lebanon cedar *Cedrus libani*, and spruce *Picea orientalis*. The landscapes were diverse, with fragmented mountains running parallel to the Mediterranean coastline, which resulted in significant differences in climatic conditions from one subregion to the next. Coastal areas had milder climatic conditions. Inland areas had extremes of hot summers and cold winters with limited rainfall. Lesvos and Chios islands had a typical Mediterranean climate.

2.2. Estimating the distribution and density of Krüper's Nuthatch

A total of 1458 points (Turkey: 1390, Lesvos Island: 51, and Chios Island: 17, respectively) at least 300 m apart from each other were visited for point counts. The point count locations were selected only in coniferous forestland which is suitable habitat for Krüper's Nuthatch. The location of each point was recorded using a Magellan SporTrack Color GPS for geographical information system (GIS) analyses.

Bird censuses were conducted during the breeding season between early March and early June 2005–2007 by Albayrak (Albayrak and Erdoğan, 2005). During the breeding season, Krüper's Nuthatch is attracted to the male playback songs due to its strong territorial behavior. Male and female are quite similar, but differentiation can be made by an expert. The males, occasionally females, and juveniles give a response to the playback song from a maximum 150 m distance within 3 minutes (unpublished data). A point count with 3-minute playback was used to estimate the population density of Krüper's Nuthatch (Bibby et al., 1992, 1998). We recorded all individuals to calculate the population density of Krüper's Nuthatch within 3 minutes at a point before going to another sample point. We used the distance (150 m) as the radius to determine the population density of Krüper's Nuthatch. According to Albayrak et al. (2010), population density is a measurement of population size per unit area. Population density of Krüper's Nuthatch was calculated using the following equation:

The population density of Krüper's Nuthatch = $n/\pi r^2$ = birds km^{-2},

where n is the number of the individuals detected at the point, and r is the radius (0.15 km).

2.3. Data analyses

The sites in Turkey and Greece (Lesvos Island and Chios Island) were divided into 378 cells of approximately 2400 km^2, the boundaries of which followed the boundary of 1:100,000 sheet maps (Geomedia Professional 6.0; Figure 1). In total, 1458 point counts were carried out in 92 cells containing coniferous forest. The total sample points in each cell were calculated using the GIS software. We only used 48 of 92 cells which had more than 10 point counts in each cell for statistical purposes (for statistical analysis, we used a total of 1299 point counts with an average of 25.8 ± 2.3 point counts per cell (min. 11 point counts; max. 93 point counts). All data for the density of Krüper's Nuthatch within each cell was tested for normal distribution, and Pearson correlation analysis was used to determine the relationship between the population density of Krüper's Nuthatch and latitude and longitude. The difference in Krüper's Nuthatch population densities between Turkey and Lesvos Island were determined by Student's t-tests. The population densities of Krüper's Nuthatch in the cells were compared using one-way ANOVA followed by pairwise post-hoc Tukey multiple comparisons when ANOVA test results were significant.

Pearson correlation analysis was used to determine the relationship between the density of Krüper's Nuthatch

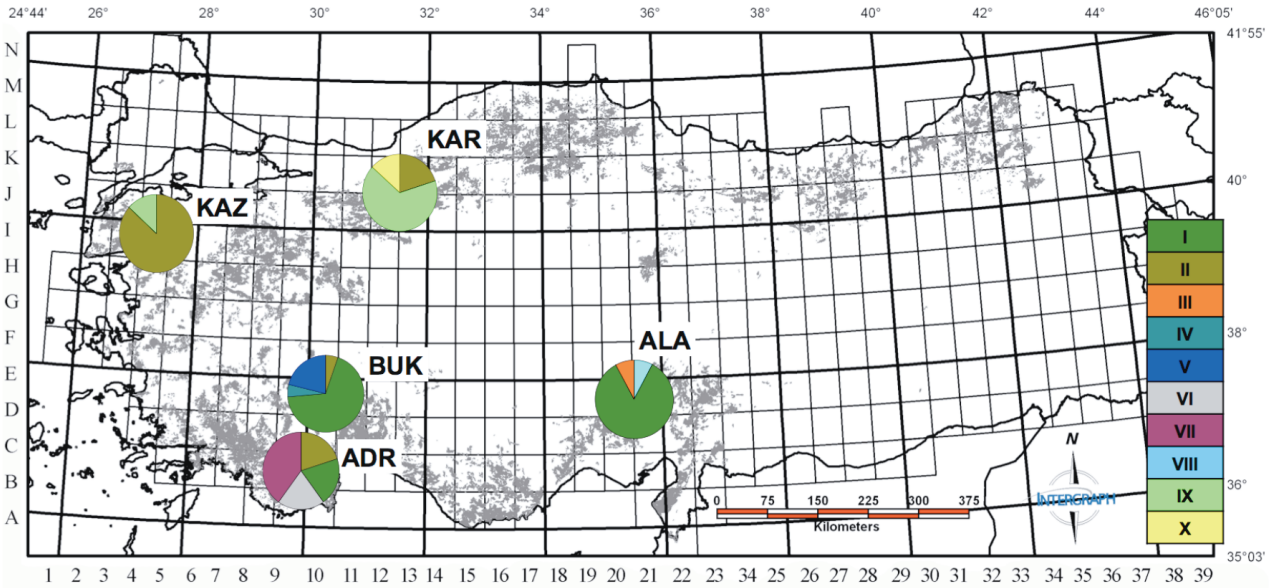


Figure 1. The sampling area for determining the distribution and population density of Krüper's Nuthatch. Y-axis letters and X-axis numbers were used to name the cells. The shaded area shows the distribution of coniferous forests (Ministry of Environment and Forestry of Turkey: www.ogm.gov.tr). Haplotypes are given as a pie chart, according to Albayrak et al. (2012).

(solely sample points) and 10-day survey periods from 1 March to 30 June. This encompassed 12 ten-day survey periods.

SPSS v11.5 statistical package was used for the statistical analyses and data evaluation. Results are presented as mean ± SE.

3. Results

A total of 1014 individual Krüper's Nuthatches were observed at 688 of 1458 sample points. They were observed as solitary individuals or pairs. Although both males and females responded to playback, males seemed to show stronger territorial behavior and approach the observer closely.

The population density of Krüper's Nuthatch in Turkey (10.25 ± 0.33 birds km^{-2}) was found to be significantly higher than on Lesvos Island (1.94 ± 0.79 birds km^{-2}; t-test = 4.83, $P < 0.001$). We did not observe any Krüper's Nuthatches on Chios Island although this island was covered with suitable habitat, mainly red pine forest.

Population densities of Krüper's Nuthatch showed a geographical pattern with statistical differences among cells ($F_{53.1245} = 8.43$, $P < 0.001$). The maximum density of Krüper's Nuthatch was found in the J8 cell (23.59 ± 3.29 birds km^{-2}), followed by K18, C15, B10, C10, L 17, E7, I4, D11, and E20, respectively (Figure 2). There was a significant negative correlation between the population density and longitude ($r = -0.22$; $F_{24.1274} = 11.35$, $P < 0.001$). These results show that the western parts of the study area had higher densities compared with the eastern parts. Maximum densities of Krüper's Nuthatch were found in longitudinal column 10 (17.36 ± 1.60 birds km^{-2}); the rest of the densities are given in Table.

The population density of Krüper's Nuthatch did not significantly increase or decrease latitudinally, although there were significant differences among some latitudinal lines ($F_{11.1287} = 3.95$, $P < 0.001$). The maximum latitudinal line was line M, the north of Turkey (17.1 ± 2.1 birds km^{-2}; Table).

There was a statistical negative correlation between the density of Krüper's Nuthatch and survey date periods ($r = -0.13$, $P < 0.001$), and a statistically positive correlation between survey date period and longitude ($r = 0.39$, $P < 0.001$). These results show that more individuals were observed in the early breeding season.

4. Discussion

The actual distribution maps of Krüper's Nuthatch are based on anecdotal data, i.e., birdwatchers' observations (IUCN, 2017), and current records are given in the literature (Neufeldt and Wunderlich, 1884; Roselaar, 1995; Kuşbank, 2015). They are not suitable for density calculation due to unstandardized observation methods. We estimated the distribution and population density of Krüper's Nuthatch using the standard point count method throughout the global distribution area of the species for the first time, with the exception of the Caucasus region.

In a previous study, we described the habitat preference and distribution in southern Anatolia (Albayrak et al., 2010). Krüper's Nuthatch inhabits only coniferous

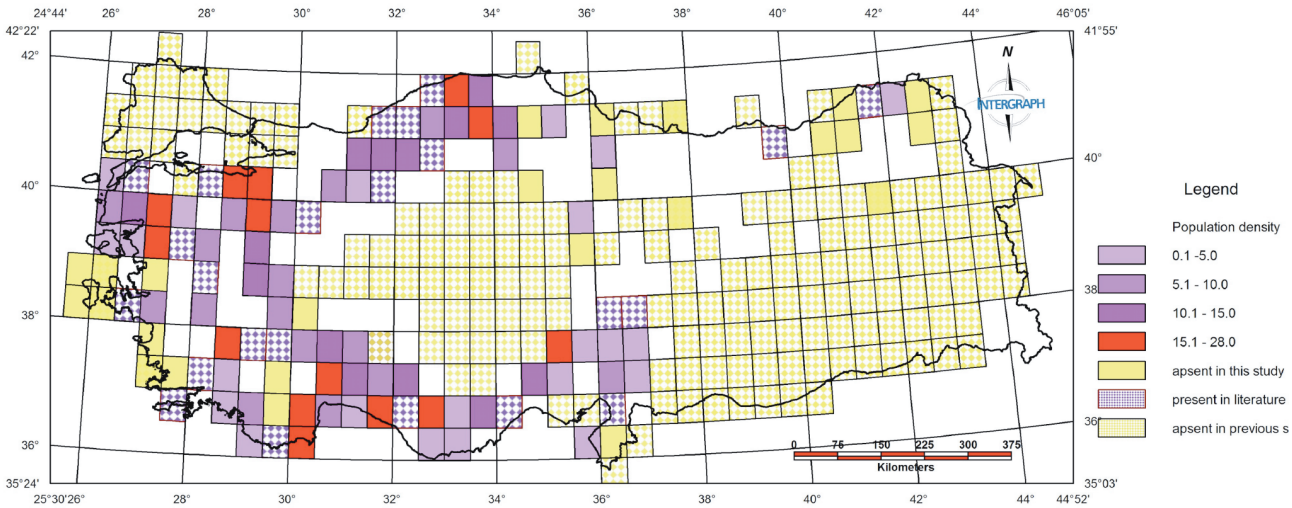


Figure 2. Distribution map of Krüper's Nuthatch using the density of Krüper's Nuthatch. Red cells show the highest density (in literature: Kuşbank, 2015; Neufeldt and Wunderlich, 1884; Roselaar, 1995).

Table. Mean density of Krüper's Nuthatch in the study area for cells, longitude, and latitude. Max. first 10 are given with SE.

Cell			**Longitude**			**Latitude**		
Cell no.*	**Mean**	**SE**	**Long. no.***	**Mean**	**SE**	**Lat. No.***	**Mean**	**SE**
J8	23.59	3.29	10	17.36	1.60	M	17.10	2.08
K18	23.16	4.38	8	17.30	1.86	C	14.31	1.51
C15	22.65	4.81	4	16.55	1.50	G	13.21	2.03
B10	20.95	1.66	17	16.45	2.30	I	12.09	0.88
C10	18.32	2.96	14	16.42	2.11	J	11.36	1.57
L17	18.32	4.16	19	13.48	2.07	F	10.76	1.65
E7	18.20	2.75	12	13.04	2.02	D	10.17	0.79
I4	17.97	2.01	13	12.99	1.60	K	9.39	1.08
D11	17.69	2.74	3	12.73	1.21	E	8.71	0.79
E20	17.46	2.69	11	12.58	1.21	L	8.49	1.26

* Given in Figure 1.

forestland (Harrap and Quinn, 1996; Albayrak and Erdoğan, 2005; Harrap, 2008; Albayrak et al., 2010), with a preference for mountainous mature coniferous forestland (Albayrak et al., 2010). Turkey has 21.18 million hectares of forest, covering 26% of the land surface of the country (Ministry of Environment and Forestry of Turkey: http://www.ogm.gov.tr). Most of these forests are in the mountains. According to Sağ (2002), there are 3.15 million hectares of forest found in zones that are 1500–2500 m a.s.l., and 42% of the forests are composed of coniferous species (Çolak and Rotherham, 2006). In this context, approximately 1.32 million hectares are suitable coniferous habitat for Krüper's Nuthatch in the Turkish mountains.

Although Frankis (1991) describes the association between ranges of red pine *Pinus brutia* and the distribution of Krüper's Nuthatch, we did not observe this relationship on Chios Island, which is covered by pure mature red pine forests. Furthermore, Krüper's Nuthatch does not occur on other islands like Chios which are covered in red pine and close to the Anatolian mainland (Harrap and Quinn, 1996). Why Krüper's Nuthatch occurs only on Lesvos Island may be explained by the founder effect of Krüper's Nuthatch on the island during the glacial period. This hypothesis is supported by the genetic diversity of Krüper's Nuthatch as well, with only 1 haplotype on Lesvos Island (Albayrak et al., 2012; unpublished data).

The mean density of Krüper's Nuthatch on Lesvos Island in red pine was lower than that reported for red pine forests in southern Turkey (7.75 ± 0.9 birds km^{-2}; Albayrak et al., 2010). It could be that there is an island effect on the breeding population, i.e., predation and suitable food availability. Although we found an average density of 10.3 birds km^{-2} and a maximum of 23.6 birds km^{-2} in coniferous stands across all sites, the highest mean density of the species was found in black pine (12.69 ± 2.4 birds km^{-2}), followed by Cilician fir (11.61 ± 2 birds km^{-2}), and Lebanon cedar (8.49 ± 1.8 birds km^{-2}) in southern Turkey (Albayrak et al., 2010). Population densities were lower than in the Caucasus Mountains, which were 32 birds km^{-2} in fir–beech *Abies–Fagus*, 48 birds km^{-2} in fir, 34 birds km^{-2} in pine *Pinus* forest, 50–90 birds km^{-2} in mixed forests, and only 4 birds km^{-2} in maple *Acer* (Hagemeijer and Blair, 1997); they were also lower than in the black pine forests of Corsica for the closely related species Corsican Nuthatch *Sitta whiteheadi* (15.8 pairs km^{-2}; Thibault et al., 2002). This lower density in Turkey could be explained by logging in suitable habitats and its breeding success (mean breeding success: 71.6 ± 7.8%, and mean clutch size: 5.6 ± 0,2 eggs; Albayrak and Erdoğan, 2005). Total forest cover is increasing in Turkey with plantations (www.ogm.gov.tr), but new planted coniferous areas are not suitable for Krüper's Nuthatch due to insufficient insect food and nesting areas (Albayrak, 2007). Albayrak et al. (2010) recommend preservation of mature coniferous forests, especially black pine forests, at high altitudes for Krüper's Nuthatch conservation in southern Anatolia. Higher population densities of Krüper's Nuthatch were found in the Beydağları Mountains (BEY) and Aladağlar Mountains (ALA) in southern Turkey, and the Ilgaz Mountains (ILG) and Kartalkaya Mountains (KAR) in northern Turkey.

Although bird species richness and abundance decrease with latitude (Bellis et al., 2009), we did not find any latitudinal relationship on the population density of Krüper's Nuthatch in our study. The Anatolian Peninsula extends only 6 degrees of latitude (36–42), which may not be enough to find a latitudinal effect. Our results showed that there is a positive correlation between the density of Krüper's Nuthatch and longitude from the eastern to the western regions. This result is similar to the results of Albayrak et al. (2010) from southern Anatolia. This may be because there tends to be more coniferous forest cover, and/or the fieldworks were done during the early breeding season in western regions. This hypothesis should be checked by using the same methodology in the late breeding season.

Some previous studies have shown that the southern and northern parts of Turkey have genetically and morphologically different subpopulations of Krüper's Nuthatch (Albayrak et al., 2011; Albayrak et al., 2012). Albayrak et al. (2012) found a total of 10 haplotypes. Two haplotypes in Aladağlar Mountain (ALA), 4 haplotypes in Beydağları Mountain (BEY), and 1 haplotype in Kartakaya Mountain (KAR) were found to be unique haplotypes in the region (Figure 1). The unique haplotypes should be used for conservation and management activities of the species. All genetic diversity of Krüper's Nuthatch should be preserved, especially in the southern and northern parts of Turkey separately.

Population density and distribution should be taken into account when developing conservation and management plans for species (Lopes et al., 2008; de Roland et al., 2009; Mattos et al., 2009). In this regard, some hotspot areas for Krüper's Nuthatch should be identified for conservation purposes. Hotspots ought to include genetic diversity and have high population density. For this reason, we do not suggest all red cell areas as hotspots (e.g., around Uludağ Mountain, north of Anamur, etc.) (Figure 2), due to low or common genetic diversity, nor Lesvos Island, due to low population density and low genetic diversity. We recommend that the Beydağları Mountains (BEY; 4 unique haplotypes) and Aladağlar Mountains (ALA; 2 unique haplotypes) in southern Turkey, and the Ilgaz Mountains (ILG) and/or Kartalkaya Mountains (KAR; 1 unique haplotype) in northern Turkey be considered as hotspots for conservation of the species. Furthermore, the Beydağları Mountains should be considered as an Important Bird Area for Krüper's Nuthatch due to its high population density, high genetic diversity (6 haplotypes), and the amount of mature forestland. For conservation of the species, logging activities should be forbidden in mature coniferous forestlands in the mountains, and the hotspots should be regularly monitored.

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References

Akman Y (1995). Türkiye Orman Vejetasyonu. Ankara Üniv. Fen Fak. Botanik ABD.

Albayrak T (2007). Determination of populatıon diversity, distribution and habitat preference of Krueper's Nuthatch (*Sitta krueperi*) in Turkey and Lesvos Island. PhD, Akdeniz University, Antalya, Turkey.

Albayrak T, Bairlein F, Erdoğan A (2010). Habitat parameters and breeding density of Kruper's Nuthatch *Sitta krueperi* Pelzeln in southern Turkey. Pol J Ecol 58: 545-552.

Albayrak T, Besnard A, Erdoğan A (2011). Morphometric variation and population relationships of Krüper's Nuthatch (*Sitta krueperi*) in Turkey. Wilson J Ornithology 123: 734-740.

Albayrak T, Gonzalez J, Drovetski SV, Wink M (2012). Phylogeography and population structure of Krüper's Nuthatch *Sitta krueperi* from Turkey based on microsatellites and mitochondrial DNA. J Ornithol 153: 405-411.

Albayrak T, Erdoğan A (2005). Breeding ecology of Kruper's nuthatch (*Sitta krueperi*) near Antalya, Turkey. Isr J of Zool 51: 309-314.

Albayrak T, Erdoğan A (2010). A GIS-based approach to assess the population size of Kruper's Nuthatch, *Sitta krueperi* at a newly found breeding area in Inner Anatolia (Aves: Passeriformes). Zoology in Middle East 49: 27-32.

Bellis LM, Rivera L, Politi N, Marti E, Perasso ML, Cornell F, Renison D (2009). Latitudinal patterns of bird richness, diversity and abundance in *Polylepis australis* mountain forest of Argentina. Bird Conserv Int 19: 265-276.

Bibby C, Jones M, Marsden S (1998). Bird Surveys: Expedition Field Techniques. London, UK: Expedition Advisory Centre.

Bibby JC, Gess ND, Hill DA (1992). Bird Census Techniques. London, UK: Academic Press.

BirdLife International (2004). Birds in Europe: Population Estimates, Trends and Conservation Status. Cambridge, UK: BirdLife International.

BirdLife International (2016). *Sitta krueperi*. The IUCN Red List of Threatened Species 2016: e.T22711184A94282660. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22711184A94282660.en. Downloaded on 01 June 2017.

Brotons L, Herrando S (2003). Effect of increased food abundance near forest edges on flocking patterns of Coal Tit *Parus ater* winter groups in mountain coniferous forests. Bird Study 50: 106-111.

Brotons L, Manosa S, Estrada J (2004). Modelling the effects of irrigation schemes on the distribution of steppe birds in Mediterranean farmland. Biodivers Conserv 13: 1039-1058.

Çolak AH, Rotherham ID (2006). A review of the forest vegetation of Turkey: its status past and present and its future conservation. Biology and Environment 106B: 343-354.

Cramps S, Perrins CM (1993). The Birds of the Western Palearctic. Oxford, UK: Oxford University Press.

de Roland LAR, Thorstrom R, Razafimanjato G, Rakotondratsima MPH, Andriamalala TRA, Sam S (2009). Surveys, distribution and current status of the Madagascar Harrier *Circus macrosceles* in Madagascar. Bird Conserv Int 19: 309-322.

Frankis MP (1991). Krüper's Nuthatch *Sitta krueperi* and Turkish pine *Pinus brutia*: an evolving association? Sandgrouse 13: 92-97.

Gottschalk TK, Ekschmitt K, İsfendiyaroğlu S, Gem E, Wolters V (2007). Assessing the potential distribution of the Caucasian black grouse *Tetrao mlokosiewiczi* in Turkey through spatial modelling. J Ornithol 148: 427-434.

Hagemeijer WJM, Blair MJ (1997). The EBCC Atlas of European Breeding Birds: Their Distribution and Abundance. London, UK: T&AD Poyser.

Handrinos G, Akriotis T (1997). The Birds of Greece. London, UK: Christopher Helm.

Harrap S (2008). Sittidae (Nuthatches). In: del Hoyo J, Elliott A, Christie D, editors. Handbook of the Birds of the World. Barcelona, Spain: Lynx Edicions.

Harrap S, Sharpe CJ (2018). Krueper's Nuthatch (*Sitta krueperi*). In: del Hoyo J, Elliott A, Sargatal J, Christie DA, de Juana E, editors. Handbook of the Birds of the World Alive. Barcelona, Spain: Lynx Edicions (retrieved from https://www.hbw.com/node/59926 on 8 June 2018).

Harrap S, Quinn D (1996). Tits, Nuthatches and Treecreepers. London, UK: Christopher Helm.

IUCN (2017). IUCN Red List of Threatened Species. Version 2017-1. <www.iucnredlist.org>. Downloaded on 01 June 2017.

Karandinos M, Paraschi L (1992). The Red Data Book of Threatened Vertebrates of Greece. Athens, Greece: WWF.

Kiziroğlu I (2008). Red Data Book for Birds of Türkiye. Ankara, Turkey: Desen Matbaası.

Kuşbank (2015). Records of *Sitta krueperi* <http://www.worldbirds.org/v3/turkey.php|>. Downloaded on 23 June 2015. Doğa Derneği/BirdLife 2005.

Lopes LE, Maldonado-Coelho M, Hoffmann D, Luiz ER, D'Angelo S (2008). Geographic distribution, habitat association, and conservation status of the critically endangered Minas Gerais Tyrannulet *Phylloscartes roquettei*. Bird Conserv Int 18: 53-62.

Mattos JCF, Vale MM, Vecchi MB, Alves MAS (2009). Abundance, distribution and conservation of the Restinga Antwren *Formicivora littoralis*. Bird Conserv Int 19: 392-400.

Meggs JM, Munks SA, Corkrey R, Richards K (2004). Development and evaluation of predictive habitat models to assist the conservation planning of a threatened lucanid beetle, *Hoplogonus simsoni*, in north-east Tasmania. Biol Conserv 118: 501-511.

Neufeldt IA, Wunderlich K (1984). *Sitta krueperi* Pelzeln-Türkenkleiber, Rotbrustkleiber. In: Dathe H, Neufeldt IA, editors. Atlas Der Verbreitung Palaearktischer Vögel. Berlin, Germany: Akademie Verlag (in German).

Pomeroy D, Tushabe H, Cowser R (2008). Bird atlases: how useful are they for conservation? Bird Conserv Int 18: 211-222.

Rodrigues P, Jorge R, Trista R (2013). Phylogeography and genetic diversity of the Robin (*Erithacus rubecula*) in the Azores Islands: evidence of a recent colonization. J Ornithol 154: 889-900.

Roselaar CS (1995). Songbirds of Turkey: An Atlas of Biodiversity of Turkish Passerine Birds. Mountfield, UK: Pica Press.

Sağ BM (2002) Türkiye'deki yüksek dağ ormanlarinin planlama ilkeleri. MSc, İstanbul University, İstanbul, Turkey.

Thibault JC, Seguin JF, Villard P, Prodon R (2002). Is the Corsican Pine (*Pinus nigra laricio*) a key-species for the Corsican Nuthatch (*Sitta whiteheadi*)? Rev Ecol-Terre Vie 57: 329-341.