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An evaluation of the distribution pattern of the common chaffinch (*Fringilla coelebs*) in Turkey

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Abstract: The common chaffinch (*Fringilla coelebs*) is one of the most common and widespread of the Western Palearctic songbirds and breeds primarily in natural forests in the northern, western, and southwestern parts of Turkey. We reevaluated the distribution of this species in Turkey with recent observational data. Although this species has been considered a breeder in southeastern Turkey, results of this study suggest that it probably does not breed in the region any longer. We examined the effect of climatic (temperature, precipitation, potential evapotranspiration) and topographic (altitude) variables on common chaffinch distribution in Turkey. Our findings show that the presence of this species is more likely in zones with high summer precipitation, which is probably associated with primary productivity and the habitats favored by this species.

Key words: Common chaffinch, distribution, climate, primary productivity, Turkey

İspinozun (*Fringilla coelebs*) Türkiye'deki dağılım deseni üzerine değerlendirme

Özet: İspinoz (*Fringilla coelebs*) Batı Palearktik Bölge'de oldukça genel ve yaygın bir ötücü kuş türüdür. Türkiye'nin kuzeyindeki, batısındaki ve güneyindeki doğal ormanlık alanlarda üremektedir. Bu çalışmada güncel gözlemsel verilerle bu kuş türünün Türkiye'deki dağılımı analiz edilmiştir. İspinoz güneydoğu Türkiye'de genellikle üreyen bir kuş türü olarak kabul edilmesine karşın, bu çalışmanın sonuçları ispinozun bu bölgede muhtemelen üremediğini göstermektedir. Bu çalışmada iklimin (sıcaklık, yağış, potansiyel evapotranspirasyon) ve topografyanın etkisi incelenmiştir. Bulgularımız türün varlığının birincil üretimle ilişkili olarak yaz yağışı ve uygun habitat varlığıyla ilişkili olduğunu göstermiştir.

Anahtar sözcükler: İspinoz, dağılım, iklim, birincil üretim, Türkiye

Introduction

The distributions of higher vertebrates have been studied for decades (Woinarski et al., 1999; Canterbury, 2002; Reichholf, 2005), and they are shaped by multiple factors that act together through space and time (Carrascal and Diaz, 2006). Important elements that determine a species' presence are the physical environment and vegetation of an area (Githaiga-Mwicigi et al., 2002). Specifically, climate is a primary force shaping the biogeographic ranges of species and may influence a species' range directly through its influence on vegetation and food availability (Andrewartha and Birch, 1954).

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With respect to birds, several studies have just been published showing that birds clearly respond to changes in abiotic factors, especially climate (Lloyd and Palmer, 1998; Dyrcz and Halupka, 2008). Therefore, birds are excellent indicators of climate (Stantchinsky, 1927), and effects on distribution patterns can be seen quickly due to their mobile lifestyles. Although many factors affect the distribution pattern of birds, temperature and precipitation may be most critical. Temperature and, especially, precipitation affect primary plant productivity (Thornthwaite and Matter, 1957), which then determines the amount of energy available to community members to turn into biomass (Evans et al., 2005). Therefore, food availability in a suitable habitat for birds may be restricted by these climatic parameters.

The common chaffinch (*Fringilla coelebs*) is one of the most common and widespread of Western Palearctic songbirds (Cramp et al., 1994) (Figure 1). In Turkey, it has both wintering and resident populations (Kirwan et al., 1998). The distribution of the common chaffinch in Turkey usually follows the natural forests (Figures 2 and 3), and thus it can be seen regularly in the northern, western, and southwestern parts of the country. However, Beaman (1978), Roselaar (1995), and several guidebooks covering Europe and the Middle East (Mullarney et al., 1999; Porter et al., 2005) show that the common chaffinch breeds in southeastern Turkey. These statements, however, are based on limited field observations that are more than 40 years old (Kumerloeve, 1961). Furthermore, the habitat structure of the region can no longer be defined as a suitable breeding area for the common chaffinch (Kirwan et al., 2008).

In the present study, an evaluation to clarify the common chaffinch's distribution in Turkey was carried out. Another aim of the study was to determine whether the distribution of the common chaffinch in Turkey is correlated with temperature and precipitation.

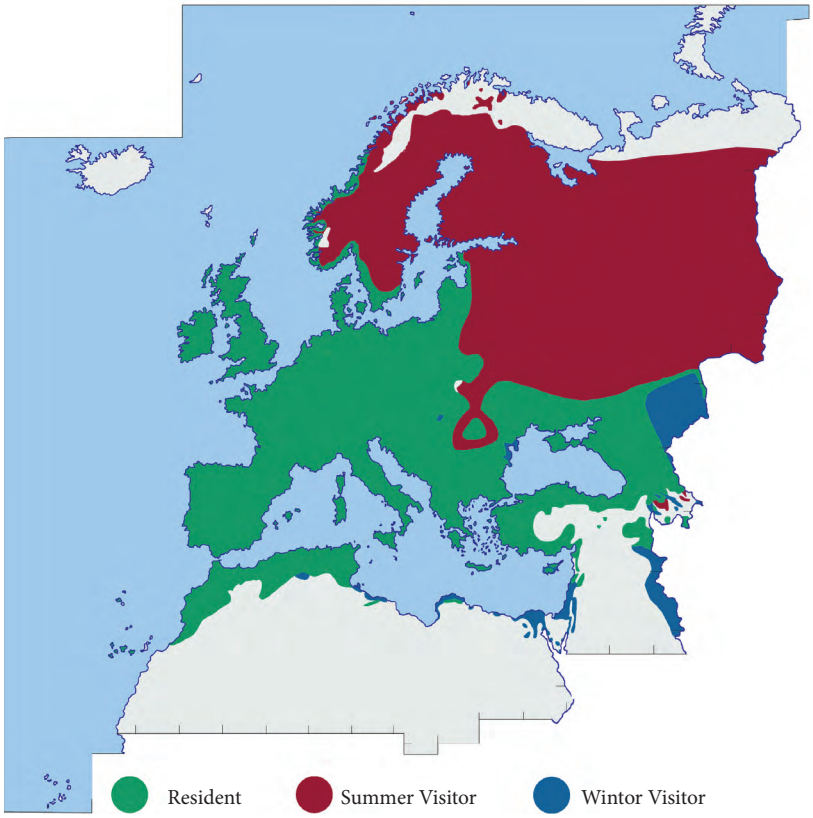

Figure 1. Distribution of the common chaffinch (*Fringilla coelebs*) in the Western Palearctic (adapted from Snow and Perrins, 1998).

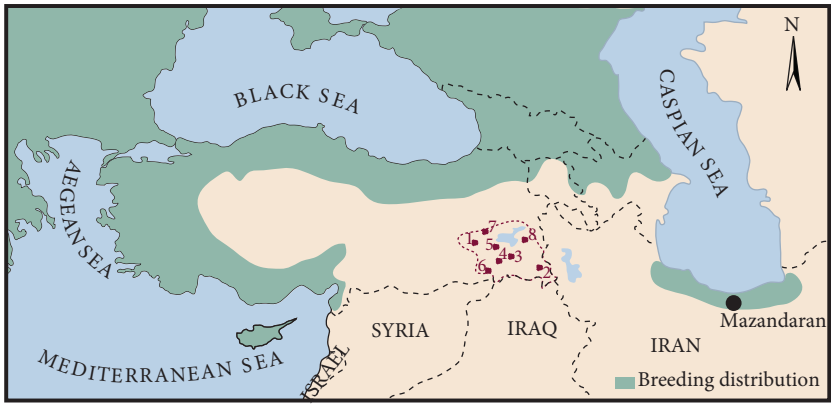

Figure 2. Regular (green area) and disputed (orange dash line) breeding distribution of the common chaffinch (*Fringilla coelebs*) in Turkey and its environs. The current breeding distribution (green area) was adapted from Snow and Perrins (1998). The red dots indicate locations we reviewed (from Cramp et al. 1994, Roselaar 1995, Snow and Perrins 1998) within the disputed area of southeastern Turkey where we did not detect breeding chaffinches (1-Bingöl, 2-Hakkari, 3-Bitlis, 4-Siirt, 5-Muş, 6-Mardin, 7-Hınıs, 8-Van). The map is not scaled.

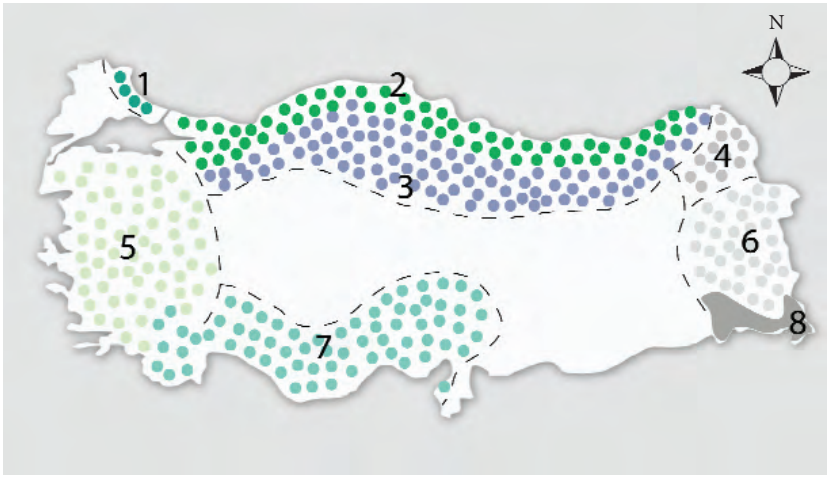

Figure 3. Natural forests in Turkey and habitat structure in the problematic area for the common chaffinch in the southeastern part of Turkey. 1- Balkan mixed forests, 2- Euxine-Colchic deciduous forests, 3- Northern Anatolian coniferous and deciduous forests, 4- Caucasus mixed forests, 5- Anatolian conifer and deciduous mixed forests and Aegean and Western Turkey sclerophyllous and mixed forests, 6- Eastern Anatolian montane steppe (uncertain area for the common chaffinch's distribution), 7- Southern Anatolian montane coniferous and deciduous forests, 8- Zagros mountains forest steppe (uncertain area for the common chaffinch's breeding distribution). The map was adapted from Kirwan et al. (2008).

Materials and methods

To determine the current distribution of the common chaffinch in Turkey, we reviewed data we collected from several field studies between 1998 and 2007, which used observation and counting methods suggested by Bibby et al. (2000) (also see T.C. Çevre Bakanlığı, 1999; Albayrak, 2002; Perktaş and Ayaş 2005 for methodological details). More recently, we performed a field study in Van and its environs in June in 2007 to find breeding evidence of the common chaffinch. We also reviewed observational records submitted to KuşBank between 1984 and 2008. KuşBank is an internet-based spatial database about birds and their distribution in Turkey that allows users from anywhere in the world to input and access Turkish bird data (www.kusbank.org). In addition to our observations and KuşBank data, we also included data published in Roselaar (1995). All observational data used in these analyses were limited to the breeding period for the common chaffinch (March-August) as defined by Cramp et al. (1994). To determine whether observations of chaffinches in our data and KuşBank data represented breeding records, we used a robust evaluation process such that breeding records had to consist of at least 10 individuals. For clear breeding records, observation time and individual numbers are important themes (Bibby et al., 2000).

To evaluate the influence of climate and topography on the current distribution of the common chaffinch, temperature, precipitation, potential evapotranspiration, and altitude (also see Matthews et al., 2004 for climatic and geographic variables) from 100 selected localities from all over Turkey were taken into consideration. To determine these 100 localities, current and possible breeding locations (n = 64) were considered first, and other locations were chosen randomly from non-breeding locations (n = 36). Non-breeding locations were locations where breeding had not been recorded yet. Climatic and topographic data were obtained from the Turkish State Meteorological Service. These data were averaged over a 31-year period (1975-2005). Locality names and breeding status of the common chaffinch are shown in the Appendix. In the Appendix, we used question marks for disputed locations. Although Roselaar (1995) suggested some breeding locations from the disputed area (Figure 2), we preferred to use question mark for locations from these areas, because, according to our survey on this area in 2007, we did not find any evidence on breeding for the species and we did not also find any recent records from KuşBank.

A principal component analysis (PCA) based on a correlation matrix was used to derive climatic axes using raw climatic and topographic data. A Kruskal-Wallis test (H) was used to analyze differences in principal component scores (PC1, PC2, and PC3) between localities in which the common chaffinch breeds and localities where it does not breed (Sokal and Rohlf, 1995). The significance level was chosen as $P < 0.05$.

Results

The correlations in PCA were mostly statistically significant ($P < 0.001$), and the first 3 axes explained 82.52% of the total variance (Table). The first axis (PC1) was characterized by temperature and potential evapotranspiration. The second axis (PC2) was characterized by summer precipitation (from June to September), and the third axis (PC3) was characterized by spring precipitation (from March to June) (Table). Localities with and without the common chaffinch were not separated when axis 1 was plotted against axis 2 or 3 (Figure 4a, b). However, some localities where the common chaffinch does not breed and/or its status is not clear were separated when axis 2 was plotted against axis 3 (Figure 4c).

Localities where the common chaffinch is present or absent did not differ significantly in PC1 scores ($X^2 = 1.920$, df = 2, $P = 0.383$). Thus, temperature and potential evapotranspiration did not affect the common chaffinch distribution in Turkey (Figure 5a). Otherwise, the same localities were significantly separated according to scores of PC2 ($X^2 = 6.613$, df = 2, $P = 0.037$; Figure 5b). PC2 axis seems more related to precipitation than temperature, evapotranspiration, or altitude. Localities in which the common chaffinch does not breed had higher scores for the PC3 axis, indicating that the common chaffinch is breeding primarily in zones with higher levels of summer precipitation ($X^2 = 7.213$, df = 2, $P = 0.027$; Figure 5c). According to these results, there is a positive correlation between precipitation and the common chaffinch's breeding distribution in Turkey. However, PC3 showed more variation than PC2 and therefore the presence of the common chaffinch is probably

Table. Principal component axes, their scores, eigenvalues, and explained variance according to precipitation, temperature (in both cases, from the breeding months), potential evapotranspiration, and altitude.

		PC1	PC2	PC3
PRECIPITATION	MARCH	0.419	0.410	0.700
	APRIL	-0.012	0.318	0.886
	MAY	-0.574	0.357	0.574
	JUNE	-0.656	0.648	-0.174
	JULY	-0.422	0.843	-0.224
	AUGUST	-0.355	0.864	-0.185
TEMPERATURE	MARCH	0.576	0.173	-0.306
	APRIL	0.893	0.214	-0.164
	MAY	0.954	0.150	-0.060
	JUNE	0.937	0.127	0.049
	JULY	0.884	0.017	0.240
	AUGUST	0.770	0.044	0.269
POTENTIAL EVAPOTRANSPIRATION		0.877	0.242	-0.04
ALTITUDE		-0.613	-0.505	0.446
Eigenvalue		**6.675**	**2.703**	**2.176**
Variance %		**47.677**	**66.982**	**82.524**

associated with low scores of PC3 (Figure 4b and c). Some localities in southeastern Turkey (Bitlis, Hakkari, Bingöl, Siirt, Muş, Mardin, and Van area) were clearly separated according to scores of PC3, suggesting that they are unsuitable for the common chaffinch because of lower summer precipitation.

Discussion

Simple environmental factors have often been used to explain the distribution of animal species (Cuento and Casenave, 1999). For instance, climate, geographical, and habitat variables have successfully been used in large-scale analyses of bird distribution (Huertas and Diaz, 2001; Canterbury, 2002; Seoane et al., 2004; Carrascal and Diaz, 2006). In particular, temperature and precipitation have been suggested as the key factors determining the distribution patterns of animals (MacArthur, 1975; Herrera, 1978; Root, 1988).

Although the climate results of this study are correlative, this paper is important to understand the effect of abiotic factors on the distribution of a widespread temperate bird species in Turkey. In Turkey, the common chaffinch is a good species for understanding the interaction of biotic (e.g., vegetative structure) and abiotic components (e.g., climatic factors) in the environment. For instance, the current distribution of the common chaffinch in southeastern Turkey is uncertain because climate conditions and habitat structure seem unsuitable. Historically, this area may have had a stable habitat structure, but abiotic factors combined with habitat degradation no longer allow the common chaffinch to survive in this region. Therefore, the distribution of the common chaffinch shown by Kumerloeve (1961) and Beaman (1978) needs to be revised.

According to Huntley et al. (2007), this species breeds in most of Europe where annual temperature sum exceeds 5 °C. However, we did not support this suggestion. Localities in southeastern Turkey, which we reviewed here, usually have average temperature higher than 5 °C.

The common chaffinch usually breeds in natural forests in Turkey. Mediterranean and Boreal forests are very important breeding habitats for the common chaffinch (Tucker and Evans, 1997). However, the

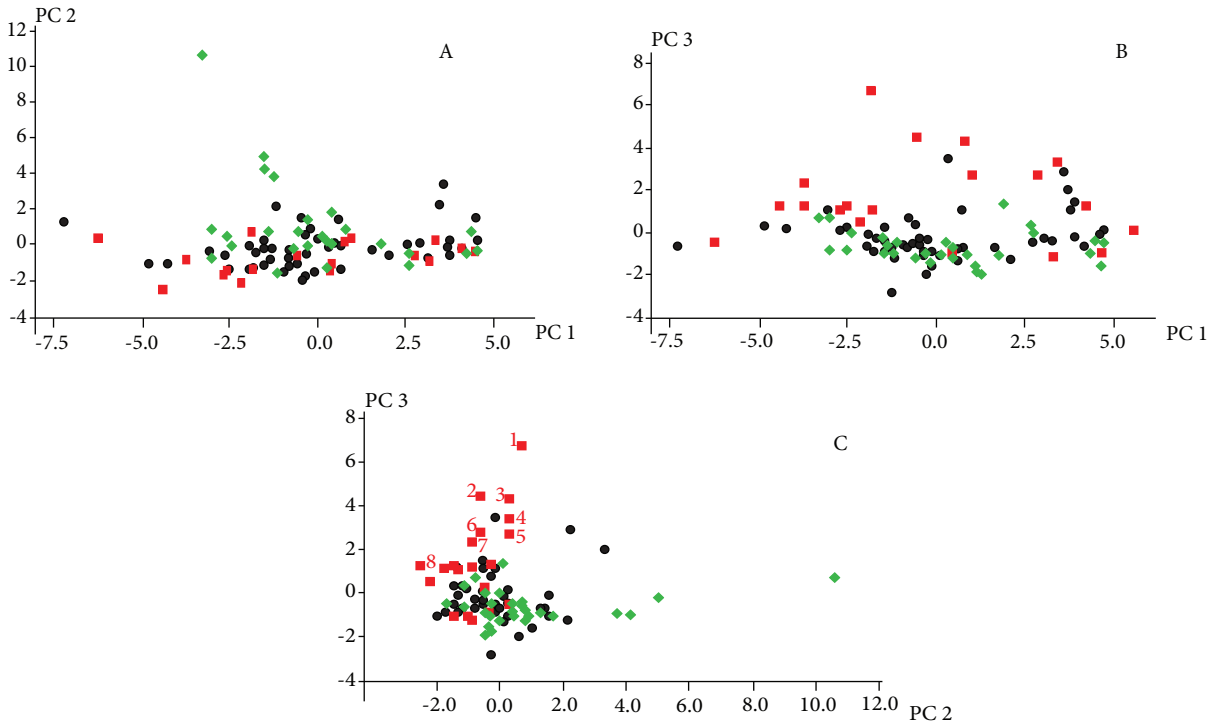

Figure 4. Plots of all PCA axes. A) Plot of the first and second axes. B) Plot of the first and third axes. C) Plot of the second and third axes. The green points show breeding localities of the common chaffinch from KuşBank; the black points show breeding localities of the common chaffinch from our observations and Roselaar (1995), and the red points show localities where we did not detect common chaffinch breeding. In C, 1– Bitlis, 2– Hakkari, 3– Bingöl, 4– Siirt, 5– Muş, 6– Mardin, 7– Hınıs, 8- Van area (Başkale, Erçiş, Malazgirt).

southeastern part of Turkey is mostly covered by mountain steppes and mountain forest steppes where forest areas were degraded (Mortan and Atalay, 2005). As stated by Sanz (2002), changes in bird distribution and abundance can be attributed to habitat alterations, especially due to human activity. Because of the habitat degradation in southeastern Turkey, there probably is no longer sufficient suitable habitat for the common chaffinch in this area. However, some oak (*Quercus* spp.) woodlands in Şemdinli Valley in Hakkari could allow limited breeding habitat for the common chaffinch (see Özhatay et al., 2005, for habitat details of Şemdinli Valley). Although Beaman (1978) indicated some breeding records of the common chaffinch from southeastern Turkey, no breeding records have been published recently from this part of the country. Furthermore, Kirwan et al. (2008), the most recent bird literature for Turkey, did not report any past and/or recent breeding information of the common chaffinch from southeastern Turkey.

In addition to climatic conditions and habitat structure, primary productivity is another important issue for understanding distribution patterns of species (Meiri et al., 2007). Primary productivity depends on precipitation (Rosenzweig, 1968). Precipitation is especially important in dry environments (Hawkins et al., 2001), where it determines the vegetation structure, directly affecting the distribution of bird species.

Therefore, after the forested habitat was destroyed in southeastern Turkey, climatic conditions in the region probably prevented the forest from regenerating fast enough to overcome continued habitat degradation. Therefore, it is plausible to say that the dry climate of southeastern Turkey in combination with habitat degradation cannot support a stable breeding area for the common chaffinch.

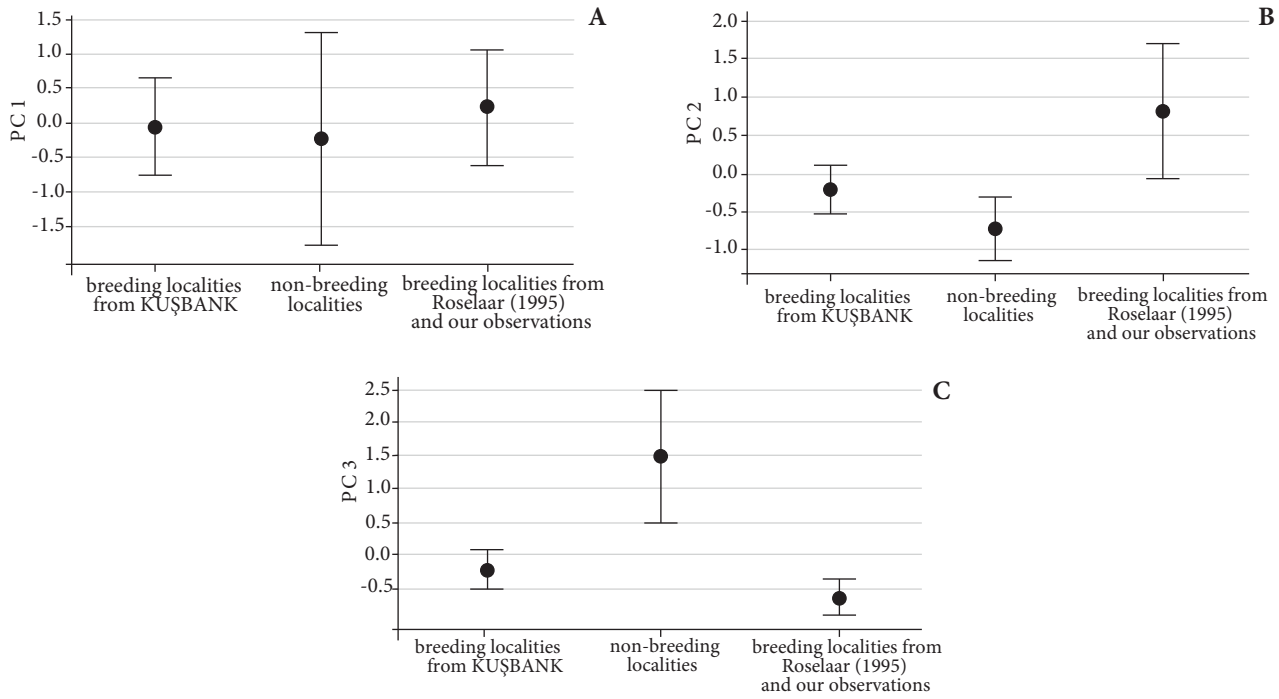

Figure 5. Average scores in the first 3 principal component axes for 1- Breeding localities of the common chaffinch from KuşBank, 2- Localities which the common chaffinch does not breed and/or it is absent, and 3-. Breeding localities of the chaffinch from our observations and Roselaar (1995). Error bars show 99.5% confidence intervals for the mean.

To corroborate our findings from Turkey, we inspected the distribution of the common chaffinch in the Middle East. Interestingly, breeding has also been reported from Mazandaran, Iran (Cramp et al., 1994). The breeding status in this region was also confirmed from museum skins (U. Perktaş). Three breeding individuals were collected from this area in July 1940, and stored in the Department of Ornithology, American Museum of Natural History. Moisture provided by the Caspian Sea creates a more suitable habitat for the common chaffinch in Mazandaran than in southeastern Turkey. In comparison, the higher spring and summer precipitation in the Mazandaran area has resulted in a suitable forest habitat. Local forest areas in northern Iran probably have high relative productivity and, therefore, may be more suitable for breeding by the common chaffinch.

Our proposed distribution for the common chaffinch in Turkey is closely correlated with the distribution created from observational data (Figures 1 and 2). However, some regions of southern Turkey (e.g. Kahramanmaraş, Antakya) could be considered "marginal" because they are characterized by relatively low summer precipitation and relatively low spring precipitation.

Birds are usually considered good indicators of changing habitat because they can fly and easily change their locations when necessary (Furness and Greenwood, 1993). Although more field studies about the common chaffinch's distribution in Turkey are needed, our main conclusion is that the breeding distribution of the common chaffinch in Turkey is correlated to climate.

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Appendix

Localities used in this study, breeding status (BS), and maximum numbers (N) of common chaffinch at these localities. • Current breeding, ◆ Possible breeding (Some locations shown as possible breeding, because we did not find any recent record from these locations but this locations are assumed within regular breeding distribution of the species), - No records. ? Disputed locations for breeding records (Some locations shown as a question mark (?), because we do not have any breeding records, and there are no recent records, and there is no widespread suitable habitat).

Locality	BS	N	Locality	BS	N
Edirne	•	20	**Mersin**	•	36
Lüleburgaz	◆		**Adana**	-	
Tekirdağ	◆		**İskenderun**	•	
İstanbul	•	1022	**Antakya**	•	
İzmit	•	287	**Elbistan**	-	
Adapazarı	◆		**Elmalı**	-	
Çanakkale	•	25	**Finike**	-	
Bursa	•	450	**Göksun**	-	
Bilecik	•	42	**Kozan**	-	
Balıkesir	◆		**Marmaris**	◆	
Kırklareli	•	1195	**Çankırı**	-	
Kütahya	◆		**Sivas**	-	
Manisa	•	200	**Eskişehir**	-	
Akhisar	-		**Ankara**	•	1006
Uşak	-		**Yozgat**	•	50
Afyon	-		**Kayseri**	-	
İzmir	•	271	**Kırşehir**	-	
Bergama	•	110	**Niğde**	•	20
Kuşadası	◆		**Beyşehir**	-	
Aydın	-		**Konya**	-	
Denizli	-		**Karaman**	-	
Muğla	•	357	**Beypazarı**	•	230
Dinar	-		**Divriği**	-	
Simav	-		**Kızılcahamam**	•	160
Zonguldak	•	25	**Erzincan**	•	
İnebolu	-		**Erzurum**	-	
Sinop	◆		**Kars**	◆	
Samsun	•	1848	**Iğdır**	-	
Giresun	•	12	**Ağrı**	-	
Trabzon	•	57	**Bitlis**	?	
Rize	•	45	**Van**	?	
Artvin	•	25	**Malatya**	◆	
Bolu	•	120	**Elazığ**	-	
Kastamonu	•	30	**Adıyaman**	-	
Merzifon	-		**Arapkir**	-	
Çorum	-		**Ardahan**	◆	
Tokat	-		**Bingöl**	-	
Akçaabat	◆		**Erciş**	?	
Amasya	◆		**Başkale**	?	
Bafra	◆		**Hakkari**	?	
Bayburt	◆		**Hınıs**	?	
Gümüşhane	◆		**Malazgirt**	?	
Ordu	•	35	**Muş**	?	
Tosya	◆		**Batman**	-	
Şebinkarahisar	◆		**Siirt**	-	
Maraş	•		**Diyarbakır**	•	50
Burdur	•	44	**Gaziantep**	•	22
Isparta	•	30	**Urfa**	-	
Antalya	•	278	**Mardin**	-	

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