Turkish Journal of Zoology

http://journals.tubitak.gov.tr/zoology/

Research Article

Turk J Zool
(2013) 37: 149-156

doi:10.3906/zoo-1207-14

Morphometric and allozymic differences between Bearded Tit *Panurus biarmicus* (Aves: Passeriformes) subpopulations in a large wetland and a small pond in central Anatolia, Turkey

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Received: 11.07.2012 • **Accepted:** 23.10.2012 • **Published Online:** 25.02.2013 • **Printed:** 25.03.2013

Abstract: The Bearded Tit (*Panurus biarmicus*) is a small passerine bird occurring only in wetland habitats. Three subspecies of the Bearded Tit are known from Turkey. The endemic subspecies *Panurus biarmicus kosswigi* has only been recorded from Amik Lake in Turkey. This subspecies is now considered extinct; the apparent cause of this extinction was the drought affecting the lake. Other subpopulations might be similarly threatened by habitat loss. Therefore, it is important to investigate the morphometric characteristics and genetic variation of these local subpopulations. In this study, body weights and 12 morphometric characters were measured for Bearded Tit individuals in the Eber Lake and Behiçbey reedbed subpopulations. Statistically significant differences were found in extended wing length, maximum wing chord, and weight between the 2 subpopulations. Allozymic variation was also studied in the 2 subpopulations. Genetic variation was assessed using isozyme systems, and 8 of 21 loci (*Pgm*, *Me-I*, *Me-II*, *Fum*, *Est*, *Mpi*, *Pgd*, and *Acon-M*) were found to be polymorphic. The percentage of polymorphic loci was higher at Eber Lake ($P_{95\%}$ = 38.1%) than in the Behiçbey reedbed ($P_{95\%}$ = 33.3%). The mean F_{ST} (0.048) and *Nm* (5.0) values showed high levels of gene flow between these subpopulations.

Key words: Allozyme, central Anatolia, genetic, morphometric, *Panurus biarmicus*, Turkey

1. Introduction

The Bearded Tit *Panurus biarmicus* (Linnaeus, 1758) is a small, sedentary passerine bird. This species breeds at middle latitudes in the Western Palearctic region; it occurs in cool and warm climates in low areas. Its populations are concentrated in small, isolated fragments of wetlands, usually in large reedy areas and dense, tall, nonwoody vegetation (Snow and Perrins, 1998). This sedentary species shows various wintering strategies. Short or long migrations may occur, or birds may remain at their breeding site throughout the year (Dürr et al., 1999; Surmacki and Stępniewski, 2003). Since the mid-1980s, the numbers of the species have increased significantly in most European countries. Simultaneously, the distribution of this species has expanded in the northern and eastern areas of Europe. These changes are thought to have resulted from the increased sensitivity of this species to harsh winter conditions because of the increase in temperature due to climate changes (Spitzer, 1972; Gosler and Mogyorósi, 1997). Furthermore, a few long-term studies have followed declines in Bearded Tit populations after hard winters (Björkman and Tyrberg, 1982; Campbell et al., 1996).

The subspecies *Panurus biarmicus biarmicus* (Linnaeus, 1758) occurs in the north and west of the Western Palearctic, in western Europe, Sweden, Poland, Italy, the Balkans, and Transcaucasia. *P. b. russicus* (C. L. Brehm, 1831) has paler plumage and occurs in the Eastern Palearctic, from Austria and the Balkans through southern Russia, the Newly Independent States, and Anatolia. *P. b. kosswigi* Kumerloeve, 1958 has darker and more rufous or pinkish brown plumage than *P. b. biarmicus* and was known only from Amik Lake (Turkey). It is now considered extinct (Roselaar, 1995; Snow and Perrins, 1998). These 3 subspecies have all been recorded from Turkey. The differences among these subspecies are based primarily on color and, to a lesser extent, on body size (Roselaar, 1995).

In Turkey, the Bearded Tit has been recorded from wetlands, such as Seyfe Lake (Husband and Kasparek, 1984), Kulu Lake (Kasparek, 1987; Richardson, 2003), Uyuz Lake (Kıraç, 1993), and Mogan Lake, which are located in central Anatolia, the area of this study. Seyfe

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Lake has become completely dry in recent years, and numerous wetlands in Turkey are suffering from the effects of dry conditions that might cause reedbeds and wetlands to disappear. These effects can be considered to represent a major threat to the Turkish Bearded Tit populations. The extinction of *P. b. kosswigi* as a result of the drought affecting Amik Lake is an example of the negative effects posed by dry conditions on Turkish populations of this species.

A number of previous records of the Bearded Tit in Turkey include only a few observations and lack detailed information. Morphological and biometrical data for Turkish populations of this species are very scarce, and studies examining genetic variation of Bearded Tit populations in Turkey are almost absent. Therefore, it is important to investigate the genetic characteristics of the remaining Bearded Tits in Turkish wetlands. The genetic structure of these birds may help to explain the possible relationships between subpopulations in Turkish wetlands. In this way, conservation strategies might improve conditions for species that have experienced changes in their living areas or have disappeared under poor conditions. Concerning morphometrical characteristics and genetic structure, this study will furnish information about Turkish populations of the Bearded Tit, which is included in the IUCN Red List. Our findings will also provide a database for further research on these populations.

Records for this species are available in Turkey; however, no morphological or genetic research has been conducted on Turkish populations of the Bearded Tit. Therefore, our objectives were to investigate and compare the morphological diversity of the sedentary subpopulations of Bearded Tits in 2 localities and to determine the genetic structure of these subpopulations.

2. Materials and methods

This study was conducted during 2007 and 2008 in the Eber Lake area (Afyon), which is a large wetland, and in a small reedbed in Behiçbey (Ankara). The distance between the 2 areas is about 250 km. Eber Lake adjoins and is connected to Akşehir Lake, a larger water area. Eber Lake (maximum lake area = 16,800 ha, maximum water depth = 6 m) (Munsuz and Ünver, 1983; Yarar and Magnin, 1997; Altınsaçlı et al., 2000; Kılıç and Eken, 2005) is shallow and is surrounded by reedbeds. Its water depth changes throughout the year (Elmacı, 1995). Although Akşehir and Eber lakes are connected by a water passage, the bird communities of these lakes differ. Akşehir Lake is wide and shallow and suffers from seasonal drought, whereas Eber Lake has a large reedbed and small islands and is surrounded by grassland (Saygılı et al., 2011). Because of the habitat differences between these lakes, Bearded Tits were observed only at Eber Lake. The Behiçbey study area includes a small pond (approximately 1 ha) and a small reedbed. The maximum water depth does not exceed 1–1.5 m. The area is near a railroad right-of-way and a number of ruined buildings. We investigated possible morphological and genetic differences between the Bearded Tit subpopulations of these 2 separate areas.

Morphometric investigations may reveal variations between sexes in characteristics such as body and wing size due to habitat influences. In each subpopulation, we measured 12 morphometric characters with a digital caliper: 1) total body length (TBL); 2) wing span (WS); 3) entire wing length (EWL); 4) wing length (WL); 5) maximum wing chord (MWC); 6) tail length (TL); 7) head length (HL); 8) head width (HW); 9) bill length (BL); 10) bill width (BW); 11) tarsus length (TAL); and 12) middle toe length (MTL) (Svensson, 1992; Meseguer et al., 2003). The body weights of the Bearded Tits were also measured with a digital scale. The morphometric characters were statistically analyzed with SPSS 13.0. An analysis of variance (ANOVA) was performed on each morphometric character between subpopulations and sexes. A multiple analysis of variance (MANOVA) was used to obtain multivariate statistics (Wilks' lambda) of morphometric characters. A discriminant function analysis was used, including a quantitative check on the discriminatory power of the discriminant functions. A stepwise discriminant function analysis was used to identify the morphometric parameters that were the most informative for discriminating between the 2 localities. This analysis incorporated the correlations between the variables.

Bearded Tits were caught by mist netting and killed with ether to obtain breast muscle tissue samples, with permission from the Ankara University Local Ethics Committee for Animal Experiments. All tissues were preserved at –80 °C until used in the laboratory. Homogenates obtained from the tissue samples were used to perform an allozyme study in order to measure the level of genetic variation between subpopulations. Genetic variation was assessed using standard horizontal gel electrophoresis modified from Shaw and Prasad (1970) and Harris and Hopkinson (1976). Allozyme variability was assessed at 21 gene loci: ACON (4.2.1.3 Aconitase hydratase; *Acon-1*, *Acon-2*); ADA (3.5.4.4 Adenosine deaminase; *Ada*); ALD (4.1.2.13 Aldolase; *Ald*); CA (4.2.1.1 Carbonic anhydrase; *Ca*); EST (3.1.1.1 Esterase; *Est*); FUM (4.2.1.2 Fumarase; *Fum*); GPI (5.3.1.9 Glucose-6-phosphate isomerase; *Gpi-1*, *Gpi-2*); IDH (1.1.1.42 Isocitrate dehydrogenase; *Idh-1*, *Idh-2*); LDH (1.1.1.27 Lactate dehydrogenase; *Ldh-4*, *Ldh-5*); MDH (1.1.1.37 Malate dehydrogenase; *Mdh-1*, *Mdh-2*); ME (1.1.1.40 Malic enzyme; *Me-1*, *Me-2*); MPI (5.3.1.8 Mannose-6-phosphate isomerase; *Mpi*); PGM

(5.4.2.2 Phosphoglucomutase; *Pgm*); PGD (1.1.1.44 Phosphogluconate dehydrogenase; *Pgd*); and SOD (1.15.1.1 Superoxide dismutase; *Sod*). The electrophoretic band patterns obtained were analyzed according to the method of Harris and Hopkinson (1976). The presumptive alleles were designated alphabetically according to their relative mobility. The electrophoretic data were evaluated with BIOSYS-1 (Swofford and Selander, 1989). We calculated the following quantities: allele frequencies (f); the mean number of alleles per locus (A); the proportion of polymorphic loci (P, 95% criterion; a locus was considered polymorphic if the frequency of the most common allele was ≤0.95); and the mean heterozygosity (H; *Ho* = observed and *He* = expected frequencies of heterozygotes under Hardy–Weinberg equilibrium). The H/P ratio was also used to compare genetic variability with other birds. The amount of genetic divergence between subpopulations was estimated with the indices of standard genetic identity (I) and distance (D). The genetic identity (I, the unbiased genetic identity) and distance (D, the unbiased genetic distance) values were calculated according to the method of Nei (1978). F-statistics (F_{IS}, F_{IT}, and F_{ST}) were used to summarize the distribution of genetic variation between and within subpopulations. F_{IS} was used to represent the deficiency or excess in heterozygosity due to inbreeding in subpopulations. F_{IT} was used to represent the deficiency or excess in heterozygosity due to inbreeding in the total population. F_{ST} was used to represent the deficiency or excess in heterozygosity due to subpopulations in the total population. The impact of migration on F_{ST} was determined by the *Nm* value given by the formula [$Nm = (1 - F_{ST}) / 4 F_{ST}$] (*N*: population size, *m*: migration rate) according to Wright (1951, 1965).

3. Results

The Bearded Tit individuals in each locality remained in the same areas throughout the year during our study. They were observed during all seasons in the Behiçbey reedbed, whereas a displacement of wintering birds was recorded at Eber Lake. The birds at Eber Lake used the reeds on the lakeshore in preference to the islets. They fed in shorter reeds in the winter habitat than in the summer habitat (Figures 1a and 1b).

The morphometric measurements are summarized in Table 1. These results revealed size variation between the sexes. The males showed larger values than the females in both localities, except that BL, BW, and MTL were found to be larger in the females in Behiçbey. Morphometric comparisons between the 2 localities showed that the observed variation was based on 2 wing characteristics, EWL (ANOVA; $F_{1,24} = 7.662$, P = 0.011) and MWC (ANOVA; $F_{1,24} = 12.269$, P = 0.002). The stepwise discriminant analysis showed that EWL served to distinguish between the subpopulations. The analysis was able to classify individuals correctly for morphometric characters. Only 3 individuals were misclassified (76.9% of the specimens were correctly classified). The shorter-winged individuals appear to represent the prevalent form of the Eber Lake subpopulation. The reason for the prevalence of this form may be the large reedbed area and the density of the reedbeds. MANOVA showed significant geographical variation for EWL, MWC, TL, and BL. However, all 4 wing characters (WS, EWL, WL, and MWC) and MTL varied geographically in the males, whereas only BL varied geographically in the females ($P < 0.05$).

The frequencies of the alleles detected at all loci by our analysis are shown in Table 2. Eight of the 21 loci showed high genetic variation. The *Me-1* locus was polymorphic only for Eber Lake, whereas *Pgm*, *Me-2*, *Fum*, *Est*, *Mpi*, *Pgd*, and *Acon-2* were polymorphic for both localities. The percentage of polymorphic loci (P) and the observed (*Ho*) and expected (*He*) heterozygosity are shown in Table 3. The percentage of polymorphic loci for Eber Lake was $P_{95\%}$ = 38.1%, higher than the value for the Behiçbey reedbed ($P_{95\%}$ = 33.3%). The average values of the observed and expected heterozygosity for Eber Lake were *Ho* = 0.122 and *He* = 0.094. For the Behiçbey reedbed, the values were *Ho* = 0.136 and *He* = 0.111. A deviation from Hardy–Weinberg

Figure 1. Bearded Tits (a) in summer and (b) in snowy winter at Eber Lake.

Table 1. Morphometric measurements (mm) and weights (g) for male and female Bearded Tits captured at Eber Lake and Behiçbey reedbed in central Anatolia, Turkey (SD = standard deviation, n = number of samples).

Measurements	Locality	Females			Males		
		Mean ± SD	Range	n	Mean ± SD	Range	n
Total body length	Eber	170.3 ± 3.5	166–177	8	177.2 ± 6.4	167–186	11
	Behiçbey	172.3 ± 10.2	165–184	3	177.3 ± 3.0	174–181	4
Wing span	Eber	186.3 ± 4.4	177–192	8	186.8 ± 3.3	182–192	11
	Behiçbey	185.7 ± 0.6	185–186	3	192.8 ± 4.6	186–196	4
Entire wing length	Eber	78.5 ± 2.1	75–81	8	79.0 ± 2.5	75–83	11
	Behiçbey	80.7 ± 0.6	80–81	3	83.0 ± 4.6	77–87	4
Wing length	Eber	58.5 ± 1.2	57–60	8	59.6 ± 1.6	57–62	11
	Behiçbey	57.3 ± 6.4	50–61	3	63.4 ± 2.4	61–66.5	4
Maximum wing chord	Eber	46.6 ± 2.5	41–49	8	46.7 ± 1.6	45–50	11
	Behiçbey	49.7 ± 0.6	49–50	3	49.8 ± 2.6	47–52	4
Tail length	Eber	81.3 ± 5.2	76–90	8	88.4 ± 3.6	81–93	11
	Behiçbey	87.0 ± 8.2	80–96	3	92.3 ± 3.6	89–97	4
Head length	Eber	16.7 ± 0.9	15–18	8	17.3 ± 1.0	16–19.2	11
	Behiçbey	17.6 ± 0.1	17.4–17.6	3	17.8 ± 0.9	16.6–18.6	4
Head width	Eber	12.5 ± 0.5	12–13	8	13.0 ± 0.4	12–13.7	11
	Behiçbey	12.4 ± 0.1	12.3–12.6	3	13.1 ± 0.1	13.0–13.3	4
Bill length	Eber	7.2 ± 0.6	6.4–8.0	8	8.0 ± 0.4	7.6–9.0	11
	Behiçbey	8.2 ± 0.6	7.59–8.8	3	8.1 ± 0.5	7.7–8.7	4
Bill width	Eber	4.3 ± 0.3	4–4.8	8	4.5 ± 0.5	4.0–5.0	11
	Behiçbey	4.5 ± 0.3	4.1–4.7	3	4.3 ± 0.2	4.1–4.5	4
Tarsus length	Eber	19.1 ± 1.1	18.0–21.0	8	20.3 ± 0.9	19.0–22.0	11
	Behiçbey	19.7 ± 0.2	19.6–20	3	20.6 ± 1.5	18.8–22.3	4
Middle toe length	Eber	17.0 ± 1.2	15.5–18.6	8	17.2 ± 0.8	16–18.2	11
	Behiçbey	17.4 ± 0.5	16.9–17.8	3	16.1 ± 1.0	14.9–17.2	4
Weight	Eber	11.3 ± 0.4	10.9–12	8	11.8 ± 0.5	11–12.4	11
	Behiçbey	14.7 ± 1.2	14–16	3	16 ± 1.1	15–17.5	4

Table 2. Allele frequencies of loci in 2 Bearded Tit subpopulations from central Anatolia, Turkey (*polymorphic locus).

Locus	Allele	Eber (n = 16)	Behiçbey (n = 7)
Idh-1	A	1.000	1.000
	B	0.000	0.000
Idh-2	A	1.000	1.000
	B	0.000	0.000
*Pgm**	A	0.938	0.857
	B	0.063	0.143
Sod	A	1.000	1.000
	B	0.000	0.000
*Me-1**	A	0.906	1.00
	B	0.094	0.00
*Me-2**	A	0.750	0.929
	B	0.250	0.071
Mdh-1	A	1.000	1.000
	B	0.000	0.000
Mdh-2	A	1.000	1.000
	B	0.000	0.000
Fum	A	0.813	0.857
	B	0.188	0.143
Gpi-1	A	1.000	1.000
	B	0.000	0.000
Gpi-2	A	1.000	1.000
	B	0.000	0.000
*Est**	A	0.938	0.786
	B	0.063	0.214
Ada	A	1.000	1.000
	B	0.000	0.000
*Mpi**	A	0.875	0.714
	B	0.125	0.286
Ald	A	1.000	1.000
	B	0.000	0.000
*Pgd**	A	0.563	0.786
	B	0.438	0.214
Acon-1	A	1.000	1.000
	B	0.000	0.000
Acon-2	A	0.938	0.643
	B	0.063	0.357
Ldh-4	A	1.000	1.000
	B	0.000	0.000
Ldh-5	A	1.000	1.000
	B	0.000	0.000
Ca	A	1.000	1.000
	B	0.000	0.000

Table 3. Genetic variability at 21 loci in 2 Bearded Tit subpopulations from central Anatolia, Turkey.

Subpopulation	Mean sample size per locus	A	P*	Mean heterozygosity		*H/P*
				Ho	*He***	
1. Eber Lake	16.0 (0.0)	1.4 (0.1)	38.1	0.122 (0.049)	0.094 (0.033)	0.32
2. Behiçbey reedbed	7.0 (0.0)	1.3 (0.1)	33.3	0.136 (0.049)	0.111 (0.038)	0.41

* A locus is considered polymorphic if the frequency of the most common allele does not exceed 0.95.
** Unbiased estimate (see Nei, 1978).

equilibrium occurred only in the Eber Lake subpopulation at the *Pgd* locus ($c^2 = 8.922$, $P = 0.003$). The genetic identity (I) between the 2 Bearded Tit subpopulations was 0.994, and the genetic distance (D) was 0.006. F_{IS} values ranged from –0.07 to –0.78 for Eber Lake and –0.08 to –0.4 for the Behiçbey reedbed, respectively. The mean $F_{IS} = -0.33$ and $F_{IT} = -0.27$ values indicated high heterozygosity. The mean F_{ST} was 0.0476, and the *Nm* value was 5.0. These values show that the gene flow between the 2 subpopulations is high, and these subpopulations do not show substantial genetic differentiation.

4. Discussion

Our findings showed that the Bearded Tits used certain parts of the area of Eber Lake rather than the entire wetland. Similar to Hoi and Hoi (2001), we found that the habitat used by these birds and the preferred height of the reeds in which they feed changed seasonally in our study area. However, our study showed that the winter displacement of these individuals occurred over a shorter distance than that previously suggested by Dürr et al. (1999). We also found that this displacement occurred within the borders of the wetland. No seasonal movement was observed in the Behiçbey subpopulation. We considered this subpopulation to be solitary, because most of the morphometric measurements were greater than the corresponding measurements for the Eber Lake subpopulation. The Behiçbey reedbed habitat was not stable, because the pond was fed by overflows from a different location. In 2011, most of the small pond became dry because the water drained. No reeds were found, and Bearded Tits were not observed in the area of the pond. The displacement of the birds could only have occurred if they followed the Ankara Stream, because no other water supply or reedbed is near the small pond. Therefore, the Eber Lake subpopulation is colonial and sedentary, in contrast to the Behiçbey reedbed subpopulation. Similarly, previous research showed that certain populations of this species might have disappeared when others established colonies in new areas (Wilson, 1993; Strehlow, 1997; Bertoli and Leo, 1998).

Bearded Tits, with their short wings and long tails, are adapted to habitats such as reedbeds (Winkler and Leisler, 1992). A number of studies have shown that wing lengths may change according to habitat preferences in this species. Hoi and Hoi-Leitner (1997) compared colonial and solitary male Bearded Tits in Austria and determined that the average wing length and tail length were greater in solitary males than in colonial males. However, the females showed no significant differences. Similarly, we found that wing length was shorter in the Eber Lake subpopulation than in the Behiçbey subpopulation. In addition, Peiró et al. (2006) suggested that the differences in wing morphology between the sexes of Bearded Tit in Spain might be explained by the short-distance trips made by the females and the long-distance trips made by the males within a reedbed microhabitat.

The average wing and tail lengths of Bearded Tits found in our study and in previous studies are shown for comparative purposes in Figure 2. The average wing lengths of Bearded Tits in Turkey are slightly shorter than those of *P. b. russicus* from Austria, Hungary, Romania, and Russia (Roselaar, 1995), but the wing lengths found in the Turkish subpopulations resemble those found in populations in England and the Netherlands (Roselaar, 1995) (Figure 2). The average tail lengths of the females in the Turkish subpopulations are slightly less than the corresponding values for the females of the Austrian population (Romero-Pujante et al., 2002, 2005). Despite these small differences, the values of these morphometric characters in the Turkish subpopulations are generally similar to the values in other populations reported by the cited studies.

The average body weights found were 14.67 g and 16 g for the females and males, respectively, in the solitary Behiçbey subpopulation. The corresponding values were 12.20 g and 12.93 g, respectively, in the colonial Eber Lake subpopulation. These weights differed between the

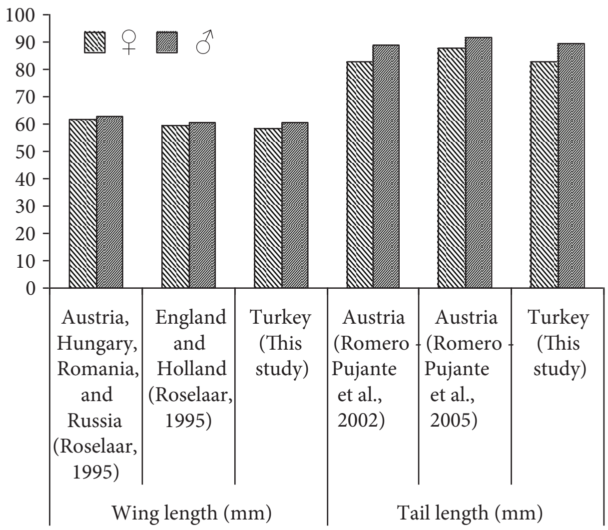

Figure 2. Comparison of average wing length and average tail length of the different Bearded Tit populations.

sexes and between the localities in our study. Peiró (1994) reported weights of 13.01 g for females and 13.45 g for males. Hoi and Hoi-Leitner (1997) found that the weights of solitary males (16.08 g) and colonial males (16 g) were almost equal.

The allozymic polymorphism (P) of 8 loci (*Me-1*, *Pgm*, *Me-2*, *Fum*, *Est*, *Mpi*, *Pgd*, and *Acon-2*) was higher in the Eber Lake subpopulation (38.1%) than in the Behiçbey subpopulation (33.3%). The expected heterozygosity (*He*) was 0.094 in the Eber Lake subpopulation and 0.111 in the Behiçbey subpopulation. These values from the subpopulations in Turkey are consistent with the values found for other Bearded Tit populations analyzed for about 25 loci (Evans, 1987; Ohta et al., 2000; Vapa et al., 2007). Crochet (2000) suggested that the normal levels of the mean observed heterozygosity and polymorphism are $Ho = 0.068$ and $P = 20\%–30\%$ for bird species. The polymorphism, observed heterozygosity, and expected heterozygosity for Bearded Tits from China were found to be $P = 4.3\%$, $Ho = 0.043$, and $He = 0.022$, respectively (Ohta et al., 2000). These values are considerably lower than the corresponding values found in the current study. The *H/P* ratio was 0.32 and 0.41 in the Eber Lake and Behiçbey subpopulations, respectively. These values are near the mean *H/P* value of 0.303 reported for nonendangered bird species (Suchentrunk et al., 1999).

In allozyme studies, the genetic distance (D), calculated according to the method of Nei and Rogers, is generally lower in bird species than in mammal species (van Wyk et al., 2001; Saag et al., 2007). The estimated values of D are 0.044 between bird species and 0.005 between bird subspecies (Barrowclough, 1980). The genetic distance between the 2 Turkish Bearded Tit subpopulations was 0.006, equal to the mean D value among subspecies of the order Passeriformes (Ohta et al., 2000).

Our study found that individual Bearded Tits from Behiçbey were larger in size than those from Eber Lake. Discriminant function analysis showed that the measurement of total wing length separated these 2 subpopulations with an accuracy of 77%. The genetic distance between the subpopulations was found to be low, and the percentage of polymorphic loci was normal in both subpopulations. This finding suggests that these 2 subpopulations are not totally isolated genetically and are not geographically separated by any natural barrier. Our genetic findings also showed that the Turkish subpopulations of the Bearded Tit are not threatened by genetic bottleneck effects, due to high *P* values. However, as the example of the Behiçbey reedbed shows, they are threatened by habitat loss. Native species, such as the Bearded Tit, that form isolated populations may be affected by genetic bottlenecks because of their discontinuous distribution and because the distances between their populations are greater than the distances that the birds can travel. The genetic diversity of colonies of birds that are isolated by behavioral barriers or by habitat suitability can be affected. Consequently, there is a need for more detailed genetic and biometrical research on the other Turkish subpopulations of Bearded Tits.

Acknowledgments
This study was supported by the Scientific and Technological Research Council of Turkey (TÜBİTAK, Project No: 108T294). We thank Şafak Bulut and Mert Elverici for help with field studies.

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