Current status of breeding bird species in the Gediz delta, Türkiye

ŞAFAK ARSLAN, AHMET KAYA, ADEM AKYOL, MEHMET KAYA & ÖZGE YAYLALI

Summary: The Gediz delta is one of the most important areas for birds in Türkiye and one of the most important wetland ecosystems in the Mediterranean Basin. Breeding bird atlas studies were conducted in 2002 and 2006. In 2021, we undertook a breeding birds atlas survey using the same methods used in the earlier studies and documented changes over the last 15 years. Bird species seen and heard between 3 May and 15 June 2021 in 294 1-km squares were classified according to internationally accepted breeding codes. Breeding codes were assigned to 113 species of 48 families. Of these, 32 species are classified as possible breeding, 34 as probable breeding and 47 as confirmed breeding. Threat factors of species and habitats are grouped under five main categories. The number of bird species breeding in the delta has increased compared to previous studies. The number of breeding bird species is likely to increase further by eliminating threats and implementing appropriate restoration actions.

INTRODUCTION

Breeding bird atlases are important studies that aim to investigate and map the presence and abundance of bird species in a certain geographical area. In an atlas study, the distribution of bird species, their population sizes, responses to environmental changes and threats can be determined by creating appropriate grids and conducting observations in a specific period. Atlases are one of the most widely employed methods to assess the biodiversity of a region (Boyla *et al* 2019). Türkiye holds a wide range of different habitat types as a result of its geographical location (Eken *et al* 2006) and hence supports a large number of species; so far 493 bird species have been recorded in Türkiye (eBird 2022). Boyla *et al* (2019) recorded the regular breeding of 313 species in Türkiye, and for three further species only a single breeding record was known. Thus in total 316 bird species were assigned breeding codes. The Gediz delta, one of the 305 Key Biodiversity Areas (KBA) in Türkiye (Eken *et al* 2006), meets the criteria of an Important Bird Area (IBA) for 28 bird species (Kılıç & Eken 2004). The earliest information on the birds in the Gediz delta dates back to the middle of the 19th century (Gonzenbach 1859, Krüper 1869, 1875). Sıkı (1985) identified 182 bird species in his study, which was only limited to the protected area of the Gediz delta. The delta has been recorded as the breeding ground of a significant portion of the breeding populations of Mediterranean Gull *Ichthyaetus melanocephalus*, Caspian Tern *Hydroprogne caspia*, Sandwich Tern *Thalasseus sandvicensis*, and Common Tern *Sterna hirundo* in the entire Mediterranean and where the first breeding colony of the Sandwich Tern in Türkiye was also discovered (Eken 1997). In 2002, it was reported that 211 bird species occur, and 59 breed in the delta (Sıkı 2002). In the first comprehensive breeding bird atlas in the Gediz delta, 92 species were assigned a breeding code (Onmus *et al* 2009). A similar study was repeated in 2006, and breeding codes were assigned to 104 bird species (Onmuş & Sıkı 2010). The last breeding bird atlas study conducted in Delta was in 2014 (Ömer Döndüren unpublished report). There were extensive studies on some bird groups in the Gediz delta. Çiftçi (2006) and Döndüren (2015) worked on White Stork *Ciconia ciconia*, Gül (2014) on Dalmatian Pelicans *Pelecanus crispus* and Kaya (2017) on terns (Sternidae).

Our study, carried out by two teams during the breeding period of birds, aims to update the list of breeding bird species in the Gediz delta and assess the current status of their populations, compare this with previous studies and evaluate the habitat use of the species, and assess the threats birds are facing in the delta.

METHODS

Study area

The Gediz delta (38° 30′ N, 26° 55′ E) is located in the Western Aegean and covers approximately 40 000 ha. The delta is the largest on the Western Anatolian coasts and is the fourth largest delta in Türkiye (Eken *et al* 2006, Kaya 2017). Gediz delta includes salty, fresh, and brackish water ecosystems. A large part of the delta-sea boundary consists of sand bars covered with glasswort *Salicornia spp.* and mussel shells. There are *Arthrocnema-Halocnemetum strobilaceum* formations in the coastal part of salt meadows, tamarisk *Tamarix* and *Limonium* communities. At points where freshwater flows into the saline area, there are small reedbeds and temporary wet meadows covered with rushes *Juncus*. The hills are usually covered with garrigue and scrub. Furthermore, there are large agricultural fields, plantation areas and gardens in the delta. One of the most important agricultural areas on the Aegean coast, the delta, especially the part known as Menemen plain, has a highly fertile soil structure.

Our study did not include some of the large agricultural fields, so our total survey area is estimated at 29 400 ha.

Data collection

The 29 400-ha study area is divided into 1x1 km UTM (Universal Transverse Mercator) squares. Fieldwork was undertaken in 294 UTM frames (Figure 1). In each square, three points were selected to represent different habitats and to be 300 meters apart from each other. Observations were made for 10 minutes at the predetermined points. All bird species seen and heard during this period were recorded. Breeding codes are given to each bird observed in their breeding habitats (Onmuş *et al* 2009, Onmuş & Sıkı 2010). Species not observed in their breeding habitats were not recorded.

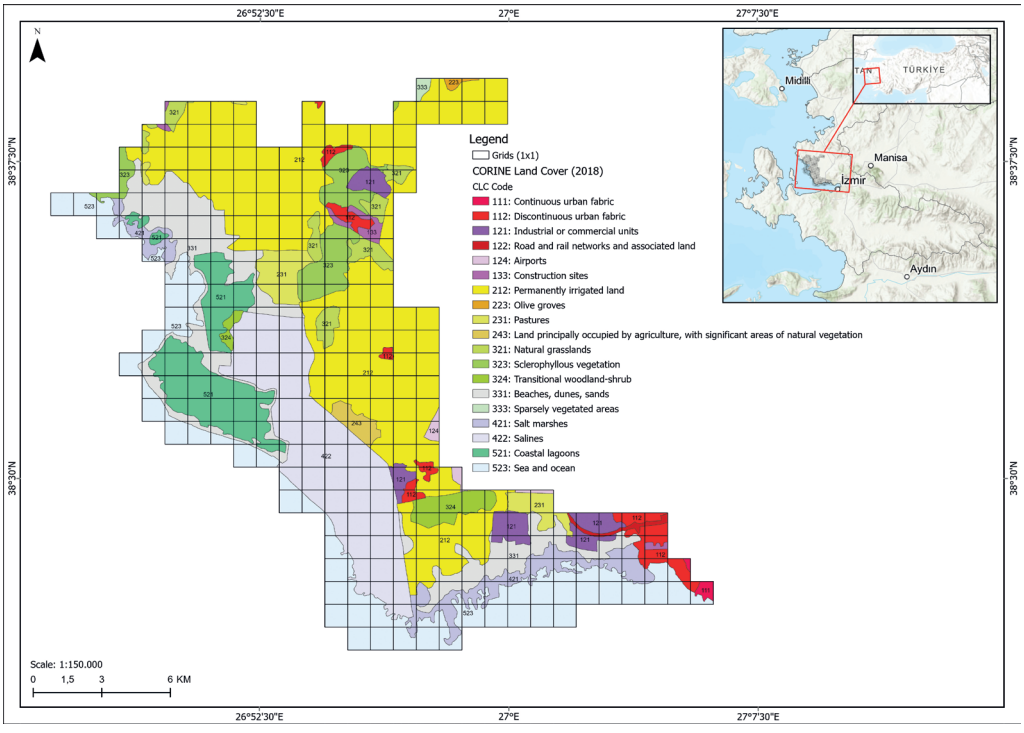

Figure 1. The study area divided into 1-km grid cells showing major habitat types.

The study was carried out with two teams between 3 May and 15 June 2021, covering the breeding period of birds. During the observations, internationally accepted breeding codes standardised by the European Bird Census Committee (EBCC) were employed. These 16 codes are divided into three main classes: A (Possible breeding), B (Probable breeding) and C (Confirmed breeding). These codes are assigned to each bird species according to the breeding behaviours they exhibit (Keller *et al* 2020).

Threat factors were also marked in forms at each point during the fieldwork. In this context, existing threats in the area were also collected. All the data collected during the fieldwork were digitised on the same day to prevent data loss.

Separate field studies were carried out for colonially breeding bird species. The number of breeding pairs was surveyed by telescope and binoculars from where the breeding colonies could be seen and counted. For the colonial species that breed on the islets and the coasts, censuses were conducted by boat.

RESULTS

During the breeding bird atlas study of the Gediz delta, 143 bird species were observed, and 113 species (79.0%) were assigned a breeding code (Table 1). Of these, 32 (29.1%) were classed as possibly breeding, 34 (30.9%) as probably breeding and 47 (41.6%) as confirmed breeding. Between them these 113 species represented 48 bird families.

When the habitat types of the 294 1-km squares were examined in the study area, permanently irrigated land, sea and ocean, and saline communities were identified as the three dominant habitat types. Olive groves, sparsely vegetated areas, and continuous urban fabric were the habitats with the lowest density (Table 2). Permanently irrigated land habitat includes agricultural fields and salt production areas within the borders of the delta (Figure 1).

Table 1. Species with breeding codes in family order. Breeding status: A = possibly breeding, B = probably breeding, C = confirmed breeding. Species marked with an asterisk were assigned breeding codes in 2021 but were not recorded in 2002 or 2006 and so may be recent arrivals.

Common name	Scientific name	Breeding status
Mute Swan*	*Cygnus olor*	C
Common Shelduck	*Tadorna tadorna*	B
Ruddy Shelduck	*Tadorna ferruginea*	C
Garganey	*Spatula querquedula*	A
Mallard	*Anas platyrhynchos*	C
Common Pochard*	*Aythya ferina*	B
Ferruginous Duck*	*Aythya nyroca*	B
Chukar Partridge	*Alectoris chukar*	B
European Nightjar	*Caprimulgus europaeus*	A
Common Swift	*Apus apus*	B
Pallid Swift	*Apus pallidus*	A
Great Spotted Cuckoo	*Clamator glandarius*	B
Rock Dove	*Columba livia*	B
European Turtle Dove	*Streptopelia turtur*	A
Eurasian Collared Dove	*Streptopelia decaocto*	C
Western Water Rail	*Rallus aquaticus*	A
Common Moorhen	*Gallinula chloropus*	C

Common name	Scientific name	Breeding status
Eurasian Coot	*Fulica atra*	C
Little Grebe	*Tachybaptus ruficollis*	B
Great Crested Grebe*	*Podiceps cristatus*	B
Greater Flamingo	*Phoenicopterus roseus*	C
Eurasian Stone-curlew	*Burhinus oedicnemus*	C
Eurasian Oystercatcher	*Haematopus ostralegus*	C
Black-winged Stilt	*Himantopus himantopus*	C
Pied Avocet	*Recurvirostra avosetta*	B
Spur-winged Lapwing	*Vanellus spinosus*	C
Kentish Plover	*Anarhynchus alexandrinus*	C
Common Redshank	*Tringa totanus*	B
Collared Pratincole	*Glareola pratincola*	C
Slender-billed Gull	*Chroicocephalus genei*	C
Mediterranean Gull	*Ichthyaetus melanocephalus*	C
Yellow-legged Gull	*Larus michahellis*	C
Gull-billed Tern	*Gelochelidon nilotica*	A
Caspian Tern	*Hydroprogne caspia*	C
Sandwich Tern	*Thalasseus sandvicensis*	C
Little Tern	*Sternula albifrons*	C
Common Tern	*Sterna hirundo*	C
Whiskered Tern	*Chlidonias hybrida*	B
Western White Stork	*Ciconia ciconia ciconia*	C
Pygmy Cormorant*	*Microcarbo pygmaeus*	B
Eurasian Bittern*	*Botaurus stellaris*	A
Little Bittern	*Ixobrychus minutus*	A
Black-crowned Night Heron*	*Nycticorax nycticorax*	A
Squacco Heron	*Ardeola ralloides*	B
Purple Heron	*Ardea purpurea*	B
Dalmatian Pelican	*Pelecanus crispus*	C
Western Marsh Harrier	*Circus aeruginosus*	B
Western Barn Owl	*Tyto alba*	C
Little Owl	*Athene noctua*	C
Eurasian Hoopoe	*Upupa epops*	A
European Roller	*Coracias garrulus*	A
European Bee-eater	*Merops apiaster*	C
Syrian Woodpecker	*Dendrocopos syriacus*	C
Lesser Kestrel	*Falco naumanni*	C
Common Kestrel	*Falco tinnunculus*	A
Eurasian Hobby*	*Falco subbuteo*	A
Peregrine Falcon	*Falco peregrinus*	C
Eurasian Golden Oriole*	*Oriolus oriolus*	A
Masked Shrike	*Lanius nubicus*	A
Lesser Grey Shrike	*Lanius minor*	A

Common name	Scientific name	Breeding status
Woodchat Shrike	*Lanius senator*	C
Red-backed Shrike	*Lanius collurio*	B
Eurasian Jay	*Garrulus glandarius*	A
Eurasian Magpie	*Pica pica*	C
Western Jackdaw	*Coloeus monedula*	C
Hooded Crow	*Corvus cornix*	B
Northern Raven*	*Corvus (corax) corax*	B
Sombre Tit	*Poecile lugubris*	A
Great Tit	*Parus major*	C
Eurasian Penduline Tit	*Remiz pendulinus*	C
Bearded Reedling	*Panurus biarmicus*	C
Eurasian Skylark	*Alauda arvensis*	A
Crested Lark	*Galerida cristata*	C
Greater Short-toed Lark	*Calandrella brachydactyla*	C
Calandra Lark	*Melanocorypha calandra*	B
Eurasian Barn Swallow	*Hirundo rustica*	C
Western House Martin	*Delichon urbicum*	B
Red-rumped Swallow	*Cecropis rufula*	B
Cetti's Warbler	*Cettia cetti*	B
Great Reed Warbler	*Acrocephalus arundinaceus*	B
Eurasian Reed Warbler	*Acrocephalus scirpaceus*	C
Marsh Warbler	*Acrocephalus palustris*	A
Eastern Olivaceous Warbler	*Iduna pallida*	B
Zitting Cisticola	*Cisticola juncidis*	B
Lesser Whitethroat	*Curruca curruca*	A
Eastern Orphean Warbler*	*Curruca crassirostris*	A
Rüppell's Warbler*	*Curruca ruppeli*	A
Sardinian Warbler	*Curruca melanocephala*	A
Common Whitethroat	*Curruca communis*	B
Western Rock Nuthatch	*Sitta neumayer*	A
Common Starling	*Sturnus vulgaris*	C
Song Thrush*	*Turdus philomelos*	A
Common Blackbird	*Turdus merula*	B
Rufous-tailed Scrub Robin	*Cercotrichas galactotes*	B
Spotted Flycatcher	*Muscicapa striata*	A
Common Nightingale	*Luscinia megarhynchos*	A
European Stonechat	*Saxicola rubicola*	C
Northern Wheatear	*Oenanthe oenanthe*	C
Isabelline Wheatear	*Oenanthe isabellina*	C
Eastern Black-eared Wheatear	*Oenanthe melanoleuca*	A
Eurasian Tree Sparrow	*Passer montanus*	B
Spanish Sparrow	*Passer hispaniolensis*	C
House Sparrow	*Passer domesticus*	C

Common name	Scientific name	Breeding status
Western Yellow Wagtail	*Motacilla flava*	C
White Wagtail	*Motacilla (alba) alba*	A
Tawny Pipit	*Anthus campestris*	C
European Chaffinch	*Fringilla coelebs*	B
European Greenfinch	*Chloris chloris*	A
European Goldfinch	*Carduelis carduelis*	B
Corn Bunting	*Emberiza calandra*	C
Cretzschmar's Bunting*	*Emberiza caesia*	B
Black-headed Bunting	*Emberiza melanocephala*	B
Common Reed Bunting	*Emberiza schoeniclus*	A

Table 2. Area and percentage of habitat types in the study area.

CLC code	CLC habitat class	Area (ha)	Area (%)
223	Olive groves	36.19	0.12%
333	Sparsely vegetated areas	47.12	0.16%
111	Continuous urban fabric	62.99	0.21%
122	Road and rail networks and associated land	84.09	0.29%
124	Airports	107.92	0.37%
133	Construction sites	167.81	0.57%
243	Land principally occupied by agriculture, with significant areas of natural vegetation	199.68	0.68%
324	Transitional woodland/shrub	466.94	1.59%
321	Natural grassland	662.52	2.25%
112	Discontinuous urban fabric	679.27	2.31%
231	Pastures	714.48	2.43%
121	Industrial or commercial units	740.68	2.52%
323	Sclerophyllous vegetation	1051.11	3.58%
421	Salt marshes	1103.33	3.75%
521	Coastal lagoons	1978.20	6.73%
331	Beaches, dunes, sands	2936.09	9.99%
422	Salines	3964.48	13.48%
523	Sea and ocean	4704.26	16.00%
212	Permanently irrigated land	9692.42	32.97%
Total		**29 399.58**	**100.00%**

Threats

The factors that threaten birds in the Gediz delta are grouped into five classes. The polluted waters of industrial facilities and domestic waste are discharged into the river and foraging area for birds in the delta. Waste, mainly glass and plastic, was also recorded on the coast, either brought to the site by wave action or left by people.

Table 3. Distribution of breeding codes by year. A = possibly breeding, B = probably breeding, C = confirmed breeding.

Code	2002	2006	2021
A	23	19	32
B	22	24	34
C	47	61	47
Total	**92**	**104**	**113**

Normally, hunting is strictly prohibited in the Gediz delta, but hunting cartridges and duck blinds were found in the study area. Poaching poses tremendous pressure, particularly on duck species.

Although the delta has national and international protection status, urbanisation and mining activities seriously pressure the delta. Even though the threat of urbanisation has been stable since the start of the century, geothermal mining activities are still proposed to be carried out under the name of renewable energy. However, no mining activity has been detected in the current study.

Unplanned vehicle entry in the delta poses a significant threat, especially where roads pass through birds' breeding areas destroying nesting territories.

Water is drawn from the Gediz river, which forms and feeds the delta, with pumps for agricultural irrigation. The freshwaters in the delta dry out during the summer periods for this reason.

When the threats in the Gediz delta are examined closely, it can be seen that these can be addressed by planning and increasing controls.

DISCUSSION

In the 2021 breeding bird atlas study, 113 bird species were assigned a breeding code, compared to 92 species in 2002 (Onmuş *et al* 2009) and 104 species in 2006 (Onmuş & Sıkı 2010). In 2002, 47 species were assigned confirmed breeding (C) status, 22 species were assigned as probably breeding (B), and 23 species were assigned as possibly breeding (A). In 2006, out of 104 bird species, 61 were assigned to code C, 24 to code B, and 19 were to code A. In 2021, 47 species of 113 were given the code C, 34 were given the code B, and 32 were given the code A. A comparison of breeding codes by year is shown in Table 3.

Little Egret *Egretta garzetta*, Eurasian Spoonbill *Platalea leucorodia*, Little Ringed Plover *Charadrius dubius*, Black Tern *Chlidonias niger*, Common Cuckoo *Cuculus canorus* and White-throated Robin *Irania gutturalis* were assigned a breeding code only in 2002, and no evidence of breeding was seen in 2021. Little Egrets established a breeding colony in the delta during the 1980s, but have not been observed breeding subsequently (Eken 1997).

Eurasian Eagle Owl *Bubo bubo*, Alpine Swift *Tachymarptis melba*, Eurasian Blackcap *Sylvia atricapilla*, Common Chiffchaff *Phylloscopus collybita*, Eurasian Blue Tit *Cyanistes caeruleus* and Cirl Bunting *Emberiza cirlus* were assigned a breeding code in 2006 but there was no evidence of breeding in 2021.

Montagu's Harrier *Circus pygargus* and Sand Martin *Riparia riparia* were assigned breeding codes in both 2002 and 2006 but not in 2021. Great Crested Grebe *Podiceps cristatus*, Pygmy Cormorant *Microcarbo pygmaeus*, Eurasian Bittern *Botaurus stellaris*, Black-crowned Night Heron *Nycticorax nycticorax*, Mute Swan *Cygnus olor*, Common Pochard *Aythya ferina*, Ferruginous Duck *Aythya nyroca*, Eurasian Hobby *Falco subbuteo*, Song Thrush *Turdus philomelos*, Eastern Orphean Warbler *Curruca crassirostris*, Rüppell's Warbler *Curruca ruppeli*, Eurasian Golden Oriole *Oriolus oriolus*, Northern Raven *Corvus (corax) corax* and Cretzschmar's Bunting *Emberiza caesia* were assigned breeding codes in 2021 but not in 2002 or 2006.

Of the 113 bird species assigned a breeding code in the 2021 atlas study, Dalmatian Pelican *Pelecanus crispus*, Ferruginous Duck *Aythya nyroca* and Eurasian Oystercatcher

Haematopus ostralegus are listed as Near Threatened (NT) and Common Pochard *Aythya ferina* and European Turtle Dove *Streptopelia turtur* as Vulnerable (VU) based on the Red List categories of the IUCN. The other 108 species are assessed as Least Concern (LC).

Our study conducted in 2021 shows that there is no evidence for a decline in the number of breeding bird species in the Gediz delta, and that some species may have arrived recently as breeders. However, the major threats to the species and the delta continue. The issues that need to be resolved most urgently are poaching and unsustainable water use and agricultural irrigation policies.

ACKNOWLEDGMENTS

This study was carried out with the permission of the General Directorate of Nature Conservation and National Parks and with the contribution of Izmir Metropolitan Municipality.

LITERATURE CITED

Boyla, KA, L Sınav & DE Dizdaroğlu. 2019. Türkiye Üreyen Kuş Atlası. *Doğal Hayatı Koruma Vakfı*. WWF-Türkiye, İstanbul. [In Turkish]

Çiftçi, A. 2006. İzmir'de Leylek *Ciconia ciconia* (L., 1758) popülasyonunun Tespiti üzerine Araştırmalar. Yüksek Lisans Tezi. Biyoloji Anabilim Dalı, Fen Bilimleri Enstitüsü, Ege Üniversitesi, İzmir. [In Turkish]

Döndüren, Ö. 2015. Gediz Nehri Havzası'nda Leylek (*Ciconia ciconia* L., 1758) Popülasyonunun Tespiti, Popülasyon Değişimlerinin ve Popülasyonu Etkileyen Etmenlerin Belirlenmesi İle Türün Göç Dinamikleri Üzerine Araştırmalar. Doktora Tezi. Ege Üniversitesi, İzmir. [In Turkish]

eBird. 2022. Birds of Turkey List. https://ebird.org/region/TR. [Accessed 12 May 2022]

Eken, G, M Bozdoğan, S Isfendiyaroğlu, DT Kılıç & Y Lise. 2006. *Türkiye'nin Önemli Doğa Alanları.* Doğa Derneği, Ankara. [In Turkish]

Eken, G. 1997. The breeding population of some species of waterbirds at Gediz Delta, Western Turkey. *Zoology in the Middle East* 14: 53-68.

Gonzenbach, GV. 1859. Excursionen an die Brutplätze von Sterna, Larus und Glareola im Golf von Smyrna im Frühling 1859. *Journal für Ornithologie* 7: 308-316, 393-398.

Gül, O. 2014. Gediz Deltası (İzmir) ve Büyük Menderes Deltası (Aydın)'nda Üreyen Tepeli Pelikan (*Pelecanus crispus* Bruch, 1832) Populasyon Büyüklüğünün, Değişiminin, Göçlerinin, Üreme ve Beslenme Biyolojilerinin Araştırılması. Doktora Tezi. Ege Üniversitesi, İzmir. [In Turkish]

Kaya, A. 2017. Homa Dalyanı Yaban Hayatı Koruma Sahasında Kuluçkaya Yatan Kuş Türlerinden Yapay Üreme Platformlarındaki Kuluçkaya Yatan Kuş Türlerinin Tespiti ve Üreme Başarılarının Araştırılması. Yüksek Lisans Tezi. Biyoloji Anabilim Dalı, Fen Bilimleri Enstitüsü, Ege Üniversitesi, İzmir. [In Turkish]

Keller, V, S Herrando, P Vorišek, M Franch, M Kipson, P Milanesi, D Marti, M Anton, A Klvanova, MV Kayakin, HG Bauer & RPB Foppen. 2020. *European Breeding Bird Atlas 2: Distribution, Abundance and Change*. Lynx Edicions, Barcelona.

Kılıç, DT & G Eken. 2004. *Türkiye'nin Önemli Kuş Alanları* - 2004 güncellemesi [Important Bird Areas in Turkey - 2004 update]. Doga Dernegi, Ankara. [In Turkish]

Krüper, TH. 1869. Beitrag Zur Ornithologie Kleinasiens. *Journal Fur Ornithologie* 17: 21-45.

Krüper, TH. 1875. Beitrag Zur Ornithologie Kleinasiens. *Journal Fur Ornithologie* 23: 258-285.

Onmuş, O & M Sıkı. 2010. State of the breeding birds in Gediz Delta: distributions, abundances, and changes in bird populations. *Bird Census News* 23/1-2: 59-69.

Onmuş, O, R Durusoy & G Eken. 2009. Distribution of breeding birds in the Gediz Delta, Western Turkey. *Zoology in the Middle East* 47: 39-48.

Sıkı, M. 1985. Çamaltı Tuzlası - Homa Dalyanı Kuş Türleri ve Bazı Türlerin Biyolojileri Üzerine Araştırmalar. Ege Üniversitesi, Fen Fakültesi Tabiat Tarihi Müzesi, İzmir. [In Turkish]

Sıkı, M. 2002. Gediz Deltası (İzmir Kuş Cenneti) Kuşları. *Ekoloji Çevre Dergisi* 11 (44): 11-16. [In Turkish]

Şafak Arslan[1,2,] Ahmet Kaya[1,3] Adem Akyol[1] Mehmet Kaya[1,4], Özge Yaylalı[1]*

[1]Doga Dernegi / BirdLife Turkey, İzmir, Türkiye

[2]Department of Forest Engineering, Faculty of Forestry, Bartın University, Bartın, Türkiye

[3]Department of Biology, Ege University, İzmir, Türkiye

[4]Institute of Social Sciences, Marmara University, İstanbul, Türkiye

**Corresponding author: arslan.safak55@gmail.com*