

Breeding birds in two riparian forests of Prespa



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Cover photo: View of the riparian forest of Great Prespa. Olga Alexandrou/ SPP

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Abstract

The riparian forests are underscored for their ecological significance and their unique role as habitats for various bird species. This report presents a comprehensive study on the breeding bird populations in two riparian forests within the Prespa region, specifically focusing on the estuary and lower parts of Kallithiotiko stream and the riparian forest of Great Prespa. The study aims to estimate bird densities and assess the avian biodiversity within these critical ecosystems. The methodology employed involves point count surveys during the breeding season, providing valuable insights into the distribution and abundance of various bird species. The discussion delves into the differences in bird densities between the two forests, attributing them to specific ecological characteristics, vegetation, and water availability. Additionally, current findings were compared with historical data, indicating changes in bird populations over the last decade. Species of conservation concern were found, such as the turtle dove, woodpecker species and several raptors, emphasizing the need for habitat preservation and monitoring.

1. Introduction

The riparian forests are of great ecological significance and are essential for the regulation of river temperatures, protecting endangered plant and animal species, and preventing floods¹. Many animals use riparian vegetation strips as corridors because they are frequently the only thing bridging remote forests. Additionally, the position of riparian forests is often in a transitional zone between the aquatic environment of the river and the surrounding area, making them unique habitats for the feeding and nesting of many bird species².

Although Prespa is a thoroughly studied region, particularly in relation to its avian biodiversity, many aspects of it have not been adequately examined, especially in terms of quantitative data on bird densities they host. One of these aspects is the riparian forests of the area. In this study we attempted to estimate the bird densities breeding in two riparian forests of Prespa, in the estuary and lower parts of Kallithiotiko stream and the riparian forest of Great Prespa.

2. Study area

The riparian forests selected for our study are two (Figure 1). The dense, impenetrable forest located at the confluence of Kallithiotiko stream in Lesser Prespa, is a preserved sample of the ancient riparian forest that once existed in the area. And the lakeside forest to the southeast of Great Prespa, a recently formed forest that emerged as the lake receded. The extent of the Kallithiotiko forest is 10 hectares, and the riparian forest of Great Prespa covers 70 hectares.

In the Kallithiotiko forest, you can find willows (*Salix caprea*, *Salix alba*, *Salix cinerea*), poplars (*Populus alba*), and dense shrub vegetation primarily consisting of holy bramble (*Rubus sanctus*), elder (*Sambucus nigra*) and dogwood (*Cornus sanguinea*)³. The Kallithiotiko stream of nearly continuous flow traverses the forest creating wet meadows. Along the sides of the river, there are embankments with heights of 2-3 meters, extending to the point where the river reaches near its mouth, the bottom of the riverbed is at the same level as the high level of the lake.

In the riparian forest of Great Prespa, you can find willows (*Salix amplexicaulis*, *Salix alba*, *Salix cinerea*, *Salix caprea*), poplars (*Populus tremula*, *Populus alba*, *Populus canescens*), alders (*Alnus glutinosa*), oaks (*Quercus pubescens*, *Quercus frainetto*), black locusts (*Robinia pseudacacia*), and birches (*Betula pendula*), with the latter being located at their southernmost extent in the European continent and forming the unique stand of the species found in a riparian forest. The riparian forest is heterogeneous and dense, almost without herbaceous undergrowth, bigger trees are around 30 years old and reaching a height of approximately 15 meters. In the area of interest within the riparian forest, there are patches of Pannonian sandy steppes and communities of tall herbs⁴.



Figure 1. Map of the study area and recording points.

3. Methodology

The method we used to estimate the number of breeding birds in the riparian forests was point count surveys⁵. In the Kallithiotiko stream and outfall we established 7-point counts, while in the riparian forest of Great Prespa we established 15 (Figure 1). To ensure coverage of the whole study area, these point counts were distributed uniformly across it. The distance between the points was at least 200 meters to avoid double-counting.

We visited each point 5 times during the breeding season, from early spring to early summer (Table 1). The recording hours were from 6.00 am to 10.00 am, and on each visit, a different starting point was chosen.

Table 1. Recording dates

Kallithiotiko	Riparian forest Great Prespa
2-May	5-May
18-May	19-May
1-June	2-June
14-June	19-June
27-June	4-July

After our arrival at each point count, we let the birds a minute to get used to our presence, and for the next five minutes we recorded everything we heard and saw within a circular area with a radius of 40 meters around the observer. The recordings were divided into zones of 0-10m, 10-20m, 20-30m, and 30-40m. For bird species like woodpeckers, cuckoos and hoopoes whose calls or songs can be heard from a considerable distance, recordings were also made in the 40-50m zone^{6,7}.

In the Kallithiotiko forest, observations were only feasible on the half side of the circle around the observer (180° out of 360°) due to vegetation and the terrain's morphology. The same observer was counting in every visit. Signs of breeding species, nests, and young individuals found outside the boundaries of the point counts were also noted during each visit.

Breeding species in the area were determined based on observations that included territorial males singing or fighting with other males, continuous presence of the species in the same locations, nests, offspring, feeding of offspring, and carrying on nest material (Table 2).

Table 2. Breeding species of the study areas and protection status.

Species	English name	2009/147/EE*	I		Riparian forest Great Prespa
			UCN**	Kallithiotiko	
<i>Aegithalos caudatus</i>	Long-tailed tit		LC	✓	✓
<i>Buteo buteo</i>	Common buzzard		LC		✓
<i>Cettia cetti</i>	Cetti's warbler		LC	✓	✓
<i>Chloris chloris</i>	Greenfinch		LC		✓
<i>Corvus cornix</i>	Hooded crow	II2	LC	✓	✓
<i>Cuculus canorus</i>	Common cuckoo		LC	✓	✓
<i>Curruca communis</i>	Whitethroat		LC	✓	✓
<i>Cyanistes caeruleus</i>	Blue tit		LC	✓	✓
<i>Dendrocopos major</i>	Great spotted woodpecker		LC	✓	✓
<i>Dendrocopos minor</i>	Lesser spotted woodpecker		LC	✓	✓

<i>Dendrocopos syriacus</i>	Syrian woodpecker	I	LC	✓	✓
<i>Emberiza calandra</i>	Corn bunting		LC		✓
<i>Erithacus rubecula</i>	Robin		LC	✓	✓
<i>Falco subbuteo</i>	Hobby		LC		✓
<i>Iduna pallida</i>	Eastern olivaceous warbler		LC		✓
<i>Lanius collurio</i>	Red-backed shrike	I	LC	✓	✓
<i>Lullula arborea</i>	Woodlark	I	LC		✓
<i>Luscinia megarhynchos</i>	Common nightingale		LC	✓	✓
<i>Oriolus oriolus</i>	Golden oriole		LC	✓	✓
<i>Parus major</i>	Great tit		LC	✓	✓
<i>Pernis apivorus</i>	Honey buzzard	I	LC		✓
<i>Phylloscopus collybita</i>	Chiffchaff		LC		✓
<i>Picus viridis</i>	Green woodpecker		LC	✓	✓
<i>Remiz pendulinus</i>	Eurasian penduline tit		LC	✓	✓
<i>Streptopelia turtur</i>	Turtle dove		VU	✓	✓
<i>Sturnus vulgaris</i>	Starling	II2	LC	✓	✓
<i>Sylvia atricapilla</i>	Blackcap		LC	✓	✓
<i>Turdus merula</i>	Blackbird	II2	LC	✓	✓
<i>Upupa epops</i>	Hoopoe		LC	✓	✓

*2009/147/EC: Annexes I & II of Directive 2009/147/EE on birds.

** IUCN Red List Category (EU27): (CR) Critically Endangered, (EN) Endangered, (VU) Vulnerable, (NT) Near Threatened, (LC) Least Concern, (DD) Data Deficient, (NE) Not Evaluated. Birdlife International (2015).

For each breeding species for which we had sufficient data from point counts, we calculated the density of singing males or those displaying some other form of territorial behavior (males fighting, chasing away predators). This was done using the maximum number of individuals recorded across the 5 repetitions in each point, and then calculating average number of individuals observed across all points. The calculation was based on the formula for estimating density (d). That is, the number of counted individuals (N) divided by the area of a circle with a radius of 40 meters around the observation point (πr^2):

$$d = N / \pi r^2$$

Since the recordings in the Kallithiotiko forest were conducted in half of the circle around the observer (180°), the area (πr^2) was divided by 2. Then, the density of each species was calculated per 1 hectare.

We also used the sum of the maximum counts per point to determine the relative abundance of each species in each of the study areas. Furthermore, we examined the use of these areas by other species on each date.

4. Results

The breeding species of Kallithiotiko forest are 21, and those of the riparian forest in Great Prespa are 29 (Table 2). In both forests, the breeding species with the highest densities are the common starling (*Sturnus vulgaris*), the nightingale (*Luscinia megarhynchos*), and the blackcap (*Sylvia atricapilla*) (Table 3).

The sampling, during which most bird species were recorded, was the 2nd one, on May 18-19, while the one with the fewest species was the 1st and 4th for Kallithiotiko forest, on May 2 and June 27, respectively, whereas for the riparian forest in Great Prespa, it was the 3rd and 4th, on June 2 and 19.

More species were seen in the areas of interest outside of the recording periods, some of which are migratory birds that were observed in May using these areas for refueling and resting, such as the collared flycatcher (*Ficedula albicollis*). Other species, such as the Eurasian nuthatch (*Sitta europaea*), were recorded after their breeding season, the time when the young birds began to be dispersed to remote areas from their nests. While some other species that were observed outside the count could potentially breed in the area, their detection though is not easy, such as the sparrowhawk (*Accipiter nisus*) (Table 5).

Table 3. Bird densities per hectare (males/ha).

Species	Kallithiotiko	Riparian forest Great Prespa
<i>Aegithalos caudatus</i>	1.5	0.5
<i>Buteo buteo</i>		0.08
<i>Cettia cetti</i>	3.5	1.2
<i>Corvus cornix</i>	1.4	0.1
<i>Cuculus canorus</i>	0.3	0.6
<i>Curruca communis</i>	0.3	0.4
<i>Cyanistes caeruleus</i>	2.1	1.2
<i>Dendrocopos major</i>	1.4	0.5
<i>Dendrocopos minor</i>	1	0.4
<i>Dendrocopos syriacus</i>	0.3	0.1
<i>Erithacus rubecula</i>		0.6
<i>Falco subbuteo</i>		0.1
<i>Iduna pallida</i>		0.2
<i>Lanius collurio</i>	1.4	0.3
<i>Lullula arborea</i>		0.2
<i>Luscinia megarhynchos</i>	5.5	4
<i>Oriolus oriolus</i>	1.4	1.6
<i>Parus major</i>	2.8	1.6
<i>Pernis apivorus</i>		0.1

<i>Phylloscopus collybita</i>		0.4
<i>Picus viridis</i>	0.3	0.3
<i>Remiz pendulinus</i>	2.1	0.6
<i>Streptopelia turtur</i>	3.2	2
<i>Sturnus vulgaris</i>	8.5	2.2
<i>Sylvia atricapilla</i>	3.2	2.5
<i>Turdus merula</i>	3.2	2.1
<i>Upupa epops</i>	1	1.6

Table 4. Relative abundance (%) of each species.

Species	Kallithiotiko	Riparian forest Great Prespa
<i>Aegithalos caudatus</i>	1.9	2.2
<i>Buteo buteo</i>		0.3
<i>Cettia cetti</i>	6.5	4.8
<i>Corvus cornix</i>	2.6	2.8
<i>Cuculus canorus</i>	1.3	2.5
<i>Curruca communis</i>	1.3	1.6
<i>Cyanistes caeruleus</i>	3.9	4.8
<i>Dendrocopos major</i>	2.6	2.2
<i>Dendrocopos minor</i>	1.9	1.6
<i>Dendrocopos syriacus</i>	1.3	0.3
<i>Erithacus rubecula</i>		2.2
<i>Falco subbuteo</i>		0.3
<i>Iduna pallida</i>		0.9
<i>Lanius collurio</i>	2.6	0.6
<i>Lullula arborea</i>		0.9
<i>Luscinia megarhynchos</i>	15.7	15.6
<i>Oriolus oriolus</i>	2.6	6.3
<i>Parus major</i>	5.6	5.4
<i>Pernis apivorus</i>		0.6
<i>Phylloscopus collybita</i>		1.6
<i>Picus viridis</i>	0.6	1.2
<i>Remiz pendulinus</i>	3.9	2.2
<i>Streptopelia turtur</i>	5.9	7.6
<i>Sturnus vulgaris</i>	19.7	8.9
<i>Sylvia atricapilla</i>	9.8	9.5
<i>Turdus merula</i>	7.8	7.9
<i>Upupa epops</i>	1.9	3.8

Table 5. Number of bird species recorded in each visit.

	1	2	3	4	5
Kallithiotiko	15	18	16	17	15
Riparian forest Great Prespa	22	30	20	21	30

Table 6. Occurrences observed outside the recorded timeframe and protection status.

Species	English name	2009/147/EE*	IUCN**		Riparian forest
			Kallithiotiko	Great Prespa	
<i>Accipiter nisus</i>	Sparrowhawk		LC		✓
<i>Anthus pratensis</i>	Meadow pipit		LC	✓	
<i>Apus apus</i>	Common swift		NT	✓	✓
<i>Apus melba</i>	Alpine swift		LC		✓
<i>Caprimulgus europaeus</i>	European Nightjar	I	LC		✓
<i>Carduelis carduelis</i>	Goldfinch		LC		✓
<i>Cecropis daurica</i>	Red-rumped swallow		LC	✓	✓
<i>Circaetus gallicus</i>	Shoer-toed snake eagle	I	LC	✓	✓
<i>Circus aeruginosus</i>	Marsh harrier	I	LC	✓	✓
<i>Columba palumbus</i>	Wood pigeon	II1/III1	LC	✓	✓
<i>Curruca curruca</i>	Lesser whitethroat		LC	✓	✓
<i>Delichon urbicum</i>	House martin		LC	✓	✓
<i>Falco tinnunculus</i>	Common kestrel	I	LC		✓
<i>Ficedula albicollis</i>	Collared flycatcher		LC	✓	✓
<i>Hirundo rustica</i>	Barn swallow		LC	✓	✓
<i>Jynx torquilla</i>	Wryneck		LC		✓
<i>Merops apiaster</i>	European bee-eater		LC	✓	✓
<i>Motacilla flava</i>	Western yellow wagtail		LC	✓	✓
<i>Muscicapa striata</i>	Spotted flycatcher		LC		✓
<i>Phylloscopus orientalis</i>	Eastern Bonelli's warbler		LC		✓
<i>Riparia riparia</i>	Sand martin		LC		✓
<i>Sitta europaea</i>	Eurasian nuthatch			✓	✓

*2009/147/EC: Annexes I & II of Directive 2009/147/EC on birds.

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5. Discussion

The results of these study showed that the most abundant species are the nightingale, the starling, the blackcap and the blackbird in both areas of interest. Most of the breeding species recorded are found in both areas, except for the raptors such as the common buzzard, the honey buzzard, the hobby, the robin, the eastern olivaceous warbler, the woodlark and the

chiffchaff, which are only found in the riparian forest of Lake Prespa. The presence of these raptors there can be explained by the size of the forest, the density, and the height of the trees, which allow for the construction of nests, unlike the Kallithiotiko forest, which consists of few trees and thus the nests would be exposed. The woodlark prefers large, forested areas with openings of infertile soil and low vegetation as its breeding grounds, a feature not found in Kallithiotiko. The presence of eastern olivaceous warbler depends on tall shrubby vegetation, oaks and willows, all of which are only found in the riparian forest of Great Prespa.

Significant differences in the density of species found in both forests occur for the species Cetti's warbler, hooded crow, red-backed shrike, penduline tit and starling, with all these species showing higher densities in Kallithiotiko forest. The presence of the stream and the dense impenetrable vegetation, combined with the thick blackberry bushes in the area, explain the density of the Cetti's warbler. Similarly, the presence of water throughout the forest area justifies the high density of penduline tit. Due to the extensive agricultural zone surrounding the Kallithiotiko forest, the densities of the red-backed shrike, the hooded crow and the starling are higher than in the riparian forest of Great Prespa.

It is important to note that turtle dove, a species that breeds in both areas, exhibits high densities in both forests and is among the most abundant breeding species, it is classified as a vulnerable species (VU) on the IUCN list with a continuously declining population. In addition, Syrian woodpecker, red-backed shrike, woodlark and honey buzzard are included in Annex I of the Directive for birds, which provides special conservation measures for their habitats. This list also includes the nightjar, the short-toed snake eagle, the marsh harrier and the collared flycatcher, which were observed to make use of the areas of interest but were recorded outside the survey period. Additionally, the common swift, a species that uses riparian forests for foraging, was observed outside the survey period and is assessed as near threatened (NT) by the IUCN.

In comparison to earlier data recorded during the years 2014-2015, 2018, 2021-2022 in the riparian forest of Great Prespa⁸, the results are consistent regarding the species present in the area, especially those that are found in abundance, such as the nightingale, the starling, the blackbird and the blackcap. During this study, certain species were observed, such as the lesser spotted woodpecker, the green woodpecker, the hobby and the honey buzzard, which have not been previously observed. Meanwhile, some other species were recorded in previous observations but were absent from the recent ones, such as the chaffinch, the circl bunting, the lesser grey shrike, the eastern Bonelli's warbler and the tree sparrow. Due to differences in observation methodology, the timeframe, observation points and repeatability, the data from the two studies are not directly comparable. However, they provide us with an overview of the changes that have occurred in the last decade. It appears that as vegetation grows and the forest matures, more woodpeckers and raptors choose the riparian forest for breeding. The presence of a few chaffinches in the past suggests that they initially colonized the forest and later abandoned it. While the lesser grey shrike and the circl bunting are species that likely were recorded at the forest's edge and left as the vegetation matured.

The results of woodpecker densities in the riparian forest of Great Prespa, are similar to the findings of a recent study that estimated the density of the overall woodpecker population at 0.34 individuals per hectare⁹. While this specific study does not present detailed densities per species, the resulting number is comparable to the results of our study, where densities range from 0.5 to 0.1 per species. Regarding the densities in the Kallithiotiko forest, values for the lesser and the great spotted woodpecker are higher compared to the riparian forest of Great

Prespa. This can be explained by the suitability of the area for finding food due to the presence of a stream that traverses the Kallithiotiko forest and the quantity of decaying wood and cavities available there. Simultaneously, the dense vegetation of the forest between large agricultural areas creates a corridor for woodpecker to move from the lakeside forest to the oak forest located at higher elevations. This makes us cautious about whether the woodpecker densities in the Kallithiotiko stream concern only breeding individuals, requiring further investigation and nest finding for more accurate results.

The study period adequately covered the breeding period of most species. However, for some endemic species that initiate their breeding processes early, such as the chiffchaff, an earlier count would have been useful. Furthermore, the spring of 2023 was particularly rainy, with low temperatures during the morning hours of the counts, which affected the activity of some species sensitive to low temperatures, like the greenfinch. Nevertheless, we consider that the results provide a satisfactory overview of the species and densities breeding in the riparian forests.

Due to the rapid growth and expansion of the riparian forest of Great Prespa, it is possible for it to be colonized by new species, such as raptors like the hobby and the honey buzzard, species that have not been observed in the past. For better monitoring of changes in the species utilizing the forest, frequent observation and recording are necessary.

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