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SURVEY OF THE MOUSTACHED WARBLER (*ACROCEPHALUS MELANOPOGON*) POPULATIONS AND MIGRATION ROUTES IN EUROPE, ROLE OF THE BLACK SEA POPULATION

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Abstract. Data on the populations of the Moustached warbler are extremely contradictory. Clarifying population sizes is a difficult and laborious but important task. The known EU population is declining, but the conservation status of the species is considered stable. There is contradictory information about the size of the Black Sea and Danube Delta populations, but these may have a very important share in the world population. The most significant causes of the population decline are assumed to be habitat loss and deterioration of habitat status and water management characteristics. Such problems have been highlighted in numerous cases both in known nesting areas and migration routes, as well as wintering areas. As the Moustached warbler is a Natura 2000 marker species, the exploration of population sizes and population trends is also important at the European level. The Carpathian Basin population of the Moustached warbler is one of the largest European populations. The Balkan migration route plays a role in the migration of the entire Carpathian Basin population, but our research has also proved that the Mediterranean basin can also be an important area for the Black Sea population. Since 2002, we have organized 48 expeditions to the Moustached warbler migration routes and wintering grounds on the Balkan peninsula. From 2015 we turned our attention to the Black Sea population, and in the first 2 years we mainly researched in Bulgaria. Subsequently, there was already a recovery from the Black Sea population in Greece, so we wanted to intensify the research of the Moustached warbler at the Black sea. Some Hungarian researchers participated in the Chituc bird ringing camp, but we found that this was not enough, the research should be intensified in the areas and times better suitable for the Moustached warbler, more in line with the life cycle of the Moustached warbler. We took part in actions aimed specifically at revealing the migration of the Moustached warbler populations in 2021 in Moldova, in 2022 in the Chituc bird ringing camp and in 2022 and 2023 on the island Grindul Lupilor during migration time, and in the breeding season. Further Moustached warbler recoveries confirmed that the Black Sea population also uses the known Balkan regions during migration and wintering.

Keywords: Moustached warbler, habitat characteristics, water-related problems, population size, population trend, connections between populations

1 INTRODUCTION

The Moustached warbler (Temminck 1823; Family: Sylviidae) is a medium-sized reed warbler (Cramp & Perrins 1977-1994). The breeding population is estimated to number 73800-188000 individuals. Europe forms 25-49% of the global range, and a very preliminary estimate of the global population size is 434000-712000 individuals (IUCN red list 2023). The population is suspected to be stable in the absence of evidence for any declines or substantial threats (del Hoyo et al. 2006). Data on the populations of the Moustached

warbler (*Acrocephalus melanopogon*) are extremely contradictory. Clarifying population sizes and possible connections between European populations is a difficult and laborious but important task.

The Moustached warbler is a unique species among reed warblers as regards to its migration and moulting strategies: it is the only short distance migrant among the *Acrocephalus* species of the Western Palearctic, and, it has a complete summer moult. It breeds throughout South and South-Eastern Europe to the Middle East (Bibby 1982). The populations along the Mediterranean coasts are resident or partial migrants (Balanca & Schaub 2005), while the populations of the Carpathian Basin, the Black Sea and the Caspian Sea coasts are short-distance migrants (Németh & Králl 2009).

As the species has an extremely large range, the population trend appears to be stable and the population size is extremely large, the species is evaluated as Least Concern (BirdLife International 2004). At the same time, the known EU population is declining, but the conservation status of the species is still considered stable. In long term the population trends are unknown or declining, however in some countries smaller populations are considered to be stable (maximum 300 pairs in Slovakia and Serbia). The significant breeding populations are clearly declining (Figure 1).

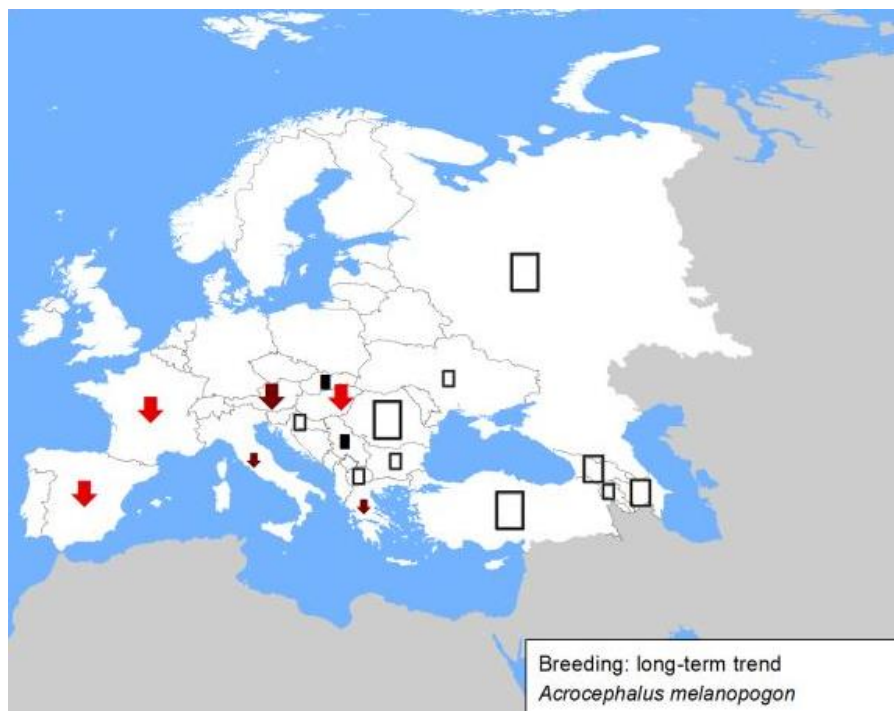


Figure 1. Long term population trends of European moustached warblers (IUCN)

There is contradictory information about the size of the Black Sea and Danube Delta populations (Table 1), but these may have a very important share in the world population.

Table 1 Distribution and number of breeding pairs (IUCN)

Country	Pair
Armenia	39-100
Austria	3000-6000
Azerbaijan	2000-10000
Bulgaria	5-25
Croatia	15-21
France	2000-3000
Georgia	810-8200
Greece	50-200
Hungary	2500-3500
Italy	470-600
North Macedonia	10-50

Romania	2300-23000
Russia	15000-25000
Serbia	210-300
Slovakia	15-20
Spain	480-1800
Turkey	8000-12000
Ukraine	12
total	36900-93800

The number of ringed Moustached warblers in Hungary was relatively low before the start of the operation of the Kolon-Lake Bird Observatory in 1999. But since then, with a yearly average of 1500 ringed individuals at one of the most important breeding areas of the species in Central Europe, the number of recoveries during migration and wintering has increased significantly (Németh & Králl 2009). For the population inhabiting the Carpathian basin, reedbeds of the Mediterranean coasts provide shelter during migration and a place for wintering, for it spends the winter a reedbeds of the wetlands which do not dry out and not freeze during the winter (Angeletti et al. 2011).

Based on a large number of studies involving marked individuals of different bird species, return rates to breeding sites by birds are now known to be variable and influenced by many factors including previous reproductive success, sex, and age of the returning individual (e.g. Newton & Marquiss, 1982; Shields, 1984; Gratto et al., 1985). Fidelity to wintering areas has been less well studied and many details concerning this behavior are unknown, but different authors claim that they do return to the same wintering place year by year (e.g. Nickell, 1968; Nisbet & Medway, 1972; Ramos, 1988, Warkentin & Hernandez 1996). Fidelity to wintering sites by migratory birds has been documented both within winters (e.g. Holmes et al. 1989, Wunderle & Latta 2000) and between years (e.g. Faaborg & Arendt 1984, Wunderle 1995).

The most significant causes of the population decline of the *M. warbler* are assumed to be habitat loss (e.g. infrastructure development along the reedbeds of the sea coasts) and deterioration of habitat status, mainly water management related habitat characteristics (especially extreme drying out of reedbeds during recent drought periods) mostly in migration routes and in wintering places. Such problems have been highlighted in numerous cases both in known nesting areas and migration routes, as well as wintering areas. As the Moustached warbler is a Natura 2000 marker species, the exploration of population sizes and population trends is also important at the European level.

The Carpathian Basin population of the Moustached warbler is one of the largest European populations. The Balkan migration route plays a role in the migration of the entire Carpathian Basin population, but our research has also proved that the Mediterranean basin can also be an important area for the Black Sea population.

Previously, starting in 2004, ornithological research was conducted with our participation for 7 years at the Ornithological Monitoring Centre on the island Grindul Lupilor, where we caught 96 specimens of the Moustached warbler, but these studies were mostly conducted in the period before and in the Moustached warbler migration (August-September) and focused more on long-term migratory *Acrocephalus* species.

As we concluded that research in the Black Sea region and the Danube Delta should be intensified in the areas and times better suitable for the Moustached warbler, more in line with the life cycle of the Moustached warbler, we took part in actions aimed specifically at revealing the migration and the importance of the area for the Moustached warbler populations in 2021 in Moldova (September), in 2022 in the Chituc bird ringing camp (October) and on the island Grindul Lupilor 2022 (October-November) during migration time, and towards the end of it, furthermore on the island Grindul Lupilor 2023 (June), in the breeding season. In the present study we also used a part of the ringing data collected by our Romanian colleagues.

2 MATERIALS AND METHODS

2.1 Capturing and ringing

We trapped passerines and marked them with standard bird rings. We used 16 mm mesh size mistnets for bird trapping. The number of mistnets used in the different years, as well as the habitat types in which they were placed are comparable in all sites, and all the periods. We placed our mistnets in reedbeds in all cases.

We used daily 120-150 m nets per site. We carried out checking from sunrise to one hour after sunset, each hour. We recorded the date and time of each capture, the species, the ring number, the age (calendar year),

the condition and the weight of each bird. In the case of adult birds and also in juveniles (when possible), we determined and recorded the sex. All recaptured birds were controlled and all recoveries of individuals ringed earlier (not in the same year) were recorded separately.

In most of the cases we used tape luring, broadcasting the display song of the Moustached Warbler. Ringing activity was not continuous, but expedition-style, concentrating mainly on autumn migration and wintering periods (Kalocsa et al. 2010).

3 RESULTS AND DISCUSSION

3.1 Importance of the Grindul Lupilor reedbeds for the Moustached warbler

We are not able to draw big consequences for the entire Black Sea population nor the Danube Delta population as the investigation has only been started and there are not enough data. In Grindul Lupilor, based on 20 years very sporadic bird ringing activity we can say the same as in Kalocsa et al. (2010) that *Acrocephalus melanopogon* (occurs both in spring and in autumn, though in spring only in very small numbers: it is present only in pentade p22, but in autumn from p43 to p61. Spring maximum was not determined because of the very low numbers, while autumn maximum falls in p56. Local breeders and migrants might occur with equal probability. Because of the small sample size the results can be highly influenced by random factors).

Furhermore, now we have proof that *Acrocephalus melanopogon* occurs during the breeding season as well. To illustrate the importance of the site in the Grindul Lupilor area we provide some of the analyses. In figs 2 to 7 we show the ratio of caught species in different pentades, afterward seasons, as well as the importance of the Grindul Lupilor reedbeds for different species based on the capture ratio – first, for all *Acrocephalus* species and *Locustella luscinioides* – then also without *Acrocephalus scirpaceus* because of the high ratio of *A.Scirpaceus* the other species are not very well visible.

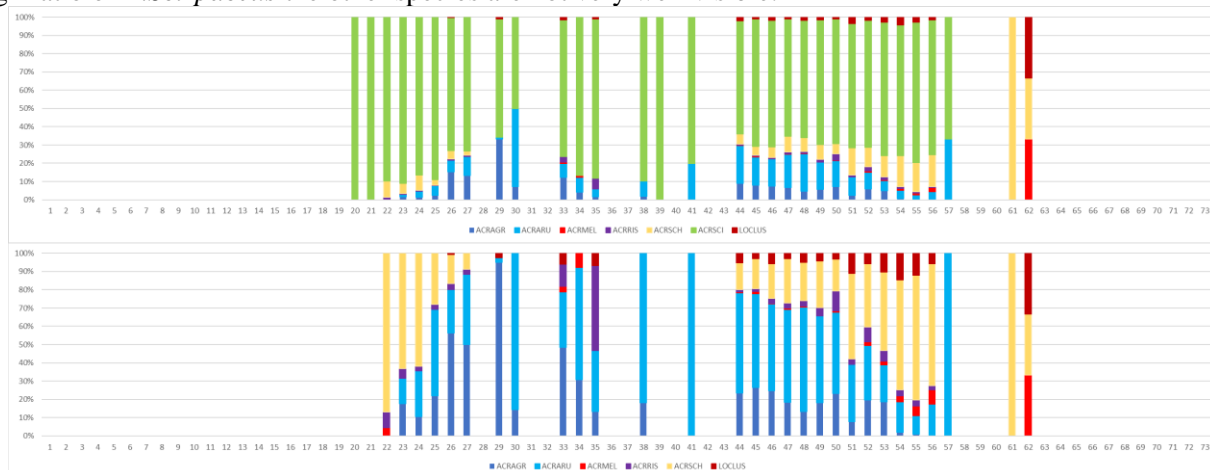
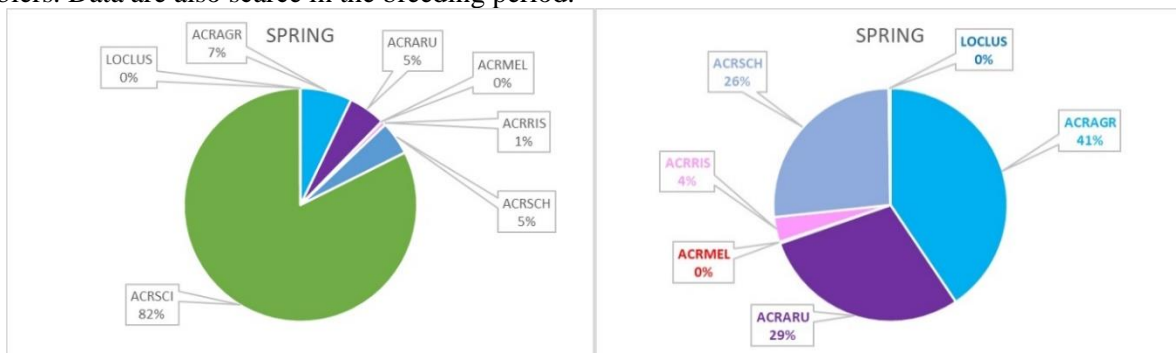
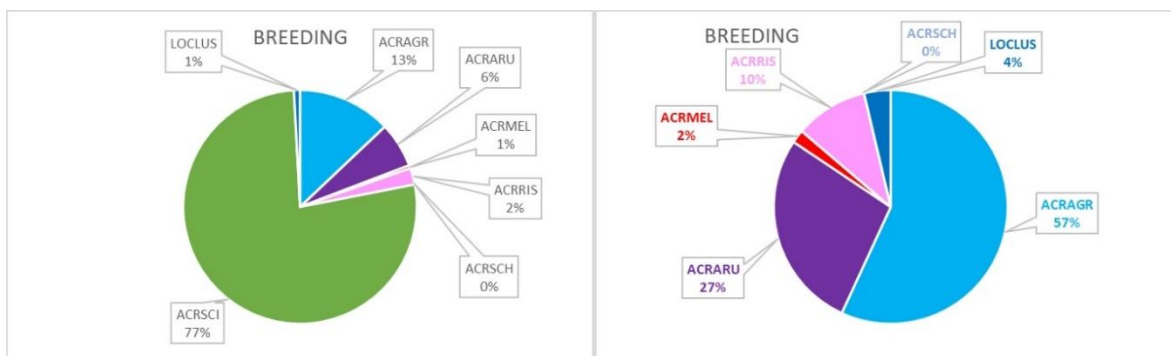


Figure 2. The capture of all *Acrocephalus* reed warblers and *Locustella luscinioides* in all pentades at Grindul Lupilor, 2004 to 2023, with *A. scirpaceus* included and *A. scirpaceus* excluded

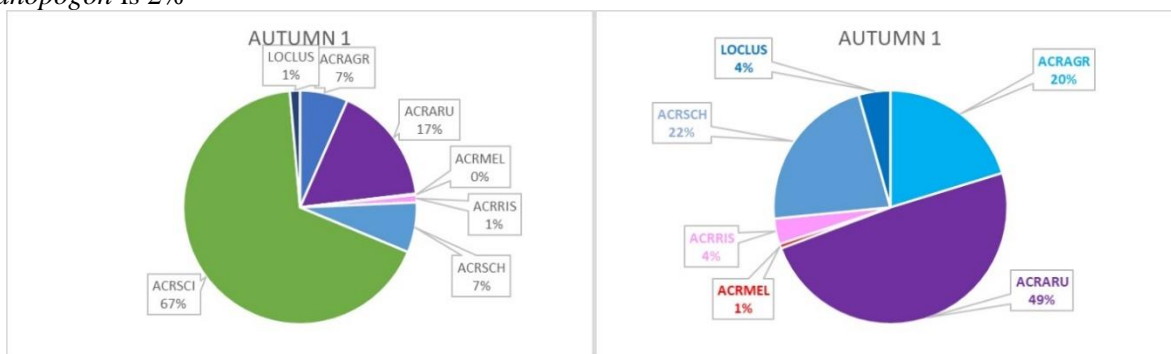
On Figure 2 the relatively occasional and not continuous ringing activity is clearly visible, apart from autumn migration, when ringing activity is totally absent in p68 to p60, the supposed migration peaks of *M.* warblers. Data are also scarce in the breeding period.



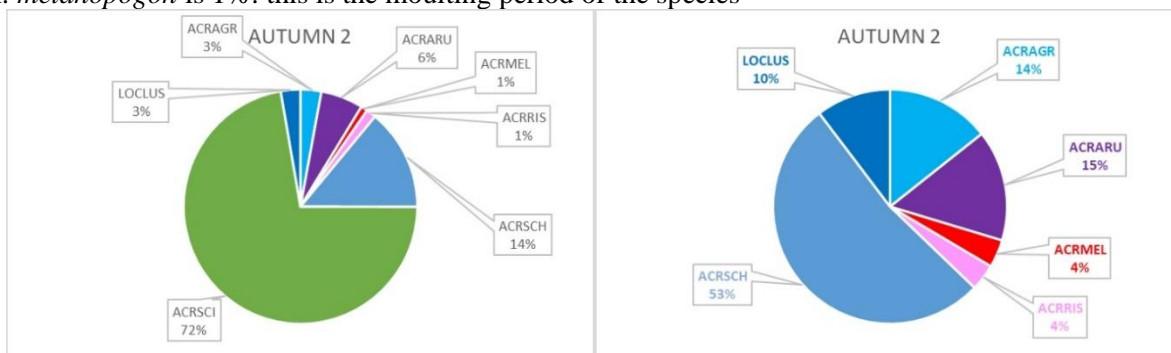
Figures 3a and 3b. Share of the reed warbler species caught on Grindul Lupilor between 2004 and 2023 in the spring migration period (p20 to p27) (a) with *A. scirpaceus* included (b) with *A. scirpaceus* excluded – share of *A. melanopogon* is less than 1%



Figures 4a and 4b. Share of the reed warbler species caught on Grindul Lupilor between 2004 and 2023 in the breeding period (p 28 to p37) (a) with *A. scirpaceus* included (b) with *A. scirpaceus* excluded— share of *A. melanopogon* is 2%



Figures 5a and 5b. Share of the reed warbler species caught on Grindul Lupilor between 2004 and 2023 in the early autumn period (p 38 to p51) (a) with *A. scirpaceus* included (b) with *A. scirpaceus* excluded – share of *A. melanopogon* is 1%: this is the moulting period of the species



Figures 6a and 6b. Share of the reed warbler species caught on Grindul Lupilor between 2004 and 2023 in the late autumn period (p 52 to p62) (a) with *A. scirpaceus* included (b) with *A. scirpaceus* excluded – share of *A. melanopogon* is 4%

In order to be able to estimate the share of the Black Sea and Danube Delta populations, we have reviewed the relevant literature. According to Chisamera et al. (2010) who collected and analyzed the then available records of the Moustached warbler in Romania (for the whole territory of the country including the Danube Delta), breeding records of the species are very rare in Romania, and the breeding records in the Danube Delta are doubtful, though they do not exclude the possibility of the breeding in small numbers and they state that the previously published numbers are overestimated. According to their study the Danube Delta area is much more important for the species during autumn migration, and this coincides with our findings but we have to say that ringing activity and in general the survey of the breeding populations is not enough intensive so as to be able to give a more exact estimation or concrete numbers on the breeding of the species.

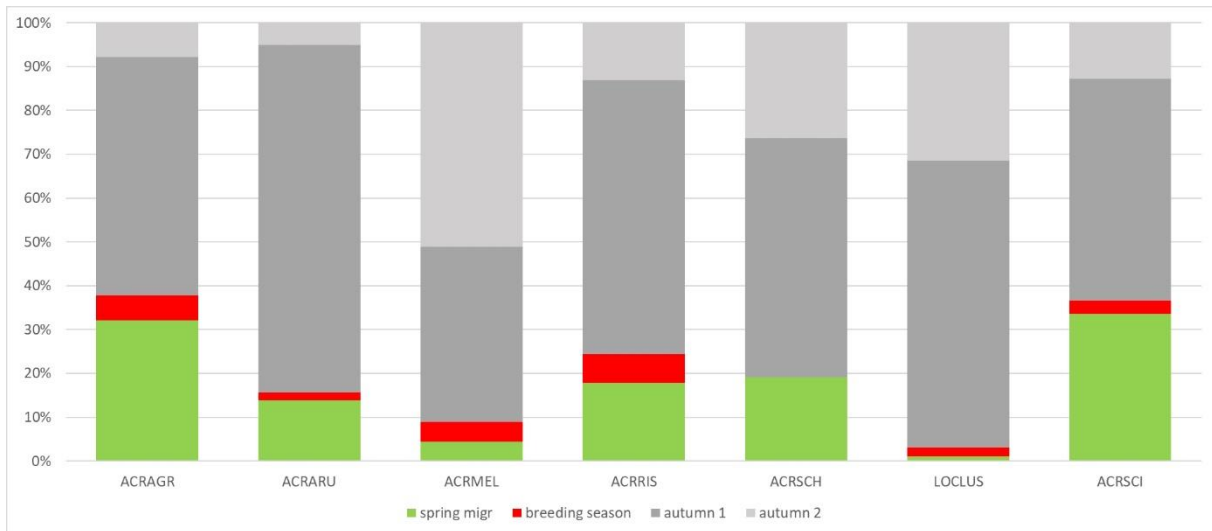


Figure 7. Distribution ratio of ringed specimens of *Acrocephalus* species and *Locustella luscinioides* in Grindul Lupilor in the different seasons

3.2 Wintering places – common to the Carpathian Basin and the Black Sea populations

Since 2002, we have organized 48 expeditions to the Moustached warbler migration routes and wintering grounds on the Balkan Peninsula. From 2015 we turned our attention to the Black Sea population, and in the first 2 years we mainly researched in Bulgaria. Subsequently, there was already a recovery from the Black Sea population (from Bulgaria) in Greece and Albania (Figure 8), so we wanted to intensify the research of the Moustached warbler at the Black Sea.

Hungarian researchers participated in the Chituc bird ringing camp, and after this we already registered the recapture of a Chituc ringed Moustached warbler in Greece (Figure 8). Further Moustached warbler recoveries (from both Bulgaria and Romania) confirmed that the Black Sea population also uses the known Balkan regions during migration and wintering thus we have proven that the areas of the Black Sea and Carpathian Basin populations used for migration and wintering are at least partly identical, so problems affecting the same habitats threaten the Black Sea and Carpathian Basin populations alike.

Greece

The bay of Amvraka is an area in the west coast of Greece. The bay of Amvraka, which comprises a series of marshes and lagoons and is one of the most important wetland systems in Greece, is a Special Protection Area and as a Specially Protected Area (SPA). In 2006 the bay of Amvraka was proposed as a National Park (Bearzi et al. 2008). The appropriate management is assured by more EU programmes; the patchy characteristic of the area is maintained by active conservation management. The northern coast of the gulf is protected under the convention of Ramsar (Konstantinos et al. 2001).

At the Amvrakikos Bay (Strongyli) the study period covered the end of autumn migration and the beginning of the wintering period. The Amvrakikos Bay is both used by the studied species for migration stopover and wintering place, though we have only a few data from the beginning of the migration and the real wintering period: data from the end of December and the month of January, are missing to date. The number of repeats is still very high, but the return rate is only 3% - this is most probably low because of the low invested ringing activity, and the very big area of the good quality reedbed. Based on our findings to date, we still suppose that this location is one of the important wintering grounds of the population inhabiting the Carpathian Basin and most probably important for the Black Sea populations as well.

Albania

The Orikum reeds are located in the southern part of Albania in the Otranto Gorge, at the foot of the Karaborum peninsula, next to the Pasha lagoon. Its area is approximately 180 ha. Although both the lagoon and the peninsula and the bay between them are marine reserves, the reeds themselves are not protected in any way. The AOS-Albanian Ornithological Society has already submitted a proposal for inclusion in the Natura 2000 network. The habitat has been well preserved despite attempts at drainage. Currently, it is threatened by growing tourism and landfills for infrastructure development. Since 2017, we have been conducting research

in the area during every migration season, ringing a total of 1552 Moustached warblers during the 135 working days so far. In addition to the 86 Hungarian ring captures, we recorded recaptures from Croatia, Greece and Bulgaria from the Black Sea population as well. We consider it primarily as a migratory area as an extremely important "stepping stone" of the region. Winter tests revealed the presence of a small number of wintering *M.* warbler individuals in the area.

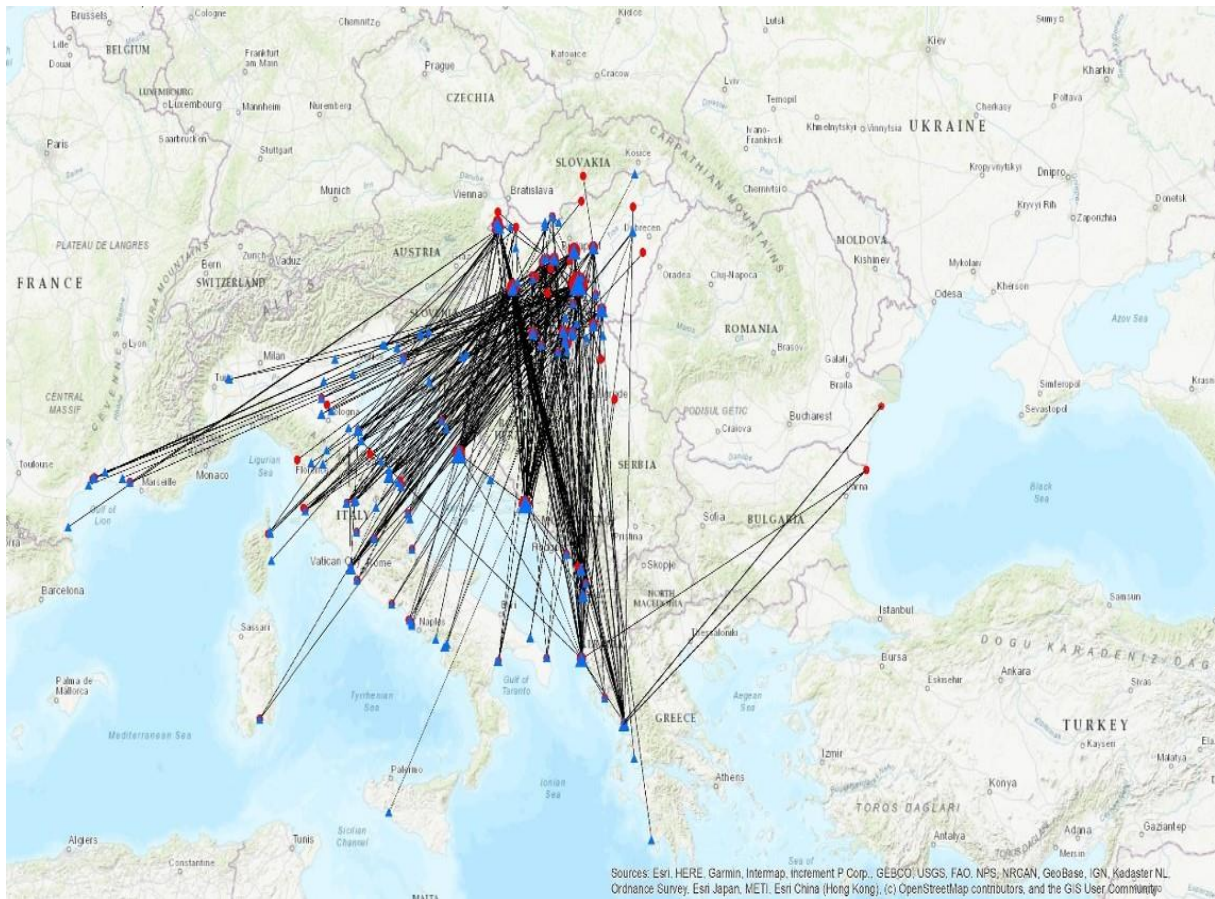


Figure 8. Recoveries of ringed *A. melanopogon* individuals at the migration stopovers and the wintering places (compiled by the Hungarian Bird Ringing Centre)

4 CONCLUSIONS

Species with high levels of site fidelity between years may be less adaptable to habitat degradation and loss. As the distances between patches of suitable habitat continue to grow, species such as these may be more vulnerable to population loss. Returning even to the same general region may not lead to the discovery of suitable habitat, resulting in lower survival probability, particularly among habitat specialists (Warkentin & Hernandez 1996).

The Moustached warbler is supposed to be a very vulnerable species because of its extreme wintering site fidelity, so for its protection, apart from the protection of breeding grounds, the persistence of good-status wet reedbeds on its migration route and wintering sites are also important. The long-term goal of our studies is to contribute to the conservation of the still remaining coastal wetlands of the Adriatic and Mediterranean region.

The changing intensity of activities and the very different periods covered in the different locations, as well as the different habitat characteristics and weather factors can have a major impact on our results. That is why, in our future research, we have to concentrate more on covering the studied period and areas better, investing comparable workload at the different places, and on including more variables in a future, more complex analysis in order to reveal the preferences of the studied species during migration and wintering.

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