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Results of the breeding passerine census carried out at the Hungarian part of Lake Fertő in 2008

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Summary A breeding bird census for reed-nesting passerine species was conducted at Lake Fertő (Lake Neusiedler) in 2008. The basic goal of the study was to quantify the population size of the target species (in terms of breeding pairs). Between 15th March and 29th June 14 censuses were carried out. The final data base of observed territorial males contained 775 records. The census method was a modified form of the Finnish line-transect method. Sampling transects were selected by a stratified quasi-random method. Stratification was based on the official classification of reedbed units, determined for the whole Hungarian part of the lake during the reedbed survey conducted by Márkus in 2007. Each class was represented by at least three independent sample transects. The population size of the six most abundant territorial passerine species (the Savi's Warbler, the Moustached Warbler, the Sedge Warbler, the Reed Warbler, the Great Reed Warbler and the Reed Bunting) was estimated. The population size of the Bluethroat could be estimated only within wide limits. The results appoint on the fact that the Lake Fertő (Lake Neusiedler) is likely to play a very important role in the meta-population system of reed-nesting passerine species within the Carpathian Basin. Regarding the Moustached Warbler, more than 90% of the population breeding in the Carpathian Basin is located at this lake. Census repeated in the next years could present very important data on population dynamics of the target species, providing valuable information for nature conservation offices.

keywords: breeding bird census, Finnish transect method, acoustic detection, territorial behavior, passerine species, Lake Fertő (Lake Neusiedler)

Összefoglalás A 2008-as év költési szezonjában a Fertő-tó magyarországi területén fekvő nádasaiban végeztünk énekesmadár költőállomány felmérést. Vizsgálataink alapvető célja a Fertő-tó énekesmadár költőállományának reprezentatív felmérése, azaz a különböző faji minősítésű énekesmadár populációk költőpárokban kifejezett nagyságának megállapítása volt. Március 15.–június 29. között összesen 14 mintavételi nap alkalmával 14 énekes madárfaj 775 rekordját rögzítettük. A mintavétel módosított finn transzekt módszer szerint történt. A mintavételi helyeket (transzekteket) sztratifikált kvázi-random eljárással jelöltük ki. A sztratifikáció alapját Márkus 2007-ben végzett Fertő-tavi nádas felmérése során megállapított, jogszabály szerinti nádas osztályokba történő besorolás képezte. Minden egyes osztályt legalább három transzekt reprezentálta. A hat legtömegesebb nádi énekesmadár faj: nádi tücsökmadár, fülemülesitke, foltos nádiposzáta, cserregő nádiposzáta, nádirigó, nádi sármány esetében lehetett elvégezni reprezentatív becslést. A kékbegy ritka és sporadikus előfordulása miatt állománynagyságának becslését csak tág határok között lehetett megtenni. Az eredmények alapján kitűnik, hogy a Fertő-tó kiemelkedő jelentőséggel bír a Kárpát-medence nádban fészkelő énekesmadár populációi szempontjából, a Kárpát-medencét metapopulációs rendszerként leképezve az egyik legfontosabb forrás populáció szerepét töltheti be a tó. Különösen nagy a helyi fülemülesitke állomány jelentősége. A Fertő-tavi adatok ismeretében kijelenthető, hogy a hazánkban költő párok több, mint 90%-a a Fertő-tavon fészkel. A vizsgálatok további folytatása fontos populáció-dinamikai adatokat biztosíthatna a természetvédelem számára.

kulcsszavak: finn transzekt módszer, akusztikus detekció, territoriális viselkedés, Fertő-tó

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Introduction

Population estimations in Europe and Hungary

In Europe, the number of bird species breeding almost exclusively in reedbeds exceeds twenty. The conservation status of populations of the reed-nesting species is usually not safe enough (Burfield & Bommel 2004), partly due to factors threatening their breeding habitats (Brix 1999). There are available data on estimated population size of reed-nesting passerines for both Europe and Hungary *(Table 1.)*. Reliability of these estimations can be characterized with a certain amount of uncertainty. There are huge areas in East Europe and Turkey, where systematic censuses have not been carried out until recently, which increases the uncertainty of estimations concerning the size and trends of European population. Regarding the population size of reed-nesting bird species breeding in Hungary there have been estimations of medium level reliability, either (MME Nomenclator Committee 2008). These estimations are based on separate local censuses lacking comparability.

Problematic aspects of population estimations

There are two major obstacles forming a barrier to making reliable estimations. One of these is the lack of data originating from huge wetlands, the other one is the lack of an adequate, calibrated census method to be used at field works. Making reliable estimations requires huge amount of time, since territorial activity and detectability of individuals belonging to certain species is quite different during the breeding period (Bell et al. 1968). For most comparative ecological studies, it is reasonable to use methods which produce relative data on density or population size, these are the so called population indices (for summary see Bibby et al. 2000, Buckland et al. 2001, Sutherland

Species	Estimated number of breeding pairs in Europe	Estimated number of breeding pairs in Hungary	Estimated number of breeding pairs at the Austrian part of Lake Fertő
Locustella luscinioides	500 000-800 000	15 000-30 000	1750
Acrocephalus melanopogon	150 000-300 000	2000-4000	8700-15 600
Acrocephalus schoenobaenus	4 500 000-7 000 000	200 000-300 000	NA
Acrocephalus scirpaceus	3 000 000-5 000 000	75 000-150 000	20 500-42 000
Acrocephalus arundinaceus	1 500 000-3 000 000	70 000-100 000	max 2000
Luscinia svecica	4 500 000-7 800 000	500-800	NA
Panurus biarmicus	240 000-480 000	6000-9000	NA
Emberiza schoeniclus	4 800 000-8 800 000	43 000-80 000	4500-6700

Table 1. The estimated number of breeding pairs of reed-nesting passerine species regarding the total population breeding in Europe, in Hungary and in the reedbeds of the Austrian part of Lake Fertő.

2006). These population indices can be used for comparing local abundances of two populations at separate habitats or drawing conclusions on demographic trends, but – due to lack of calibration – these data cannot be used for making estimations on real population sizes.

Lack of data on population size at the Hungarian part of Lake Fertő

Regarding the reed-nesting passerines, there was absolute lack of data on sizes of populations breeding at the Hungarian part of Lake Fertő. Taking into consideration the fact that this is the largest reedbed in Hungary (exceeding 6000 hectares), the overall estimations for Hungary could not be regarded as reliable. There have been systematic censuses at the Austrian part of Lake Fertő in coordination of Vögelwarte Illmitz (Dvorak et al. 1997 – see *Table 1.*), but – due to different structure of reedbeds influenced by different management practice – simply extrapolating from Austrian data would not produce reliable estimations, either.

Goals of the study

Practical conservation works, such as habitat management, require data of certain precision (Sutherland et al. 2001). It is of cardinal importance to possess reliable data on population sizes and trend of species forming the goal of these practices. With our study we would like to contribute to making population estimates comparable.

Materials and methods

The study area

Lake Fertő is the westernmost steppe lake in Europe. Water level of this lake is heavily fluctuating. During its history, there have been times when the lakebed completely dried out. The shoreline is some 100 kilometer long, with 25 kilometers falling to the Hungarian part The lakebed is plain, the depth of water is 0.5-0.6 m at outer parts and 1.0-1.2 m at the inner parts. After the drainage of the Hanság (a huge, former wetland) major part of the lake got covered by reed.

Class and definition	Number of polygons	Total area (ha)
I.A Homogenous, closed reedbeds	70	410.54
II.A Homogenous reedbeds with looser structure	250	920.76
III.A Aged reedbeds with looser structure	251	2649.33
IV.A Degradated reedbeds	385	1101.02
V.A Degradated reedbeds	324	803.06
I.B Natural large sedge beds	24	237.62
II.B Degradating large sedge beds	25	102.05
III.B Degradated large sedge beds with weeds	19	20.63
IV.B Dry degradated large sedge beds with weeds	31	12.60
V.B Dry degradated reedbeds with bushes	32	32.53
Total	**1411**	**6290.14**

Table 2. Extension of reedbeds belonging to the ten main classes

The reed belt is 4 kilometer wide at certain parts. Regarding the Hungarian part the total extent of reedbeds is 6,290.14 ha (Márkus in litt.). Reedbeds are quite diverse in terms of both conservation and economic status.

Sample sites

Since the lake is too huge to carry out a census covering the total area, it was reasonable to designate representative sample sites. These location of sample sites (transects) were selected by a stratified random process. Stratification was based on the classification performed by I. Márkus in 2007. that classified all the reed-covered parts of Lake Fertő as one of the 10 categories that have been laid down in the 22/1998. governmental order *(Table 3.)*. This classification system is basically used for economic purposes. Fortunately, since it is based on specific parameters of vegetation structure, such as stem density, amount of litter, etc. that heavily influence the local abundance of reed-nesting passerines it was regarded as a biologically plausible stratification method. Each class was represented by at least three independent transect sections. Sample sites were randomly selected from those polygons that can be sampled by walking on banks or by kayaking along canals. Since the estimation of size of a certain population was based on extrapolation from local densities of detectable territorial males and the maximum distance of detection of singing males was determined as 100 m, the extent of each sample polygon was determined using the following algorithm: (a) if the polygon to be sampled was fully covered by the 100 m wide belt surrounding the census transect, the extension parameter in the geo-database created by I. Márkus was used, (b) else, if the polygon to be sampled was only partly covered by the 100 m wide belt surrounding the census transect, the extension of the overlapping section of the polygon and the 100 m wide belt was calculated as the extension of the sample site. Polygons belonging to classes IB, IIB, IIIB were located near to the shores, since these are reedbeds which are dominated or co-dominated by tall sedge species. These polygons were censused by walking on banks or on tracks of Seiga reed-cutting machines. Classes IVB and VB were not sampled since these do not represent important breeding habitats for reed-nesting passerines. Polygons belonging to classes IA, IIA, IIIA, IVA and VA were sampled by kayaking along canals or by walking on banks.

Species	Correction factor
Locustella luscinioides	2000
Acrocephalus melanopogon	1000*
Acrocephalus schoenobaenus	1297
Acrocephalus scirpaceus	2242
Acrocephalus arundinaceus	1000*
Emberiza schoeniclus	1140

Table 3. The species-specific correction factors expressing the difference in probability of detection of territories between 7 and 3 repetitions. Since *Acrocephalus melanopogon* and *A. arundinaceus* territories were regarded to be detected with reasonable precision, it was not necessary to use correction

Sample dates

Sampling was carried out during the period between 02. March 2008 and 15. June 2008. Sampling was carried out only on those days which provided suitable weather conditions (speed of wind not exceeding 10 km/h, no rain). In total sampling was conducted during 14 days. Sampling took 4 hours in each morning, beginning at sunrise.

The sample method and its precision

The sample method was developed from the Finnish transect method (Järvinen & Väisänen 1975, 1976). Walking or kayaking along the sample transect with speed of 4 km/h, the positions of all the males performing territorial behavior were recorded as a point in a shape file using Arc Map software. The position of males singing from a distance no more than 50 meters (from the census transect) can be estimated with the precision of 5 meters, while it was possible to estimate the position of males singing from a distance between 50 and 100 meters from the census transect with the precision of 10 meters. After all, the estimated positions of males singing in the 100 meter wide belt surrounding the census transect were recorded. When performing a classical territory mapping, one can observe only a smaller area. The method used by us is suitable for sampling larger areas, even 60-80 hectares per sample day. It is evident that increasing the area to be sampled during a fix time (i.e. 4 hours) automatically decreases the time to be spent at a certain areal unit. So it was vital to know how effectively (i.e. to what extent) this method can represent the real number of territorial males. The calibration of precision of the method developed by us was conducted during previous censuses performed at other localities, most of which are located in the Danube-Tisza interflow region. Field calibration was conducted using three independent methods. The results reached using the above mentioned method were compared with the results of two other methods: territory mapping and the detection of males responding to playing species-specific songs. These methods (i.e. territory mapping and the playback method) require much more time, but are known as ones producing totally reliable results. Using the modified Finnish transect method with at least 7 repetitions was estimated to produce detection probability of more than 90%.

Since most sample sites at Lake Fertő were censused less than 7 times (3 times, to be more precise), it was necessary to multiply the value of observed density by a correction factor. The correction factor was derived from the probability of detection of a certain territory and it was expressed as a function of repetitions. In order to acquire sufficient data for this calibration, a particular study site (the so called Herlakni ditch) was censused every second week. The correction factor can be regarded as a quotient derived from dividing the number of territories observed after 7 repetitions by the number of territories observed after 3 repetitions.

The number of breeding pairs was regarded to be equivalent with the corrected number of territorial males. In the case of the socially monogamous passerine species it is thought to make no bias, but in the case of socially polygamous species (first of all the Great Reed Warbler *Acrocephalus arundinaceus*) it can lead to underestimation of number of breeding females.

Results

Expressing the probability of detection as function of repetitions

The species-specific correction factors expressing the difference in probability of detection of territories between 7 and 3 repetitions are included in *Table 3*.

Reedbed class	*Locustella luscinioides*	*Acrocephalus melanopogon*	*Acrocephalus schoenobaenus*	*Acrocephalus scirpaceus*	*Acrocephalus arundinaceus*	*Emberiza schoeniclus*
I.A	1,82 ± 0,64	1,04 ± 0,68	0,00 ± 0,00	2,48 ± 1,00	1,08 ± 0,73	0,79 ± 1,29
II.A	1,16 ± 2,00	2,06 ± 0,93	0,00 ± 0,00	1,96 ± 1,20	0,00 ± 0,00	0,75 ± 0,90
III.A	0,88 ± 1,14	2,42 ± 0,57	0,00 ± 0,00	1,65 ± 1,02	0,05 ± 0,18	0,39 ± 0,07
IV.A	0,00 ± 0,00	2,03 ± 0,66	0,00 ± 0,00	2,65 ± 1,22	0,07 ± 0,15	0,43 ± 0,37
V.A	0,00 ± 0,00	1,60 ± 0,45	0,05 ± 0,09	3,41 ± 1,89	0,05 ± 0,17	0,05 ± 0,07
I.B	1,09 ± 0,08	1,08 ± 0,07	2,79 ± 0,78	0,37 ± 0,52	0,00 ± 0,00	1,06 ± 0,37
II.B	1,19 ± 0,34	1,19 ± 0,37	0,87 ± 0,35	0,00 ± 0,00	0,00 ± 0,00	2,68 ± 0,08
III.B	1,83 ± 0,24	1,83 ± 0,24	1,95 ± 0,92	1,09 ± 1,54	0,00 ± 0,00	0,57 ± 0,82

Table 4. The estimated density of territories (average number of territories per hectare) of reed-nesting passerine species in different reedbed classes at the Hungarian part of Lake Fertő, in 2008.

Reedbed class	*Locustella luscinioides*	*Acrocephalus melanopogon*	*Acrocephalus schoenobaenus*	*Acrocephalus scirpaceus*	*Acrocephalus arundinaceus*	*Emberiza schoeniclus*
I.A	747 ± 263	427 ± 279	0 ± 0	1018 ± 411	443 ± 300	324 ± 530
II.A	1068 ± 1842	1897 ± 856	0 ± 0	1805 ± 1105	0 ± 0	691 ± 829
III.A	2331 ± 3020	6411 ± 1510	0 ± 0	4371 ± 2702	132 ± 477	1033 ± 185
IV.A	0 ± 0	2235 ± 727	0 ± 0	2918 ± 1343	77 ± 165	473 ± 407
V.A	0 ± 0	1285 ± 361	40 ± 72	2738 ± 1518	40 ± 137	40 ± 56
I.B	518 ± 38	257 ± 17	663 ± 185	88 ± 124	0 ± 0	252 ± 88
II.B	243 ± 69	121 ± 38	89 ± 36	0 ± 0	0 ± 0	273 ± 8
III.B	76 ± 10	38 ± 5	40 ± 19	22 ± 32	0 ± 0	12 ± 17
Total number of territories (± standard deviation)	**4983 ± 5242**	**12671 ± 3793**	**832 ± 312**	**12961 ± 7234**	**693 ± 1078**	**3099 ± 2120**

Table 5. The estimated number of territories of reed-nesting passerine species in different reedbed classes at the Hungarian part of Lake Fertő, in 2008.

Territorial species

Regarding the locally abundant passerine species, the final database included 924 records (number of records per species: Savi's Warbler *Locustella luscinioides* 72, Moustached Warbler *Acrocephalus melanopogon* 328, Sedge Warbler *A. schoenobaenus* 76, Reed Warbler *A. scirpaceus* 309, Great Reed Warbler 22, Reed Bunting *Emberiza schoeniclus* 117). The estimated density and the estimated number of breeding pairs (calculated for each reedbed classes) is summed up in *Tables 4.* and *5*.

Non-territorial and rare species

In the case of the Bearded Tit *Panurus biarmicus* it was not possible to make precise estimations, since this is not a territorial species. Since it can breed in loose colonies and the number of individuals cannot be determined at certain localities, the number of breeding pairs can be estimated only very roughly. Since individuals were at least as abundant as in the case of the Moustached Warbler, the estimated minimum population size must be about 8000-10000 pairs – but it is based on subjective impressions, not on scientific methods.

The Bluethroat *Luscinia svecica* is a relatively rare breeding species at Lake Fertő, with the number of breeding pairs previously estimated to range between 20 and 30 (unpublished data of S. Mogyorósi & A. Pellinger). Regarding the census transects, 14 territories were recorded. In each case the singing male was recorded more than 1 time, so taking the proportion of sampled areas and the total area of the Hungarian part of Lake Fertő into consideration, the number of breeding pairs would be about 120–150.

Discussion

The conservation status of reedbeds is unfavorable across Europe (Bibby & Lunn 1982, Andrienko 1999, Alvarez-Cobelas el al. 2001). During historic times the extent of reedbeds fell back by 95–99% caused by transformation of natural habitats by human impacts (Németh 1996). Deterioration of reedbeds and their ecosystems is still in progress, caused by several factors (Ostendorp 1989, Van der Putten 1997). Effective conservation of reed ecosystems requires reasonably precise field data on abundance of the target species in order to obtain feedback about the efficiency of the conservation efforts: this is must be regarded as one of the underlying principles of 'evidence-based conservation biology' (Sutherland et al. 2004). The trends of European breeding populations are derived from regular estimations (e.g. Burfield & Bommel 2004). In the case of many species population estimates are not reliable enough; and as a typical example, reed-nesting passerines belong to that group. Population estimates on these species for Hungary (MME Nomenclator Committee 2008) are encumbered by lack of information from both qualitative and quantitative aspects. The problem about the quality (reliability and precision) of these data is basically caused by censuses done using quite different and usually not comparable methods. In addition to that, several large reedbeds have never been surveyed for population data, resulting in deficiency from quantitative aspect. Until recently, the Hungarian part of Lake Fertő which is the largest reedbed of Hungary has never been surveyed for deriving population estimates, either. This study was planned and implemented in order to stop that gap.

In order to reach higher spatial coverage, it was necessary to reduce the number of occasions at the particular sample sites. This way the probability of detecting a territory is less than 1.00 and the ratio between the number of detected and that of all the existing territories can be estimated (see our other article in this volume for details). According to that, population size of a particular species simply extrapolated from the number of detected territories can be interpreted as 'cautious' minimum number, which may be a kind of underestimation of the real population size. Multiplying the number of detected territories by a correction factor (which is to express the ratio between detected and all the existing territories) we can get a more realistic estimation on population size. It is likely that in case of all the investigated passerine species except for the Moustached Warbler it is the corrected value which is closer to the realistic population size.

It is worth to look at the deviation of means. Based on the relative value of deviation, species can be categorized into two groups. Regarding the first group it can be seen that deviation in much less than the mean value. This group includes the Moustached Warbler, the Sedge Warbler, the Reed Warbler and the Reed Bunting. The occurrence of these species follows well definable rules not only in terms of presence/absence, but in terms of local abundance as well. The Moustached Warbler and the Reed Warbler are characteristic breeding species of the inundated reedbeds, while the Sedge Warbler can be regarded as the typical breeding species of reedbeds of the bank zone. The Reed Bunting occurs in both the inner and the outer reedbeds at constant level. It is likely that population sizes of these species are close to the maximum of carrying capacity (when carrying capacity is used in a wider meaning, not restricted for the quantity of available food only).

In the case of the Reed Warbler the relative density compared to that of the Moustached Warbler can be regarded as low. The Reed Warbler and the Moustached Warbler are in interspecific competition, and usually it is the Reed Warbler which is regarded as the better competitor (Catchpole 1973, 1978, Catchpole & Leisler 1986, Leisler 1988, Hoi et al. 1991, Laubmann & Leisler 2001). It is suspected that the definitely high density of the Moustached Warbler territories may have resulted in relatively low density of the Reed Warbler territories.

In the case of the Savi's Warbler and the Great Reed Warbler deviation of means is expressly high indicating that spatial occurrence of these species is much more heterogeneous. In the case of the Savi's Warbler deviation parameter is extremely high in classes IIA and IIIA, which suggests that we should apply other factors in the stratification.

In the case of the Great Reed Warbler the high overall deviation originates from the heterogeneous occurrence of individuals at small canals and the inner reedbeds. Local density of the Great Reed Warbler at reedbeds located closed to open water can be characterized by much lower deviation. This type of habitat holds up two third of the overall population. It is likely that optimal habitats are fully occupied, whereas the inner (suboptimal) habitats are occupied by those individuals which are squeezed out from optimal habitats.

Judging by the results of our study, the Hungarian part of Lake Fertő is a very important breeding site of reed-nesting passerine species. More than 1% of the total population breeding in Hungary nests here in the case of the Savi's Warbler, the Moustached Warbler, the Great Reed Warbler, the Bluethroat, the Bearded Tit and the Reed

Bunting. Regarding the Moustached Warbler, it is more than 90% of the total population breeding in Hungary is located here. The results evidently overwrite the estimated population size of that species, since earlier the total breeding population in Hungary was thought to be 2000–4000 pairs, and we calculated the local population to be as numerous as 13 000 breeding pairs.

In the case of the Bearded Tit the local population size can be equal with the previously estimated size of the total Hungarian population (6000–8000 breeding pairs). Unfortunately, due to lack of adequate estimation method (Hoi & Hoi 2001) this assumption cannot be tested.

Finally, comparing our results with the previous Austrian censuses (Dvorak et al. 1997), it can be seen that in the case of the Moustached Warbler, the Great Reed Warbler and the Reed Bunting the estimated species-specific densities are almost totally equal in the two parts of the lake. It was the Reed Warbler where a decided difference could be observed between the results of censuses.

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