Ekológia (Bratislava) Vol. 17, No. 4, 384-390, 1998

FACTORS INFLUENCING THE OCCURRENCE OF GREAT WHITE EGRET (*Egretta alba*), MALLARD (*Anas platyrhynchos*), MARSH HARRIER (*Circus aeruginosus*), AND COOT (*Fulica atra*) IN THE REED ARCHIPELAGO OF LAKE VELENCE, HUNGARY

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Abstract

Báldi A., Kisbenedek T.: Factors influencing the occurrence of Great White Egret (*Egretta alba*), Mallard (*Anas platyrhynchos*), Marsh Harrier (*Circus aeruginosus*), and Coot (*Fulica atra*) in the reed archipelago of Lake Velence, Hungary. Ekológia (Bratislava), Vol. 17, No. 4, 384-390, 1998.

Landscape ecology became a useful discipline in the design of nature conservation. In the present study we analysed the occurrence patterns of the Great White Egret (*Egretta alba*), Mallard (*Anas platyrhynchos*), Marsh Harrier (*Circus aeruginosus*), and the Coot (*Fulica atra*) in the reed archipelago of Lake Velence (24km²), Hungary, in 1994. We related the presence/absence of the species to three landscape ecological variables and three vegetation characteristics of the reed islands, and built logistic regression models. We found that area proved to be the most important factor determining the occurrence of all the four species. In addition, the isolation and vegetation characteristics were included into to models of the Great White Egret, and isolation to models of the Marsh Harrier and the Coot. We concluded that the survival of the four species at Lake Velence requires the preservation of large reed islands.

Introduction

Fragmentation of natural habitats is a basic problem for nature conservation (e.g. Soulé, Kohm, 1989; Báldi, 1996). To preserve the original species and community structure, we should know which factors influence the occurrence of species in the remnant habitat patches. Several features of the habitat selection of some bird species are known (e.g. Cody, 1985; Moskát et al., 1993), and there are detailed analyses on the distribution of birds in wood patches (e.g. Møller, 1987; Haila et al., 1993; Hinsley et al., 1995). Indeed, there is a large

number of forest fragmentation studies (e.g. Murcia, 1995; Báldi, 1996). However, investigations on the effects of fragmentation of other habitats (e.g. reed-beds) were almost totally ignored (Rosenberg, Raphael, 1986). Exceptions are the ornithological works by Celada, Bogliani (1993), Schiess (1989), Báldi, Kisbenedek (1994, 1998) and a review by Tscharntke (1992) on several insect taxa and birds. However, for birds Tscharntke cited Schiess' work. Therefore, the distribution patterns of birds in reed patches were not studied in detail.

The aim of the present paper is to examine which landscape and habitat factors affect the occurrence of four non passerine bird species in reed islands at Lake Velence, Hungary. The four species are the Great White Egret (*Egretta alba*), Mallard (*Anas platyrhynchos*), Marsh Harrier (*Circus aeruginosus*) and Coot (*Fulica atra*). Although all the four species are abundant in Europe, they may require conservation concern for, at least, four reasons: 1. they may be key species in the ecosystem as top-predators, and/or because they form a large part of the biomass; 2. as large and conspicuous species, they attract public attention; 3. the Mallard and the Coot are important for hunting; and 4. their occurrence at fishponds is usually undesirable.

Study area and methods

The study was conducted at Lake Velence, Hungary (47° 10' N 18° 32' E). It is ca 24 km² large, but its average depth is about 1.5 m. There are reed (*Phragmites australis*) vegetation on the lake, forming a large reed-bed on the western part, and many islands of various sizes on the remaining parts. Approximately 40% of the lake is covered by reed. We made censuses of the four bird species on 109 reed islands ($\bar{x}$ = 17413.6 m² ± 37164 m², range: 25 – 257100 m²) in 1994, and in 1993 only for the Marsh Harrier. Only the real islands were considered, which had no connections with the mainland. There were two censuses made, in April and May.

We used six variables to describe the reed patches (Table 1). The landscape variables were measured from 1:10,000 maps (EOV) and from air-photos. The isolation of a patch was measured as the distance from the nearest patch and nearest large patch/continent. To detect the possible effects of the vegetation, we used three variables as follows: 1. we grouped the patches according to the main structure of the reed stand: dense or sparse, forming a clumped structure. The average height of the reed stand was estimated both 2. in April (last year reed) and 3. in May (new sprouting reed). The vegetation height is assumed to be a good measure of the

Table 1. The measured landscape variables and vegetation characteristics of 109 reed islands at Lake Velence, Hungary

Area (Area): Area of the reed islands [ha].
Distance from the nearest island (DisNear): Distance between the edges of a reed island from the edge of the nearest reed patch [m].
Distance from the nearest continent (DisCont): Distance between the edges of a reed island from the edge of the nearest large reed patch/continent.
Type of reed stand density (ReedDens): Two main types were clearly present: the reed stand of an island was dense or sparse/clumped.
Height of last year reed (LastReed): Height of the last year reed estimated in April [m].
Height of new sprouting reed (NewReed): Height of the new sprouting reed estimated in May [m].

quality of reed stands for birds, partly because high reed stems are usually stronger than low reeds, thus the overall vegetation structure is different, partly because, height is a good indicator of human activities, like burning or mowing. These activities significantly influence bird occurrence (Báldi, Moskát, 1995).

We built models to predict the occurrence of species using logistic regression analysis (Norusis, 1990). This technique has the great advantage in that it accepts binary (presence/absence) data, and lacks statistical assumptions concerning the distribution and variance of data.

Results and discussion

Area proved to be the most important factor determining the occurrence of all the four species. In twelve out of 14 possible cases area was incorporated into the logistic regression model. The two variables measuring isolation of the reed patches were incorporated into 5 model out of the 14. The height of new sprouting reed was incorporated into two models. Two variables were not included in neither model: the reed stand type, and the vegetation height of the last year reed.

However, there are clear differences in the models of the different species. The occurrence of the Great White Egret strongly related to the area of the patch and to its distance from continents (Table 2). With increasing area, increases also the chance of Egret present on the patch. In fact, the Great White Egret was found in large undisturbed reed-beds and marshlands in the middle of the century, when it was less abundant then recently (Harasztby, 1984). Both, the model for April and the model for May involved the vegetation height of new sprouting reed, however, with different signs (this may be the reason for the missing of this variable from the pooled model). It may indicate that egrets avoid dense reed stands, because in April they prefer islands where there will be strong reed in May, i.e. in April the stand is not so dense, because a dense stand of the old reed might prevent the development of strong new reeds. The negative effect of the new sprouting vegetation in the May model can be explained similarly: where the vegetation is high, the reed is usually strong. Great White Egrets preference for sparse reed patches may be the consequence of their large body size. Not including the type of vegetation density into the models may be the consequence of the binary character of this variable. The selection of patches by the egrets may rely on other spatial resolution. The preference for large islands that are far from other large islands/continents may results in a uniform spatial distribution pattern. A possible explanation is the improvement of food resource exploitation. The egrets visit the patches mainly for foraging, their breeding colony may be outside the lake, at Dinnyési Fertő marshland.

Table 2. Models of logistic regression analysis predicting the presence of Great White Egret (*Egretta alba*) in reed islands at Lake Velence, Hungary. The R value, its significance (R (p); d.f.=1 for all cases), and the variable(s) incorporated into the model are shown. A positive R value indicates that the variable increases, so does the chance of the event occurring. Large R value indicates that the variable has a large partial contribution to the model. (See Table 1 for abbreviations.)

	April 1994	May 1994	All observations
Area	0.253 (0.014)	0.338 (0.004)	0.292 (0.002)
Distance from nearest island	0.0	0.0	0.0
Distance from nearest continent	0.0	0.255 (0.017)	0.138 (0.054)
Reed stand density	0.0	0.0	0.0
Height of last year reed	0.0	0.0	0.0
Height of new sprouting reed	0.184 (0.043)	–0.173 (0.054)	0.0
Incorporated variables	Area, NewReed	Area, DisCont, –NewReed	Area, DisCont
Number of islands with Great White Egret	9	8	17

The occurrence of Mallards was clearly predictable on the basis of the area of the given reed island (Table 3). The distance from the nearest continent may have a minor effect, since its R value was not zero, although it was not included into the model. May be a spacing mechanism similar to that of the Great White Egret is responsible for this pattern, which may result in better foraging possibilities. In case of Mallards better predator avoidance may also be a factor that is responsible for the observed pattern.

Table 3. Models of logistic regression analysis predicting the presence of Mallard (*Anas platyrhynchos*) in reed islands at Lake Velence, Hungary. The R value, its significance (R (p); d.f.=1 for all cases), and the variable(s) incorporated into the model are shown. A positive R value indicates that the variable increases, so does the chance of the event occurring. Large R value indicates that the variable has a large partial contribution to the model. (See Table 1 for abbreviations.)

	April 1994	May 1994	All observations
Area	0.150 (0.052)	0.283 (0.008)	0.176 (0.024)
Distance from nearest island	0.0	0.0	0.0
Distance from nearest continent	0.0	0.0	0.042 (0.140)
Reed stand density	0.0	0.0	0.0
Height of last year reed	0.0	0.0	0.0
Height of new sprouting reed	0.0	0.0	0.0
Incorporated variables	Area	Area	Area
Number of islands with Mallard	13	9	22

The five models predicting the occurrence of Marsh Harrier exceeded the area 3 times (Table 4). In an additional case the R value was almost significant (p = 0.054). The larger the area, the larger the chance of finding Marsh Harrier in the reed patch. However, the role of area may be an artefact in this case, simple the result of increased chance of observation during the census of a large island, which took longer time than that of small islands. The harriers fly over a large area, which includes many reed islands, while the other species live on a small area (Coot and Mallard), or are foraging for several hours in a patch (Great White Egret). The Marsh Harrier's patch preference should be investigated by following

T a b l e 4. Models of logistic regression analysis predicting the presence of Marsh Harrier (*Circus aeruginosus*) in reed islands at Lake Velence, Hungary. The R value, its significance (R (p); d.f.=1 for all cases), and the variable(s) incorporated into the model are shown. A positive R value indicates that the variable increases, so does the chance of the event occurring. Large R value indicates that the variable has a large partial contribution to the model. (See Table 1 for abbreviations.)

	April 1993	May 1993	April 1994	May 1994	All observations
Area	0.0	0.373 (0.002)	0.166 (0.054)	0.501 (0.001)	0.268 (0.002)
Distance from nearest island	0.0	0.0	0.0	0.0	0.0
Distance from nearest continent	0.0	0.174 (0.059)	0.0	0.0	0.0
Reed stand density	0.0	0.0	0.0	0.0	0.0
Height of last year reed	0.0	0.0	0.0	0.0	0.0
Height of new sprouting reed	0.0	0.107 (0.107)	0.0	0.0	0.0
Incorporated variables	–	Area, DisCont	–	Area	Area
Number of islands with Marsh Harries	5	7	9	4	25

the individual animals, and marking their hunting route on airphotos. Then it would possible to decide whether there is a preference for any patch type. One model incorporated the distance from the nearest continent, as well, suggesting some regularities in the pattern of individuals. The height of the new sprouting reed may have a minor role since it has no zero R value in one case out of the 5.

The occurrence of Coots on reed islands depended mainly on the area of the reed patches (Table 5). The Coot uses small home ranges, therefore this result reflects to the real preference of the species. It preferred large islands with no other reed patches in the proximity in April. The type of vegetation density was not included in the model, although it has

T a b l e 5. Models of logistic regression analysis predicting the presence of Coot (*Fulica atra*) in reed islands at Lake Velence, Hungary. The R value, its significance (R (p); d.f.=1 for all cases), and the variable(s) incorporated into the model are shown. A positive R value indicates that the variable increases, so does the chance of the event occurring. Large R value indicates that the variable has a large partial contribution to the model. (See Table 1 for abbreviations.)

	April 1994	May 1994	All observations
Area	0.208 (0.013)	0.205 (0.012)	0.202 (0.007)
Distance from nearest island	0.124 (0.061)	–0.148 (0.039)	0.0
Distance from nearest continent	0.0	0.0	0.0
Reed stand density	0.022 (0.156)	0.0	0.0
Height of last year reed	0.0	0.0	0.0
Height of new sprouting reed	0.0	0.0	0.0
Incorporated variables	Area, DisNear	Area, – DisNear	Area
Number of islands with Coot	18	20	38

a non-zero R value. This variable suggests that Coots preferred dense reed stands. The model of the May occurrences incorporated the same two variables, but the distance from the nearest reed island variable had different sign. It suggested a preference for nearby reed islands, i.e. for large reed cover. This may be explained as a need for hiding, and avoiding predators, since these are living in families already (Haraszthy, 1984).

What are the implications for conservation for the studied four bird species? Because area had an overwhelming positive effect on the occurrences of the species, we may conclude that their survival at Lake Velence requires the preservation of large reed islands. However, to more fully understand which factors may contribute to the presence of these species, a more detailed analysis is required, which includes more landscape and habitat variables, as well as, the effects of human disturbances. It is necessary to investigate the interactions among the animal populations in the landscape, in order to find out whether it is competition, mutualism or predation that significantly affects the patterns of species occurrences. It may be carried out using spatial pattern analysis (e.g. Moskát et al., 1992).

Translated by the authors

Acknowledgement

We are indebted to A. Bankovics for comments on the manuscript. We thank the Budapest Nature Conservation Authority for permission to work within the reserve and for help to engage our field observations. The study was supported by the Hungarian Scientific Research Fund (OTKA F/5249, T/16510).

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Received 27.6.1997

Báldi A., Kisbenedek T.: Faktory ovplyvňujúce výskyt volavky bielej (*Egretta alba*), divej kačice (*Anas platyrhynchos*), kane močiarnej (*Circus aeruginosus*) a lysky (*Fulica atra*) na trstinovom súostroví na jazere Velence, Maďarsko.

Krajinná ekológia je užitočnou disciplínou uplatňujúcou sa pri návrhu ochrany prírody. V predkladanej štúdii analyzujeme vzorku výskytu volavky bielej (*Egretta alba*), divej kačice (*Anas platyrhynchos*), kane močiarnej (*Circus aeruginosus*) a lysky (*Fulica atra*) v trstinovom súostroví na jazere Velence (24 km^2), Maďarsko v roku 1994. Uvádzame súvislosť medzi existenciou/neexistenciou druhov k trom krajinno-ekologickým premenným a trom vegetačným charakteristikám trstinových ostrovčekov a zostavili sme logistické regresívne modely. Zistili sme, že územie sa zdá byť najdôležitejším faktorom determinujúcim výskyt všetkých štyroch druhov. Na dôvažok, izolácia a charakteristika vegetácie sú zahrnuté do modelov volavky bielej, izolácia do modelov kane močiarnej a lysky. Došli sme k záveru – aby štyri druhy vyskytujúce sa na jazere Velence prežili, vyžaduje sa ochrana veľkých trstinových ostrovov.