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HABITAT PREFERENCE OF SYLVIIDAE WARBLERS IN A FRAGMENTED WETLAND

PREISZNER, B. and CSÖRGŐ, T.

Eötvös Loránd University, Department of General Zoology
H-1117 Budapest, Pázmány sétány 1/c, Hungary, E-mail: csorgo@elte.hu

Degradation of wetland habitats usually begins with small scale fragmentation. Species indicate this progress differently depending on their microhabitat preferences. This study was carried out at the most fragmented, mosaical part of the Ócsa Landscape Protection Area (Hungary), in years 2002–2005. This work involves the results of the 3 most characteristic Passerine species of the area. Birds were captured in different, representative vegetation types with 51 mist nets. Distributions were compared among the species; within the species in separated periods and between age classes in the post-breeding period. Processing the recapture data using GIS let us estimate the mean home range of the different species in different life periods. However the distribution patterns and home range sizes showed differences among the studied groups, the habitat choice proved to be a very small scale decision. This reinforced the importance of fragmentation for conservationists. Monitoring avian community composition – after collecting data using our model – could be a way to detect changes in an area's state of degradation. A model to estimate an area's value for nature conservation also has been processed.

Keywords: Passerines, Sylviidae, habitat preference, fragmentation, wetland

INTRODUCTION

Exact knowledge of habitat preference is important in different aspects. It is important in understanding the basic of bird community relations like competition or predation etc., on the other hand it is important for conservation biology. To know a species' habitat preference is an unquestionably operative matter in protecting the species. Then again to know the dynamic of species composition – which strongly depends on the species' habitat preference – is important in protection of the area.

Habitat preference shows a huge diversity amongst the species and it may also vary in the different life periods of a kind (VEGA RIVERA *et al*. 2003). Most of the Passerines are territorial, they protect their territory in breeding season, after that they usually leave it. Lot species spend the rest of the year in a completely different habitat (BARLEIN 1983, BILCKE 1984, CSÖRGŐ 1995). The strength of habitat preference usually weakens during the dispersion already. Further habitat change after dispersion is a common phenomenon for migrating birds, but it is also observable in case of resident species (COMBARRO & CSÖRGŐ 1986, BERTHOLD 1996, TÖRÖK 1998). This behaviour buffers competition (BERTHOLD 1993).

Habitat preference studies for passerines usually deal with the quality properties of habitat choice (MACNALLY 1990, LEISLER 1992); fewer studies deal with another notable property, the scale of preference (HERBERT *et al.* 1998).

Precise identification of the optimal habitat is so momentous that selection affected the males to arrive earlier, so they have the chance to choose the best available territories even in a seemingly homogeneous habitat (SHENNAN 1985). Another important point of view is for conservationists. For example degradation of wetland habitats usually begins with small scale fragmentation due to desiccation. Species indicate this progress differently depending on their microhabitat preferences. Monitoring the changes in species composition of Passerines of an area could be a way to detect its condition changes (DERLETH *et al.* 1989, BALENT & COURTIADE 1992, POULIN *et al.* 2002).

Generating a model of habitat preference studies using characteristic species was the goal of this research. This model could be used on other species – even smaller populations – for nature conservation projects.

MATERIALS AND METHODS

This study was carried out in the northern part of the Ócsa Landscape Protection Area, Hungary. This postglacial relictum area served as a peat mine until it became nationally protected in 1975. It is also a part of the Ramsar Convention since 1989 (RAMSAR CONVENTION BUREAU 1997). As it was a mine the original water level was lowered on most of the area, and large peat boxes were set up. The primary and the secondary succession resulted very heterogeneous and mosaical vegetation and it is still under permanent change (NAGY 2001).

Birds were captured on constant sites in different, representative vegetation types with standard methods since 1983. Fifty one Japanese type mist nets (length: 12 m; height: 2.5 m; mesh: 16 mm; shelves: 5) were used for capturing birds. Every single captured bird was marked with an individually numbered ring and released. This method is a reputable routine for habitat preference studies (BERTHOLD & SCHLENKER 1975, BERTHOLD 1993).

Four consecutive years' (2002–2005) data were used. The time and place (identification code of the net) of capture, the species, and age of individual were used in this study. The two detached age classes were: juvenile (fledged in the current calendar year – code 1y); and adult (fledged in previous calendar years – code 1+).

This work involves the 3 most characteristic species of the area. All of them are territorial in breeding season and they all bear interspecific and intraspecific interactions (CATCHPOLE 1973, CODY 1978, 1985, HOI *et al.* 1991, BONTE *et al.* 2001).

Reed Warbler (*Acrocephalus scirpaceus*) nests and forages in homogeneous reed-beds (CSÖRGŐ 1982, 1998*a*, BÁLDI 1995, BÁLDI & KISBENEDEK 1999). Marsh Warbler (*Acrocephalus palustris*) prefers the reed-bed's drier edges for nesting, and foraging (CSÖRGŐ 1998*b*). Blackcap (*Sylvia atricapilla*) is forest and woodland warbler, it nests in shrubs and in woodlands as well (SCHMIDT 1998).

Table 1. The different periods' beginning, and ending days

	Breeding season	Post-breeding period
Reed Warbler	15th of May – 9th of July	From 10th of July
Marsh Warbler	1st of June – 9th of July	From 10th of July
Blackcap	1st of May – 30th of June	From 1st of July

Two different periods of the year were separated: breeding season (starting with the end of spring migration of the species until fledging), and the post-breeding period (dispersion, and autumn migration). The periods were determined by the four years' average, and they were slightly different for the three species (Table 1). The post-breeding period includes the dispersion and the autumn migration as well. This period's data certainly involves a few data of breeding individuals due to the overlong extra incubations which are impossible to filter, but it is negligible because of this period's large dataset. Microsoft Office 2003 software kit's Access and Excel were used for the analysis of the ringing data.

Exact net site coordinates were located with Trimble GeoExplorer3 GPS receiver (http://www.trimble.com) during the summer of 2005. The GIS (Geographical Information System) data were analyzed with GPS Pathfinder Office 2.90 and ArcView 3.2 softwares. During this analysis aerial photograph and the GPS data were used to create a schematic map. A database also was created, which contains the exact coordinates of the net poles in Hungarian EOV projection.

The individuals' distribution in the nets was calculated in breeding season for the different species, and in the post-breeding period for different species and for the different age classes of the same species. This was expressed in percent, where 100% means the total captures of the given species in all nets in the current period. The implications of the vegetation are based only on common field experiences; yet adequate vegetation map was not made.

Habitat preference was studied among the different age classes of the same species and the two periods for the same species were also compared (Figs 1–2). Linear trend lines were laid on the data points; the equation and the R^2 of the trend line were calculated. Higher R^2 value means that the two sample's individuals prefer the same nets – or rather the same habitats around the nets.

In case of recapture the two consecutive captures' distance could be calculated with the help of the GIS database. This distance gives us the individual's minimal movement between the two captures. Using these data a mean minimal movement – and from these a mean minimal home range – could be calculated for each species. In breeding season it might understood as a minimal territory size for the species. Lack of recapture data in breeding season for Marsh Warbler (Table 2) from the studied nets caused its movements and home range could not be analyzed in this period.

Table 2. Studied species' record (and recapture data) number in the two different periods in 2002–2005

	Breeding season		Post-breeding period	
Reed Warbler	238	(24)	3082	(672)
Marsh Warbler	42	(1)	1299	(162)
Blackcap	364	(23)	7428	(908)

RESULTS

The studied species differ in the quality of the preferred habitat (Table 3). They also differ in the pattern of preference; namely intraspecific differences are observed in distinct extent for the three species. We got different results between the two separated periods (Fig. 1). The results in the post-breeding period for the different age classes do not show such differences as in the previous two aspect (Fig. 2). The minimal movement distances, and the minimal home range sizes show differences between the species and between the periods as well (Table 4).

During breeding season Reed Warblers (Table 3) choose mainly reed-beds, they could be found nearly in one block, only a few individuals were captured in different vegetation types, tough these were patches of Common Reed (*Phragmites australis*). Marsh Warblers (Table 3) could be found in more various vegetations in

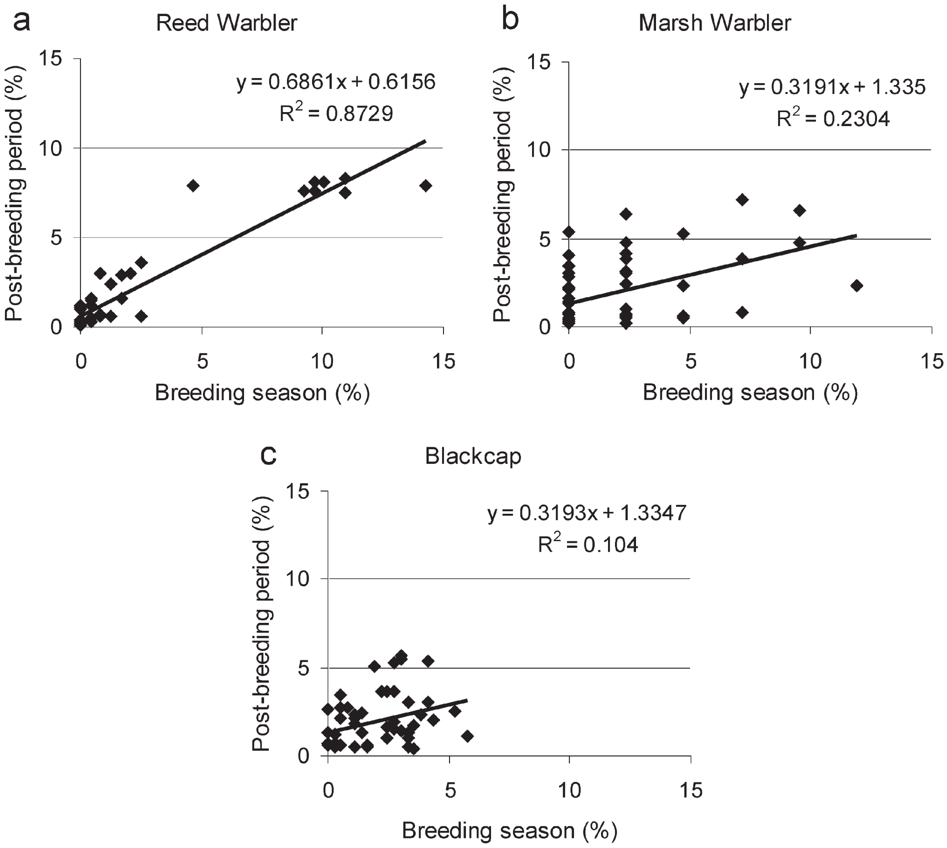

Fig. 1. The interdependence of the two periods' distributions

smaller blocks, but more spread on the area, and they don't choose really closed vegetation structure. Blackcaps has the most uniform distribution (Table 3), they occurred at every net site more or less in wood and bush vegetations.

In post-breeding period all three species' distribution levels off a little bit. However Reed Warblers (Table 3) still mostly turn up in the reed-bed's nets, a few mostly juvenile individuals were found in other nets. Marsh Warblers (Table 3) this time choose more open vegetations. Blackcaps (Table 3) could be found in every net.

Studying the two periods within a species resulted those that follow. In case of Reed Warbler the distributions in the nets changed very slightly ($R^2 = 0.87$) (Fig. 1*a*). For Marsh Warbler this change in distribution is much higher ($R^2 = 0.23$), so

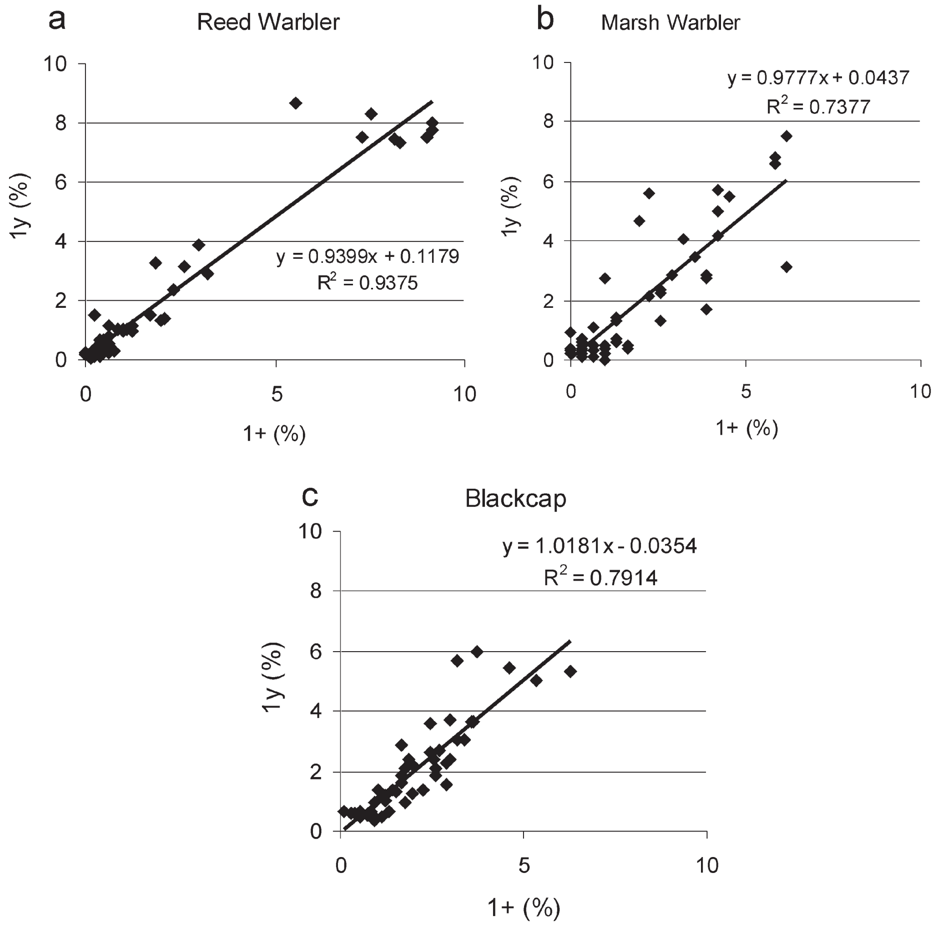

Fig. 2. The interdependence of the ages' distributions

Table 3. Catch ratio distribution of the three species in percent, where 100% is the total captures of the given species in all nets in the current period (B – breeding season; P-B – post-breeding period; Net ID – identification code of the nets, I – tree vegetation, II – reedbed, III – bushy meadow, IV – tree vegetation, V – bushy tree vegetation)

Species	Marsh Warbler			Reed Warbler			Blackcap		
Period & Age	B.	P-B.		B.	P-B.		B.	P-B.	
Net ID		1+	1Y		1+	1Y		1+	1Y
I/5	0.0	0.0	0.2	0.0	0.1	0.1	3.3	0.3	1.1
I/4	0.0	0.0	0.3	0.0	0.2	0.2	3.0	0.2	1.2
I/3	0.0	0.2	0.2	0.0	0.2	0.2	3.6	0.4	1.3
I/2	0.0	0.4	0.4	0.4	0.1	0.3	4.4	0.3	1.8
I/1	0.0	0.0	0.7	0.0	0.1	0.1	2.5	0.2	1.4
I/0	0.0	0.1	0.2	0.0	0.0	0.1	0.3	0.1	0.5
II/10	2.4	1.0	3.2	1.7	0.5	2.4	0.8	0.2	2.5
II/9	0.0	0.9	2.6	0.8	0.7	2.3	1.1	0.2	1.6
II/8	2.4	1.4	5.0	4.6	1.5	6.4	0.0	0.2	1.1
II/7	7.1	1.5	5.7	9.7	2.0	6.1	0.3	0.2	1.1
II/6	4.8	1.1	4.2	9.7	2.1	5.5	0.5	0.0	0.6
II/5	9.5	1.4	5.2	14.3	2.4	5.5	0.0	0.1	0.5
II/4	9.5	1.0	3.8	9.2	2.2	5.4	0.3	0.0	0.5
II/3	0.0	1.0	4.3	10.9	2.4	5.9	0.5	0.1	0.6
II/2	2.4	0.5	4.3	10.9	1.9	5.5	0.0	0.1	0.6
II/1	0.0	0.5	3.6	10.1	2.4	5.7	0.3	0.1	0.5
III/1	2.4	0.8	3.1	0.4	0.5	1.0	1.9	0.8	4.3
III/2	4.8	0.2	2.1	0.0	0.2	0.7	2.2	0.5	3.1
III/3	0.0	0.3	1.0	0.0	0.3	0.7	1.1	0.3	2.0
III/4	2.4	0.6	1.8	0.0	0.3	0.8	0.5	0.4	2.3
III/5	0.0	0.9	1.3	0.0	0.2	0.8	0.5	0.4	3.1
III/6	0.0	0.9	2.1	0.0	0.3	0.7	0.0	0.4	2.2
III/7	2.4	0.9	2.1	0.0	0.3	0.8	1.1	0.3	1.9
III/8	0.0	0.7	2.2	0.0	0.3	0.7	3.3	0.5	2.6
III/9	0.0	0.5	1.6	0.8	0.2	0.6	1.4	0.4	2.1
III/10	2.4	0.4	0.3	0.4	0.1	0.4	0.5	0.4	1.8
IV/1	2.4	0.1	0.5	0.0	0.0	0.1	2.7	0.3	1.2
IV/2	0.0	0.2	0.2	0.0	0.1	0.2	2.5	0.3	0.8
IV/3	0.0	0.2	0.2	0.0	0.0	0.2	3.3	0.1	0.8
IV/4	0.0	0.2	0.3	0.0	0.1	0.1	1.1	0.1	0.4
IV/5	0.0	0.1	0.5	0.0	0.0	0.1	0.3	0.2	0.5

Table 3 (continued)

Species	Marsh Warbler			Reed Warbler			Blackcap		
Period & Age	B.	P-B.		B.	P-B.		B.	P-B.	
Net ID		1+	1Y		1+	1Y		1+	1Y
IV/6	0.0	0.2	0.1	0.0	0.1	0.1	3.3	0.1	0.4
IV/7	0.0	0.1	0.1	0.0	0.1	0.1	1.6	0.2	0.4
IV/8	2.4	0.1	0.4	0.0	0.1	0.1	1.6	0.1	0.5
IV/9	0.0	0.0	0.2	0.0	0.0	0.0	1.6	0.1	0.4
IV/10	0.0	0.3	0.5	0.0	0.1	0.2	2.7	0.4	1.6
V/1	0.0	0.1	0.3	0.0	0.0	0.2	5.8	0.2	1.0
V/2	0.0	0.1	0.4	1.3	0.1	0.5	5.2	0.4	2.1
V/3	7.1	0.3	0.5	0.4	0.1	1.1	2.7	0.4	3.2
V/4	2.4	0.9	2.2	1.3	0.6	1.8	2.7	0.5	4.8
V/5	11.9	0.6	1.7	2.1	0.8	2.1	4.1	0.7	4.7
V/6	7.1	1.5	2.4	2.5	0.8	2.9	3.0	0.5	5.1
V/7	0.0	0.3	1.1	1.7	0.5	1.1	3.0	0.9	4.6
V/8	2.4	0.2	0.9	0.0	0.3	0.7	4.1	0.5	2.6
V/9	0.0	0.6	1.0	0.4	0.6	1.0	2.5	0.5	3.2
V/10	4.8	0.2	0.4	0.0	0.2	0.2	3.8	0.4	1.9
V/11	4.8	0.2	0.4	0.8	0.1	0.4	1.4	0.1	1.2
V/12	0.0	0.1	0.2	0.4	0.1	0.2	2.5	0.2	0.9
V/13	2.4	0.0	0.2	0.0	0.1	0.1	0.5	0.1	0.5
V/14	0.0	0.2	0.0	2.5	0.2	0.4	3.6	0.1	0.3
V/15	0.0	0.1	0.1	2.5	0.1	0.5	0.5	0.1	0.5

those nets, which are frequently chosen in breeding season are stock down in the post-breeding period (Fig. 1*b*). This difference between the two periods is the most expressed ($R^2 = 0.10$) in case of Blackcap (Fig. 1*c*).

Differences between the age classes within a species in the post-breeding period are not so expressed. Again Reed Warbler's age classes show the smallest difference ($R^2 = 0.94$) (Fig. 2*a*). In case of Marsh Warbler there is also strong correlation ($R^2 = 0.74$) between the distributions of the different age classes (Fig. 2*b*). The strength of correlation ($R^2 = 0.79$) in case of Blackcap is between the other two species' (Fig. 2*c*).

The minimal movement distances, and the minimal home range sizes are different for the three species in both period, and for the two periods within a species (Table 4). During breeding season all three species home range size is very small (Table 4). The home range sizes grow four to ten times bigger in post-breeding pe-

Table 4. Mean minimal movement (MMM) in meters, and mean minimal home range (MHR) sizes in hectares and the standard deviations (SD) in the two different periods

	Breeding season		Post-breeding period	
	MMM (SD)	MHR (SD)	MMM (SD)	MHR (SD)
Reed Warbler	20.66 (18.96)	0.06 (0.13)	83.83 (70.26)	0.94 (1.34)
Marsh Warbler	–	–	109.75 (77.93)	1.42 (1.62)
Blackcap	49.51 (43.41)	0.34 (0.43)	106.15 (69.60)	1.26 (1.46)

riod. In case of Blackcap difference between the periods is more expressed than in case of Reed Warbler, however Blackcap has a larger home range in both periods.

During the statistical analysis problems occurred due to the differences in the sample sizes (Table 2). Another typical matter, that large standard deviation values were experienced.

DISCUSSION

Our study reinforced those results that on an area which endured anthropogenic disturbances species could behave distinctly of their preference (MCINTYRE 1995). For instance, Marsh Warbler's smoother distribution is not due to weaker habitat preference, but to the mosaical vegetation (NAGY 2001). The captures occur mostly in its optimal vegetation patches, thus we interpret that Marsh Warbler chooses its optimal habitat with a good accuracy. A different aspect; Marsh Warbler has the largest minimal movement distance, and home range but these noticeable distances are because it has to fly longer between its habitat patches.

Differences in habitat use are not known between the age classes in *Acrocephalus* warblers (LEISLER *et al.* 1989), those smooth variances we found could be originated from the natal dispersal behaviour (SUTHERLAND *et al.* 2000) or from the less accurate choice of the inexperienced juveniles as well. Latter could be confirmed with the experience, that these juvenile individuals were captured in the close surroundings of the preferred vegetations of the adults. The Blackcap's preference shifts towards the edge-like vegetations, but for this species the adult ones show this pattern as well. A reason for this is the change in foraging habits (SCHMIDT 1998); the post-breeding period's preferred nets are usually close to Elderberry bushes (field experience).

Our study showed the habitat choice to be very accurate. A small change in a net-site's vegetation is enough to change the species distribution in the nets. For instance one or two bushes at the northern end of the net-site in the reed-bed are enough to decrease the Reed Warbler's, and increase the Blackcap's occurrence. It shows that the birds could decide in this microhabitat scale whether a vegetation structure is optimal, or suboptimal for them. So vegetation's fragmentation in comprisal of its species composition and physical structure is an important attribute (MACNALLY 1990, LEISLER 1992). This emphasizes the importance of the scales when interpreting habitat preference studies (HERBERT *et al.* 1998). For nature conservation it also means that for a species with a preference for homogeneous habitats, small scale fragmentation could already cause a problem (MCCOLLIN 1998).

The well-known negative impacts of habitat fragmentation are species composition and diversity changes (RUMBLE & GOBEILLE 1998). The mosaical vegetation also increases edge habitats, which includes other dangers, like increased nest predation and brood parasitism (GATES & GYSEL 1978, MCCOLLIN 1998, DAVIS 2004, DRISCOLL & DONOVAN 2004). Less-known problem for closely relative, genetically not completely isolated species – e.g. Reed Warbler and Marsh Warbler – might produce hybrid specimens (LEMAIRE 1977). In case of natural zonation these species' individuals' territories are in two not adjacent belts; they should be separated by an intermediate zone and a genetically more detached species' – the Sedge Warbler (*Acrocephalus schoenobaenus*) – specimens' territories. If the natural zonation no longer exists – like in the studied area – Marsh Warblers individuals' territories in the patches are right next to the Reed Warblers individuals'. Since isolation ended, there is a high risk of hybridization, which deteriorates the genome of the two kinds (FAIVRE *et al.* 1999). However these genetic impacts are better known in landscape scale (NAGUIB & TODT 1998, BATES 2000), this phenomenon emphasizes the importance of small scale fragmentation's role in this problem.

For avian conservation, the habitat preference – which could be detected with the methods above – is needed to be well-known (MCINTYRE 1995). In case of a species with strong preference, large homogeneous areas are necessary (MCCOLLIN 1998), e.g. it is important for Reed Warbler. Required homogeneous Common Reed vegetation could be maintained with water level management against the desiccation, and with reed-bed management against the succession (HAWKE & JOSÉ 1996). If these necessary interferences are not done in order of nature conservation, generalist species like Blackcap are helped by fragmentation (RAIVO & HAILA 1990), so they could become dominant, and this might devalue the area (MCCOLLIN 1998).

However long-term trends in avian communities not always correlated with habitat change (WESZOLOWSKI & TOMIALOJC 1997), the success of an environment changing management should be followed up. This could be carried out with monitoring species composition (CSÖRGŐ *et al.* 1998). However during monitoring effects from outside the monitored area and the scale of the study has to be considered (BÁLDI & KISBENEDEK 1999, FOPPEN *et al.* 1999, WANG *et al.* 2000,

DRISCOLL & DONOVAN 2004, FIELD & ANDERSON 2004). To interpret species composition, exact preference patterns are needed to be known.

A model to decide a species' preference strength was processed. In order of this, three species with different but more or less known preference was chosen, so at the same time a control of the model was able to be performed. The method easily could be applied on other species of the studied area. As shown above the home range sizes could demonstrate the preference dimensions. This attribute could give a value of a species. If every species is assigned with a certain value, than a single species list could be enough to decide whether an area deserves attention or not.

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