

Community structure and activity levels of bats above waters in the Łęczczok Reserve, southern Poland

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Abstract. Species composition and activity of bats above large ponds (0.36–0.91 km²) and a river (5 m wide, 0.5 m deep), both surrounded by old oak stands, were studied during 2001–2003 in the Łęczczok Reserve (Silesian Lowland, S Poland). Bats were captured using mist nets. The most abundant species above ponds was *Myotis daubentonii* (65.9%), while *Nyctalus leisleri* (38.9%), *M. daubentonii* (18.5%) and *Nyctalus noctula* (15.7%) were the most numerous above the river. Species diversity was higher above the river, whereas bat activity was more intensive above ponds. The results suggest that medium-sized watercourses and water bodies are important feeding habitats for many species.

Chiroptera, species composition, foraging activity, riparian habitats

Introduction

The structure of bat communities reflects the diversity and resource richness of the environment. Bats heavily avoid intensively managed areas such as moorland, improved grassland or arable land, and prefer woodlands, watercourses and water bodies (Vaughan et al. 1997, Racey 1998a). Wetlands and rivers serve as sources of both food and drinking water for bats (Racey 1998b). Differences in the character of watercourses, such as their dimensions, surrounding plant cover, water movement, and level of eutrophication, also strongly influence bat species composition (e.g. Vaughan et al. 1996, Racey 1998b, Seidman & Zabel 2001).

Kowalski et al. (1996) and Ciechanowski (2002) showed differences in the composition of bat communities between rivers and small ponds in Poland, but their results were contradictory. In the Puszcza Kozienicka Forest, bat species which forage in open spaces (genera *Nyctalus*, *Eptesicus* and *Vespertilio*) were dominant above rivers, while at small ponds there was a prevalence of species foraging in cluttered habitats (genera *Myotis*, *Pipistrellus* and *Plecotus*, Kowalski et al. 1996). Contrary to this study, in the Puszcza Darżłubska Forest, species from the *Myotis*, *Pipistrellus* and *Plecotus* group prevailed above the river and species from the *Nyctalus*, *Eptesicus* and *Vespertilio* group above ponds (Ciechanowski 2002). In the Białowieża Primeval Forest, bats from the *Nyctalus*, *Eptesicus* and *Vespertilio* group appeared to be the most numerous above the river (Rachwald et al. 2001), but no data on species composition above water bodies were provided.

Mist netting, as a method of studying bats, has several potential biases due to the location of nets, as well as the abilities of different species and individuals to avoid nets (Kunz & Kurta 1990). Nevertheless, this method is often used to examine species structure and nocturnal activ-

ity of bats (e.g. Bell 1980, Kunz & Kurta 1990, Thomas & La Val 1989, Rachwald 1995). When studying bat activity above water, mist netting produced similar results (Ciechanowski 2002) as ultrasonic detector recordings (Kunz & Brock 1975, Murray et al. 1999).

The aim of our study was to compare species composition and bat activity above large fishponds and a river with similar conditions, situated in a small forest complex in the lowland part of southern Poland.

Study Area

The Łęczczok Reserve (4.08 km²) was established in 1957. It is situated in the Silesian Lowland (S Poland), near Racibórz, in the Landscape Park "Cistercian Landscape Compositions of Rudy Wielkie", at the altitude of 181–184 m a. s. l. (50° 08' N, 18° 16' E). The reserve is an isolated forest island surrounded by the town of Racibórz and several villages. The main part of the reserve consists of managed fishponds and woods covering an area of 2.47 and 1.34 km², respectively. Old oaks *Quercus robur* dominate the woodland (64% are more than 100 years old, 24% 61–100 years old). The average stand volume is 440 m³/ha. The mean temperature in January is –2 °C, and 18 °C in July (Denisiuk et al. 1994). The mean annual rainfall is approximately 630 mm. Eleven species of bats were recorded within the reserve (Mysłajek et al. 2002, 2005).

Material and Methods

Our surveys were carried out from May to September in 2001–2003. Bats were caught in mist nets in two habitats: at large fishponds (three sites) and at a small river (two sites). The large ponds (0.36–0.91 km²) were surrounded by old trees (mainly oaks), covering banks and dikes. The river, on average 5 m wide and 0.5 m deep, had a very slow current and was situated in an old oak stand.

In total, bats were captured during 14 nights (6 in 2001, 6 in 2002, and 2 in 2003), equally in both habitats. Nets were exposed between 7.30 pm and 6.00 am. At one night, mist netting was carried out only at one locality. Mist nets were installed on pond banks and dikes between ponds, as well as over the river and along its banks. At each site we used 2–4 mist nets (3×7 m, Ecotone, model 719/7). The total bat catching effort included 154 net nights at the river and 161 at ponds.

Mist nets were checked every 15 minutes. We recorded the time of capture, species, sex, and age for each bat. Cryptic species of the *Pipistrellus pipistrellus* complex (sensu Jones & Barratt 1999) were not distinguished in this study, and were classified as *P. pipistrellus* sensu lato. We used the dominance (D%), constancy (C%) and Simpson's index (D) for description of the bat community structure.

Following Rachwald & Labocha (1996), bat species were divided into two groups: (1) species using long-range hunting strategy and foraging mostly in open space – N/V/E (genera *Nyctalus*, *Vespertilio* and *Eptesicus*) and (2) species using short-range hunting strategy and foraging mostly in cluttered habitats – M/P (genera *Myotis*, *Pipistrellus* and *Plecotus*). To check for statistical significance of differences in the proportion of species from both groups between ponds and river, the G test was applied.

Bat activity was defined as the mean number of captures of all species per net night. The significance of differences in this factor between both habitats was estimated using the Mann-Whitney test.

Results

During the study in the Łęczczok Reserve, we recorded ten species of bats (Table 1). At ponds, nine species were found, with *Myotis daubentonii* being the most abundant and constant. Other species accounted for less than 35% of the bat community in this habitat. At the river, ten species were recorded and representatives of the genus *Nyctalus* (*N. leisleri* and *N. noctula*) totalled up to 54% of the whole community. The highest species diversity (D) was recorded above the river (Table 1). The proportion of N/E/V and M/P groups visibly differed significantly between ponds and river ($G=71.411$, $df=1$, $p<0.0001$).

The level of bat activity was higher above ponds than above the river ($U=4.0$, $p<0.01$). On average, 14.1 (SD=6.4, range 6.0–23.7, $n=7$ nights) and 4.6 (SD=3.8, range 0.3–10.0, $n=7$ nights) individuals were captured per net night, respectively.

Table. 1. Number of individuals (n), dominance (D%), constancy (C%) and Simpson's index of diversity (D) of bat species captured in mist nets over ponds and a river in the Łęczczok Reserve (2001–2003)

Tab. 1. Liczba osobników (n), dominacja (D%), stałość (C%) i wskaźnik różnorodności gatunkowej Simpsona (D) nietoperzy odłowionych w sieci nad stawami i rzeką w rezerwacie Łęczczok (2001-2003)

species	ponds			river			total		
	n	D%	C%	n	D%	C%	n	D%	C%
<i>Myotis daubentonii</i>	205	65.9	100.0	20	18.5	71.4	225	53.7	85.7
<i>Myotis brandtii</i>	11	3.5	57.1	1	0.9	14.3	12	2.9	35.7
<i>Myotis mystacinus</i>	11	3.5	57.1	1	0.9	14.3	12	2.9	35.7
<i>Myotis nattereri</i>	4	1.3	28.6	3	2.8	28.6	7	1.7	21.4
<i>Myotis myotis</i>	–	–	–	2	1.9	28.6	2	0.5	14.3
<i>Plecotus auritus</i>	13	4.2	71.4	5	4.6	28.6	18	4.3	50.0
<i>Pipistrellus pipistrellus</i> s. l.	31	10.0	71.4	15	13.9	14.3	46	11.0	42.9
<i>Pipistrellus nathusii</i>	25	8.0	85.7	2	1.9	100.0	27	6.4	92.9
<i>Nyctalus noctula</i>	10	3.2	28.6	17	15.7	57.1	27	6.4	42.9
<i>Nyctalus leisleri</i>	1	0.3	14.3	42	38.9	57.1	43	10.3	35.7
total	311	100.0	100.0	108	100.0	100.0	419	100.0	100.0
Simpson's index (D)		0.544			0.767			0.676	

Discussion

Our study confirmed the earlier reports of Kowalski et al. (1996) and Rachwald et al. (2001) that bats from the N/E/V group dominate above rivers surrounded by forests. However, *M. daubentonii* is also numerous in such habitats (Rachwald et al. 2001, Ciechanowski 2002, this study). These findings show that the river is an important habitat for the bat community in the Łęczczok Reserve, even though the number of bats seems to be lower in this habitat. Our data support the hypothesis that the great number of bat species at medium-sized rivers is a result of the overlap of feeding grounds suitable for both the N/E/V and M/P bat groups (Rachwald et al. 2001).

The most important factor influencing the species structure of bats above water is the adjacent plant cover (Rydell et al. 1994, Zahn & Maier 1997). However, we suggest that the overlap of feeding grounds of the two ecological species groups is also a consequence of the size of rivers and water bodies. Medium-sized waters surrounded by forests are a mixture of different habitats suitable for both groups (open space as well as cluttered habitats), and thus provide abundant resources for numerous bat species. In contrast, small water bodies and rivers can be unattractive for species foraging above water (e.g. *Myotis daubentonii*) due to the limited amount of their favoured prey, insects taken from water surface (Flavin et al. 2001). On the other hand, large rivers and water bodies may attract almost exclusively these species. This is consistent with the results of our mist netting at large ponds, where *M. daubentonii* comprised 65% of the whole bat community.

Streszczenie

Struktura gatunkowa i aktywność nietoperzy nad wodami w rezerwacie Łęczczok, południowa Polska. Badania prowadzono w latach 2001–2003, w rezerwacie Łęczczok (Nizina Śląska, południowa Polska). Porównywano skład gatunkowy oraz aktywność nietoperzy nad rozległymi stawami (0,36–0,91 km²) oraz nad rzeką (o szerokości 5 m i głębokości 0,5 m), otoczonych starodrzewem dębowym. Nietoperze odławiano w trakcie całej nocy w sieci chiropterologiczne. Udział nietoperzy z grup *Nyctalus/Eptesicus/Vespertilio* oraz *Myotis/Pipistrellus* był istotnie różny pomiędzy oboma środowiskami ($G=71,411$; $df=1$; $p<0,0001$). Nad

stawami najliczniej odławiany był nocek rudy (65,9%), podczas gdy nad rzeką dominowały – borowiaczek (38,9%), nocek rudy (18,5%) i borowiec wielki (15,7%) (Tab. 1). Różnorodność gatunkowa mierzona wskaźnikiem Simpsona była wyższa nad rzeką (0,767) niż nad stawami (0,544). Natomiast aktywność nietoperzy, oceniana na podstawie średniej liczby nietoperzy odłowionych w jedną siatkę w czasie nocy, była większa ($U=4,0$, $p<0,01$) nad stawami niż nad rzeką i wynosiła odpowiednio 14,1 (zakres: 6,0–23,7) i 4,6 (zakres: 0,3–10,0) osobnika/siatkę/noc. Badania wskazują, że niewielkie rzeki płynące przez tereny leśne, mogą być ważnymi żerowiskami nietoperzy z różnych grup ekologicznych.

Acknowledgements

The authors would like to thank K. Kurek, A. Henel, M. Nowak, U. Klare and K. Engelhard for help with fieldwork. We also would like to thank Nathan Owens for correction of the English in this article. This work was undertaken with the permission of the Ministry of Environment (DLOPiKog-4201-72/00 and DLOPiKog-4201-04A-26/2001/2002). The research was partly supported by the Global Environmental Facility – Small Grant Programme.

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received on 30 April 2007